Upper Midwest Freight Corridor Study

Final Report

University of Wisconsin-Madison
Midwest Regional University Transportation Center

University of Toledo
Intermodal Transportation Institute
Center for Geographic Information Sciences and Applied Geographics

April 12, 2006

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16. Abstract **Growing travel, freight movements, congestion, and international competition threaten the economic wellbeing of the Upper Midwest States. More congestion, slower freight movement, fragmentation, and economic slow-down are the probable outcomes if the threats are not addressed. However, planning for and managing the growth of freight transport are very complex issues facing transportation agencies in the region. In an effort to crystallize the issues and generate thought and discussion, eleven white papers were written on important factors that influence freight and public policy. The papers provide the background on specific aspects of freight in the Upper Midwest. As a collection, the papers provide a primer on freight issues and related responses that may form the basis for a regional freight agenda.**			
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Upper Midwest Freight Corridor Study-Phase II

Volume I
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Introduction

Ernie Wittwer-Wittwer Consulting

Freight in the Upper Midwest States is a very complex issue with many factors that influence the development of public policy. In an effort to crystallize these of these issues and generate thought and discussion, *eleven* white papers were written on important factors that influence freight and public policy. The authors are members of the research team for Phase II of the Upper Midwest Freight Corridor Study. This document is a compilation of those papers. The logic of their selection and order is simple:

Defining the Problem

The Challenge Ahead is a short paper that draws on the findings of the first phase of the Upper Midwest Regional Freight Study to define why a problem exists, or is in the making, that requires some actions on the part of governments in the region. Growing travel, growing freight movements, congestion, and international competition threaten our economic wellbeing.

Trade between China and the Upper Midwest States is a short monograph on one key aspect of growing freight movements, trade with China. It provides insights for those who have a particular interest in the topic.

Finding Solutions

Solutions can be found in highways, rail and water. Since highway is the mode that is most directly influenced by public agencies, five separate papers are dedicated to it:

- In *The Null Alternative in Highway Capacity and Management*, the author describes the future if no actions are taken. More congestion, slower freight movement, continued fragmentation and economic slow-down are the probable conclusion.
- In *Applying Regular Federal Aids to Highway Freight Capacity Issues*, the paper provides an overview of existing federal programs that might be tapped by the region.
- The paper, *Creating Capacity,* reviews the federal dollars that come to the region, how they are used and the possible impacts of diverting them to freight-related projects.
- In *The Role of Tolls in Moving Freight***,** the author explores the current federal rules on the use of tolls, the experience of other states and regions and the potential for using truck-only lanes as toll facilities.
- In *Using Technology*, the authors explore a number of technologies that might be employed to better manage and utilize existing highway capacity.

Rail transportation and many of the issues related to it are covered in *Railroads and Freight in the Future.* The current state of the rail industry, its probable direction and the possible public policy options to influence that direction are covered.

Maritime issues on the Great Lakes are described in *Great Lakes Maritime Transportation System*. The paper provides a historical perspective, current usage, constraints and public policy options related to the continued and possible expansion of the Great Lakes Marine Transportation system in the Midwest freight corridor.

Intermodal issues are covered in the paper *Encouraging Development of Intermodal Freight Facilities*. Intermodal here refers primarily to truck/rail. The paper looks at the possible benefits of moving more freight by rail using trailer or container on rail. It also outlines some of the constraints that may hinder intermodal expansion and some of the policy options that might deal with those constraints.

Finally, a perennial issue in transportation policy in the public sector relates to investing public funds in non-revenue modes or in facilities that are not owned by the public sector. This paper***,*** *Investing in Non-Revenue Modes*, outlines some of the arguments for and against such investments

Individually, these papers provide the essential background on specific aspects of freight in the upper Midwest. Taken together, as they were intended, the papers provide a primer on freight issues and the policy options that must be considered to deal with those issues. The papers form the basis for regional freight agenda, which is the final product of the Phase Two study.

The Challenge Ahead

Ernie Wittwer-Wittwer Consulting

Introduction and Summary

The Upper Midwest faces a significant challenge over the next few years. How the states and the nation respond to this challenge will have a major influence on their economic health in the Twenty-First Century. The freeways, railroads and waterways that have moved the product of our farms and factories for the past forty years are at, or nearing, capacity. This is happening at a time when freight ton-miles (metric ton-kilometers) are projected to increase by as much as 80% over the next fifteen years; and when automobile mileage continues to grow at more than one percent per year. While the resulting grid-lock will be costly, wasteful and inconvenient for the commuter and business traveler, it will be devastating for those businesses that are dependant on reliable, inexpensive transportation to move their raw and finished products.

Figure 1: The Upper Midwest

Freight, which is closely correlated to a healthy economy, moves beyond state and national borders. Our traditional post-interstate era approach to freeway capacity expansion has individual states making some modest improvements to small stretches. It also has each state implementing traffic management and traveler information systems independently. Our traditional approach to rail and water-borne freight is to let the market dictate the services offered. All of these traditional approaches will not meet the challenge that we face over the next decade. They will not produce the capacity or the efficiency needed to move the freight—and people—we will have to move to maintain our economic position.

The states of the Upper Midwest (Figure 1), with the cooperation of the Federal Highway Administration and neighboring Canadian Provinces, have undertaken an effort to define a regional agenda for freight. This includes a review of national policies that might benefit the region, a look at state policies that might be better coordinated, and an effort to better develop plans for regional, complimentary traffic information and management systems, particularly as they relate to commercial vehicle operations. Developing this agenda is one first step in meeting the challenge ahead.

Freight and the Economy

Historically, the volume of freight has tracked very closely with Gross Domestic Product (GDP) and employment. Figure 2: Freight and Economic Activity outlines the experience of the last thirty years of freight and economic activity. Ton-miles (metric ton-kilometers) of freight and total employment track very closely (blue and tan lines). Intercity truck mileage and gross domestic product also track very closely (the red and green lines).

The tie of freight and manufacturing is even greater than that of freight and the general economy. This is significant for the Upper Midwest because the region is more dependent on manufacturing than is the balance of the nation. In fact, 27% of the nation's manufacturing jobs are located within the seven states. The region's reliance on manufacturing is also illustrated by the top commodities shipped, as measured by value. All ten of the commodities are manufactured products, starting with motorized and other vehicles and ending with printed materials.

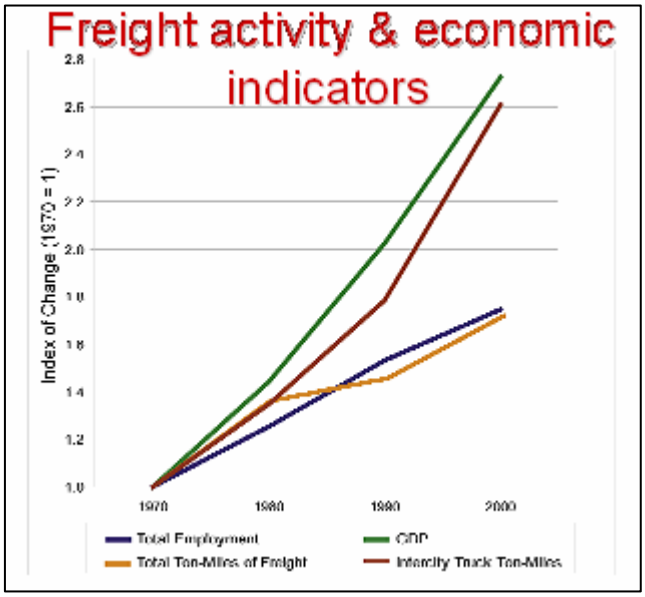

Figure 2: Freight and Economic Activity

Agriculture is also a major force in the regional economy. A look at commodities from the perspective of ton-miles (metric ton-kilometers) illustrates their importance. Five of the ten top ton-mile (metric ton-kilometers) commodities are agricultural, starting with cereal grains and ending with animal feeds.

In total the region has a major role in the national economy. Situated as it is in the center of the country, it connects the coasts and the growing economy of Ontario to the rest of the nation. Overall in the range of 30% of the nation's freight is either destined to or starting from the region. All modes, whether measured by value, tons (metric ton) or ton-miles (metric ton-kilometers), show the same pattern.

The reliable and efficient movement of freight is vital to the economic health of the region. A challenge to that movement is a challenge to our economic wellbeing.

Modal Shares

Freight moves by one mode or another because of one or more of several factors:

- The value of the freight
- The weight of the freight
- The length of the haul
- The dependability of service required

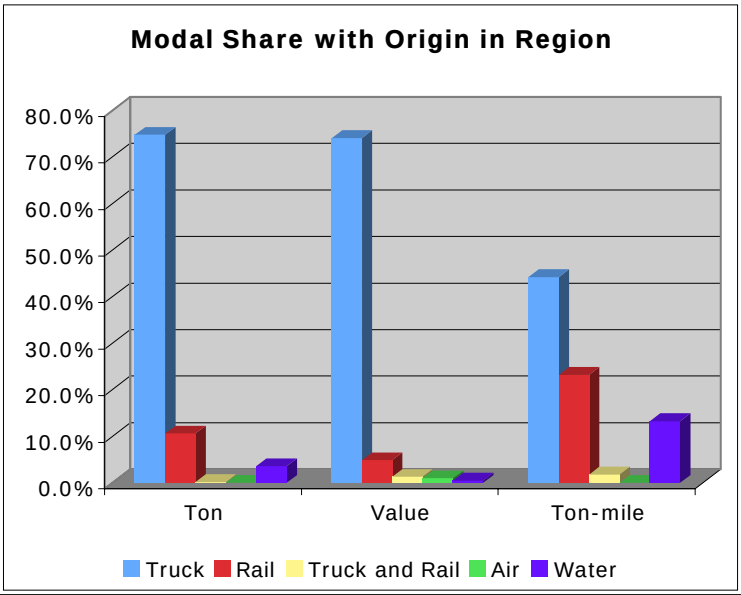

Figure 3: Modal Share with Origin in Region

Typically, high value freight with a high service requirement moves by air or by truck. High weight freight with low service requirements moves by rail or water.

As Figure 3: Modal Share with Origin in Region illustrates, freight in the region is moved predominately by truck. Whether measured by tons (metric ton), value, or ton-miles (metric ton-kilometers), truck is the major mode, carrying 40% or more of the total.

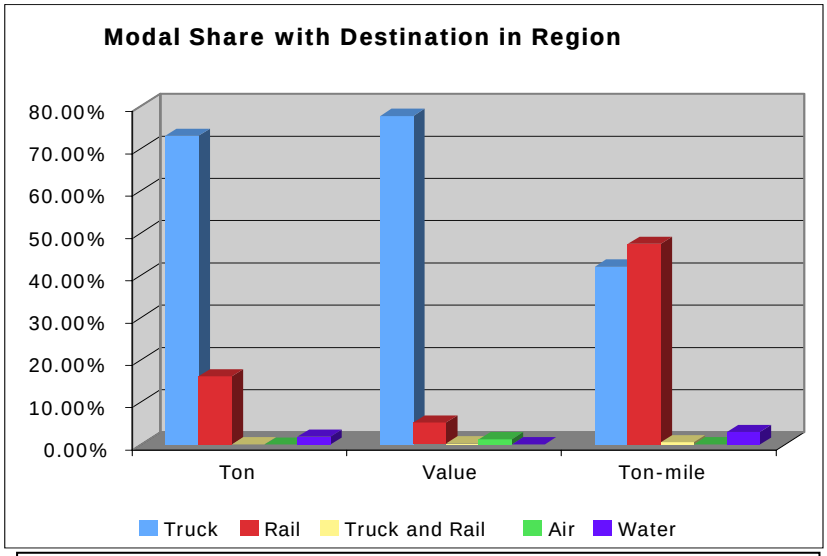

Figure 4: Modal Share with Destination in Region

Perhaps the most striking element in Figure 3: Modal Share with Origin in Region and Figure 4: Modal Share with Destination in Region is the height of the yellow bar representing truck-rail, or intermodal. It now carries a very small proportion of the total freight. The share with an origin in the region is

largely the auto industry and largely destined for Texas and California.

The notion of a seamless, truly intermodal, transportation system has gained support in recent years. Unfortunately, current public and private policies make that vision difficult to attain. The rule-of-thumb used by most shippers is that a haul must be at least 500 miles (805 kilometers) in length before it is economically feasible to use rail. Chicago transit times are also a determining factor for intermodal in this region. That transit time is now measured in days. To be attractive for shippers who have higher service standards that measure must be reduced to hours.

Water is the other mode to be pointed out from the above figures. Despite the fact that the Upper Midwest is blessed with the Great Lakes, the Mississippi, Illinois, Missouri and Ohio Rivers, water carries very small amounts of freight.

Projections of Freight

A number of factors combine to increase the amount of freight moving in our economy. First of all, world trade is growing. Figure 5: Freight and Economic Activity provides an overview of the change in imports and exports for the US and its major trading partners for the ten years ending in 2002.

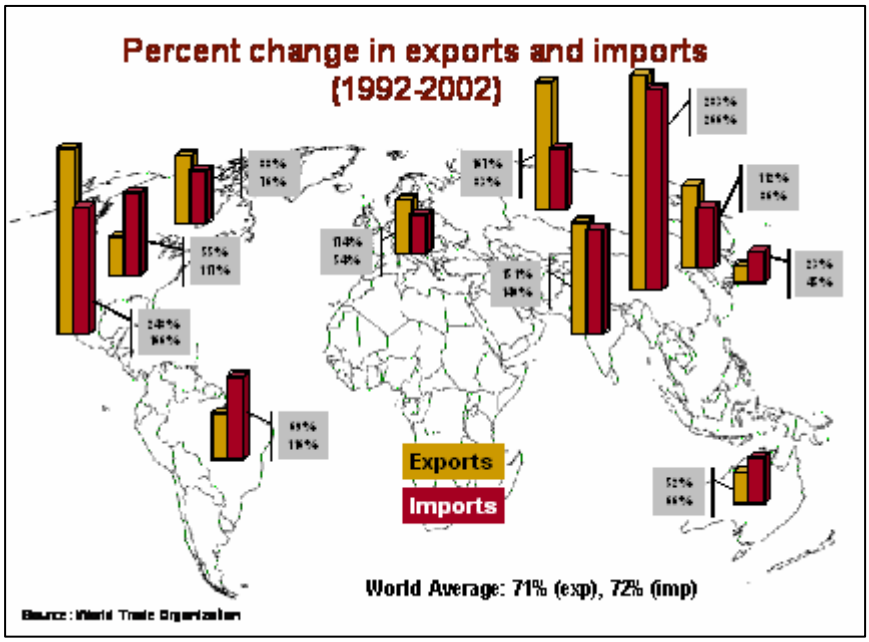

Figure 5: Freight and Economic Activity

For our region the impact of the growing of Ontario economy is significant. Each week thousands of trucks leave Ontario for the states of the Upper Midwest.

Another major change that has taken place is in the nature of manufacturing. Historically, manufacturing was geographically consolidated. The Ford plant at River Rouge in the early Twentieth Century was a good example of such consolidation. Raw materials, in the form of iron ore and coal, entered one end and finished automobiles emerged form the other. Now manufacturing is largely distributed across wide regions. Auto engines might be

made in one state, transmissions in another, instrument packages in still another, bodies in a forth, with assembly in a fifth. All of this requires more extensive and complex freight movements.

Finally, the efforts of retailers and manufacturers to minimize warehousing costs by timing shipments, the just-in-time approach, have placed higher service demands on the transportation system. This in turn has forced more freight to the modes that support higher service levels; generally, this means truck.

The Federal Highway Administration and several states in the region have done estimates of future freight. Those estimates suggest growth to 2020 in the range of seventy to eighty percent. As noted earlier, freight movements closely track with economic indicators. Recent projections of those indicators for 2020 show a range of growth from 19% to 78%. If the observed correlation holds, growth in the range of 80% would be on the high range of probability, but growth in excess of 50% would seem likely.

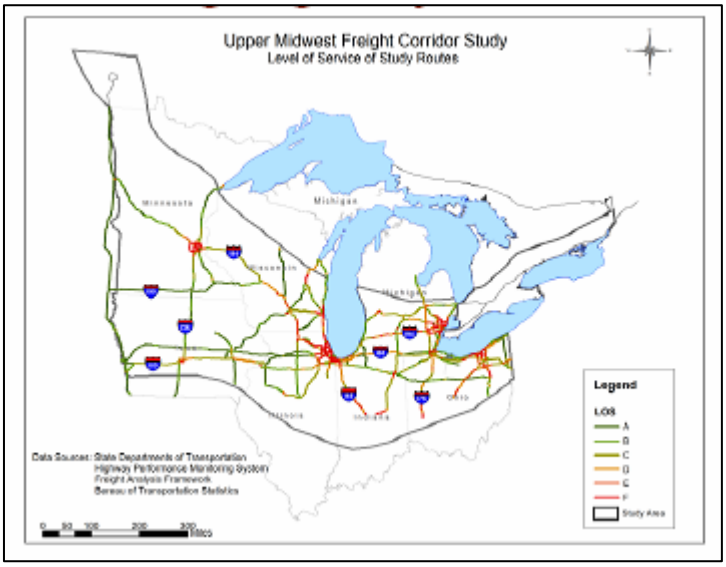

Figure 6: Freeway Capacity

Capacity

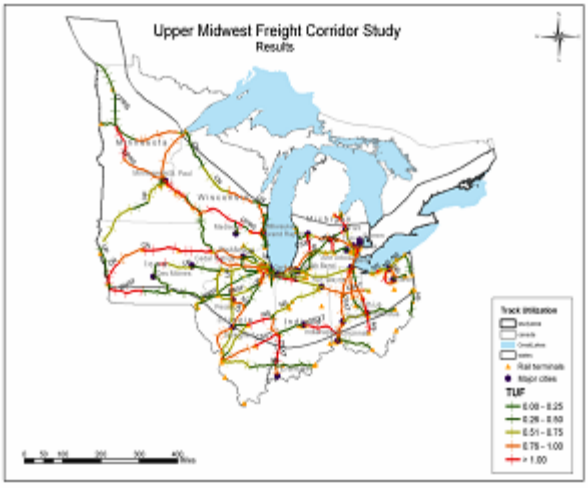

Figure 7: Rail Track Capacity

The first phase of the Upper Midwest study measured the current capacity of the freeways (I-80-90-94), railroads and waterways through the region. All three modes show many links at or beyond capacity.

We would expect red lines, indicating constrained capacity, in the urban areas; but now, as shown in Figure 6, orange and red lines are appearing in the rural portions of the region as well. The rural links that connect the major business centers of the region are nearly all operating at or

near capacity. And this is using 2002 and 2003 data.

Figure 7: Rail Track Capacity provides similar information for the class one railroads in the region. Again, much of the system shows capacity constraints. Both this and the highway measures are conservative. They do not consider terminal constraints or operational features, such as interchanges, that can limit capacity.

The inland waterways also show capacity constraints. Since the locks are the primary capacity constraint, it is a good indicator of the operations of the rivers. Delays of up to four hours per transit are common at each lock on the Upper Mississippi and Illinois. Lack of investment and federal statutes and regulations have also effectively limited the capacity of the Great Lakes.

Conclusions

Pulling all the parts together paints a depressing picture. The demand for the movement of freight is growing. Increasingly, service requirements limit the modal choice to truck. Intermodal movements are very small. And capacity is already constrained.

Figure 8 tries to portray data that is largely unknowable. But let us assume that relative modal capacity relates closely to current utilization. The blue, red, and yellow show that approximate distribution for each of the modes. Together, they represent the total freight capacity available in 2000. Then let us assume that capacity changes as well or slightly better in the next 20 years than it did in the previous 20. In the diagram, both rail and truck show slight increases to the year 2020. Previously, we have seen the growth in freight projected to be in the 50 to 80% range. Exactly how much of current capacity is used is unknown, but a conservative guess would place it at about 85% of highway, rail, and water

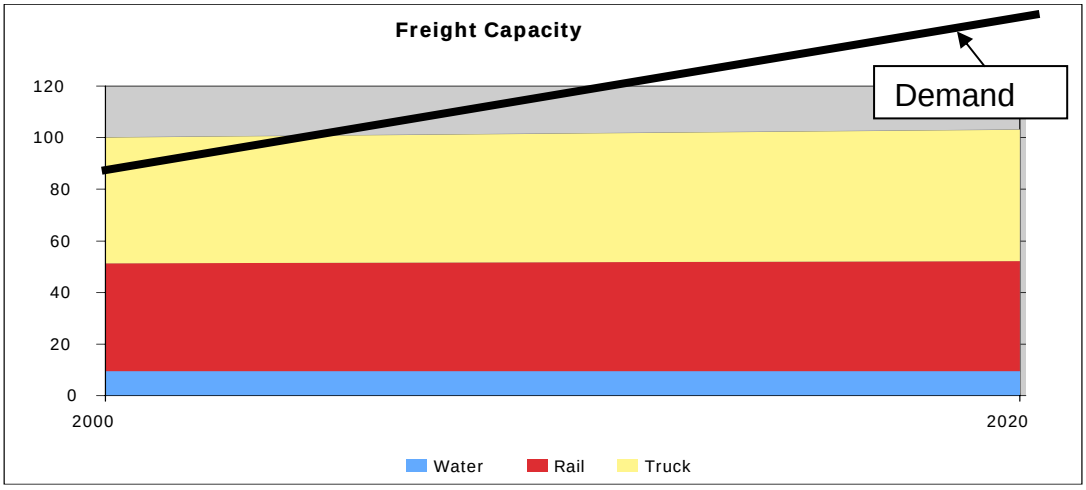

Figure 8: Conceptual Future Capacity

capacity. Plotting all of these lines produces a conceptual deficit in capacity over the next one or two decades. The question is: Will it become real? And the challenge is to avoid it or manage it.

As the region the region considers the future of freight, it will have to evaluate a number of options, many of which will represent major departures from existing policy. Our creativity and courage will determine how well the challenge is met.

The Null Alternative in Highway Capacity and Management

Ernie Wittwer, Wittwer Consulting

It has been said that one of the truest forms of insanity is repeating the same actions and expecting a different outcome. In this paper, the writer attempts to envision the most likely outcomes for highway freight transport if current policies and processes are continued in the Upper Midwest. Past experience is the primary guide to the future along with the projections of experts in the field of energy and environment. With this guidance, the outlook is not good. We can expect congestion to get worse, our competitive position to be diminished, fuel consumption to increase, and pollution to be needlessly high.

Capacity

The US has what is often called a system of state-administered, federally assisted highway transportation. Under this system, the federal government provides aids to the states along with broad guidance as to how those aids can be used. Each state makes the decision as to how federal aids and state raised funds will be used to maintain and improve its highway system. In making those decisions, state transportation, and political leaders usually seek to maximize the benefit to their citizens and the impact to their state. They make the best possible decisions for transportation within their borders. Consultation and planning for issues beyond their borders is minimal. Problems that exist within a state are to be dealt with by that state, without regard to the impact that those problems might have for other states. The result for the region and the nation may be less than optimal.

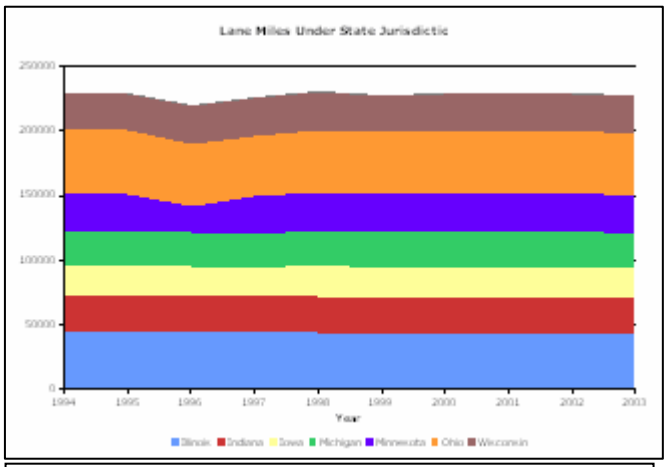

Figure 1: Lane Miles under State Jurisdiction (*1*)

Since the completion of the Interstate Highway System, no mechanism has existed to either facilitate or compel states to develop projects or routes that are consistent and complimentary across state borders. Indeed, since the completion of the Interstate System, much of the emphasis of state departments of transportation has turned to maintaining their highway investments through rehabilitation, reconstruction, or replacement. The result has been a marginal

change in highway lane miles. Figure 1 provides an overview of the change in overall highway lane miles, regardless of facility type, under state jurisdiction in the Upper Midwest. For the past ten years, overall mileage has not changed.

The picture for limited access lane miles (kilometers) is somewhat better. Over the past ten years, limited access lane miles (kilometers) have increased, but at a rate much smaller than overall traffic mileage has increased. This is illustrated in Figure 2.

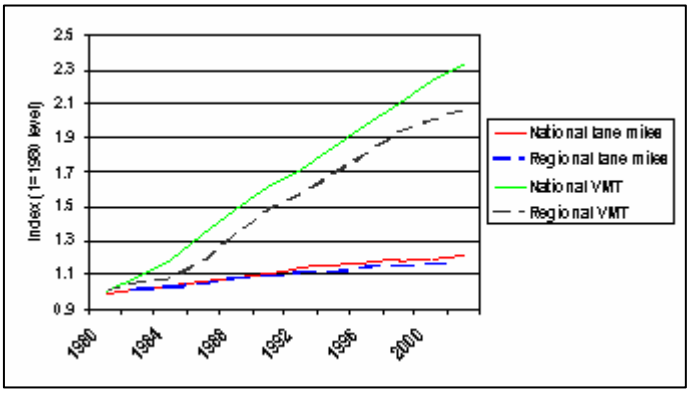

Figure 2: Freeway Lane Miles and changed Vehicle Miles of Travel (*1*)

We might expect this trend to continue into the future under the assumptions of a null alternative. The only major plan currently being implemented within the region that might provide a slight increase is that of the Illinois Tollway Authority. Under this plan, additional lanes will be added to 117 miles (188 kilometers) of toll ways in Northern Illinois and toll collections will be modernized to eliminate many of the currently required stops. Both of these efforts will add to capacity in Northern Illinois, which will benefit much of the region.

We can, therefore, expect under this alternative a very modest increase in highway lane miles (kilometers) through the year 2020. During those same years, even if annual increases continue at what are historically low rates in the range of 1.5%, automobile travel can be expected to increase by about one-third. If freight ton-miles (metric ton-kilometers) increase in those years by 50% or more, as they are now project to do, we can expect nearly twice the number of truck miles (kilometers) on our highways.

Operational Improvements

Freeway
- Transportation management center operations
- Incident management
- Event management
- Ramp metering
- Lane controls
- Managed lanes
- Real-time traveler information
- Electronic toll collection
- Work zone management
- Road weather information systems
- Variable speed limits
- Ramp closures
- Bottleneck removal

Freight
- Vehicle tracking
- Real-time freight information
- Roadside electronic clearance programs

Figure 3: Operational Improvements (*2*)

Technology

Many have argued that highway capacity alone is not the issue. Our focus should be on how well existing capacity is managed and how the factors which contribute to demand are managed. Figure 3, which is an edited version of an FHWA Office of Operations graphic (portions of the original were deleted to focus on operational tools), illustrates this thinking and what options might be considered. Most of the options shown are Intelligent Transportation System (ITS) tools. Indeed, national studies indicate that these tools could contribute to the reduction in congestion in the region. However, the states of the region have not come to agreement on which tools should be implemented, how they should be implemented or what standards should be employed.

The Government Accounting Office, in its review of the FHWA's progress in implementing a national ITS system, concluded that:

> Generally, the promise of ITS as an integrated tool for managing congestion has not yet been met. Although we recognize that [US] DOT cannot always influence ITS investments, limitations of DOT's efforts in goal setting, measuring, and other activities such as evaluating outcomes have reduces DOT's ability to facilitate state and local governments' strategic investment in ITS.

Stated another way, ITS tools may hold promise, but implementation has been slow and inconsistent. Nothing on the horizon would suggest change in the near or mid-term future.

Energy

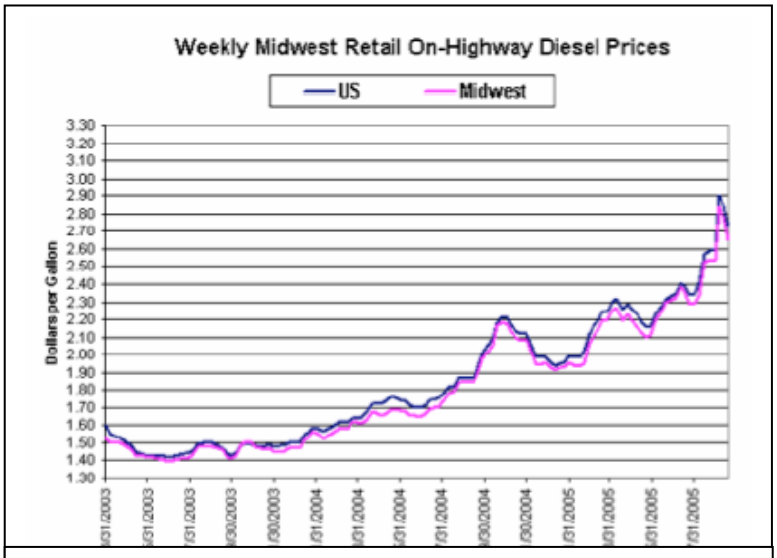

Figure 4: Change in the price of Diesel fuel, 2003 to 2005 (*3*)

If a bright spot can be found in the recent surge in fuel prices, it is in its potential impact on congestion. With fuel prices increasing, people may choose to drive fewer miles (kilometers), canceling trips, or using other modes.

A recent informal poll of fuel retailers reported in the New York Times found that

sales were off an average of 10%. This was when gasoline prices were well over $3.00 per gallon ($0.79 per litter). If the data is sound, this may translate to a 10% reduction in miles (kilometers) of travel. More probably it means that the Hummer stayed in the garage and the Prius got more miles (kilometers), or the tank on the Hummer got refilled at near empty rather than at half full.

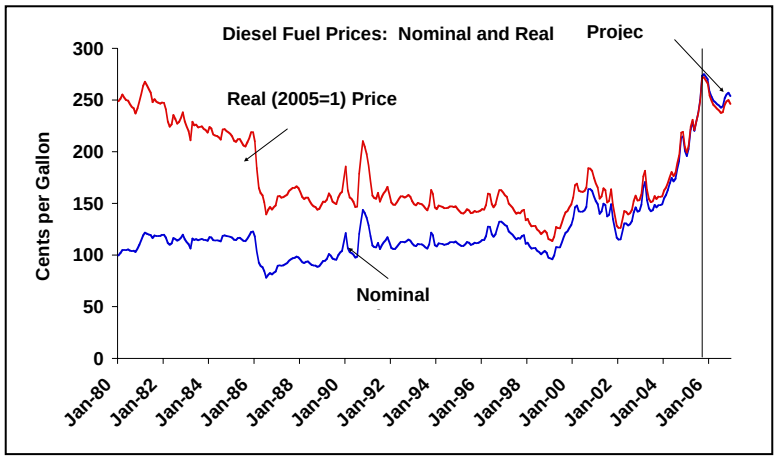

Figure 5: Real versus Nominal: Price of Diesel Fuel (*3*)

We would normally assume that a price jump of about 100%, as illustrated in Figure 4, would bring about significant changes in behavior. In fact, fuel prices are much higher than they have been in the recent past, but they are comparable to historic levels. Figure 5, contains information on the nominal (the-current or actual dollar value) and real (inflation adjusted value) price of diesel over the last 25 years. In 1980, the real price of a gallon (litter) of diesel was $2.50 ($0.66), not much less than it is in 2005.

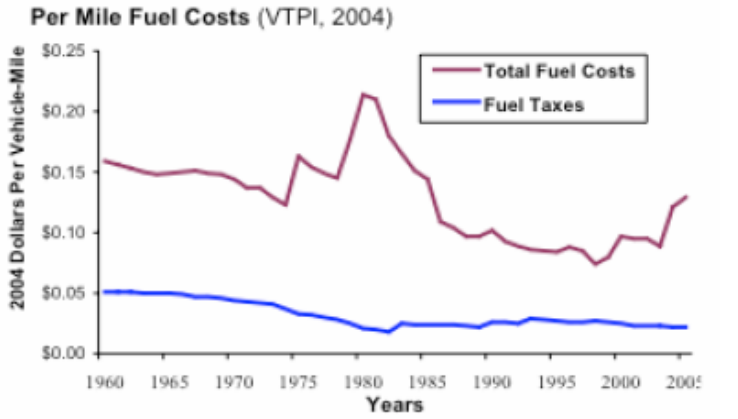

Figure 6: Per Mile Fuel Costs (*4*)

Another way to look at price is how much we spend to drive a mile (kilometer). Again, as shown in Figure 6, we are at historically low levels. The real price of fuel is comparable to what it was in the past and our vehicles—at least automobiles—are much more efficient.

Finally, to understand the consequence of rising fuel prices on travel, we have to consider the economic concept of elasticity. How much does a change in price change consumption? The answers in the literature are all over the map, but Goodwin and Hanly (Transport Review, May 2004) did a review of past empirical studies of the issue and found that a real, continuing, price increase of 10% would cause:

- Traffic to fall by 1% within a year
- Traffic to fall by 3% in about 5 years
- Fuel consumption to fall by 2.5% within a year
- Fuel consumption to fall by 6% in the long run

The reason for the smaller change in traffic than in fuel consumption is the expected increase in the efficiency of fuel use—the Hummer is parked.

All of these changes provide a new base from which growth will occur. At this point it is impossible to tell what the continuing price rise will be. Production has risen and prices are falling. But even a 30% lasting real rise would produce only about a 10% real reduction in traffic in the long run. Therefore, it does not seem reasonable to rely on price change to cure traffic congestion.

Air Quality

The Upper Midwest has a number of areas that are classified by the Environmental Protection Agency as non-attainment that is they have dirtier air than the federal standards deem to be healthy. Figure 7 is a map showing non-attainment and maintenance counties in the US.

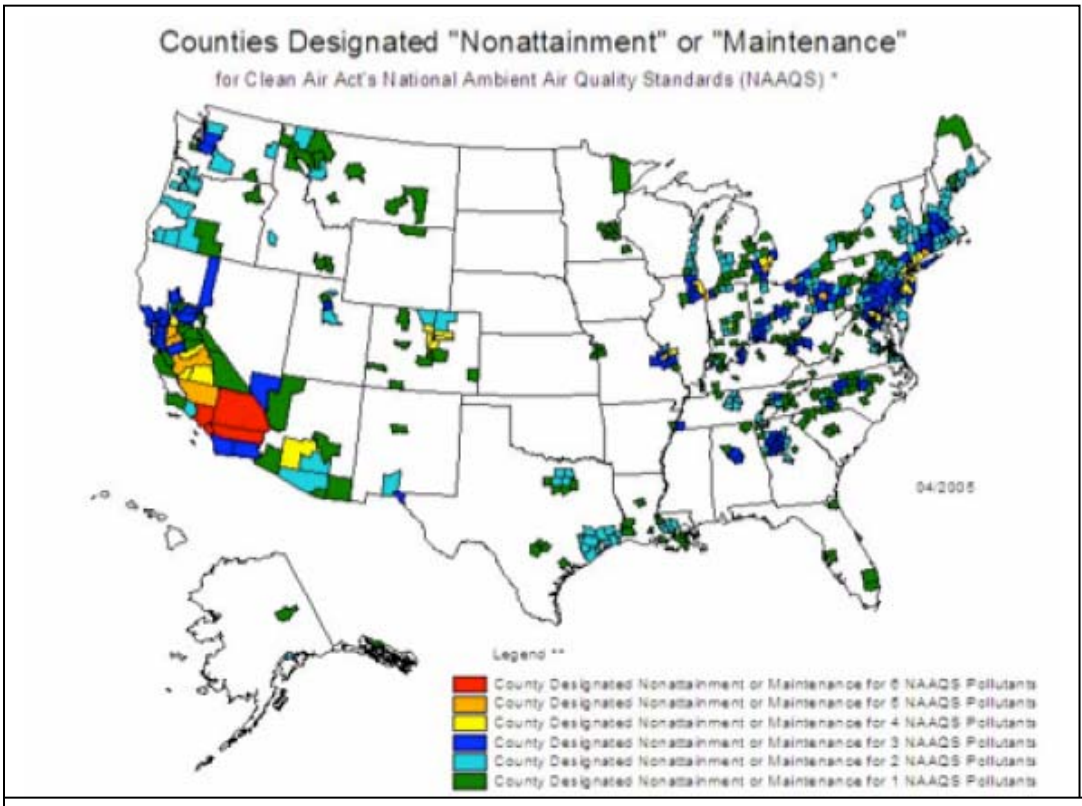

Figure 7: Air Quality Non-attainment or Maintenance Areas (*5*)

From the perspective of freight, the major pollutants are nitrous oxides (NOx) and particulates, the product of diesel engines. Chicago, Detroit, Indianapolis, St. Louis, and much of the Ohio River Valley are non-compliant with particulate standards. NOx is one of the gases that produce ozone, so it is problematic in many parts of the region.

The EPA did a study of the impacts of freight on air quality in several urban areas around the country, including Chicago and Detroit. Figure 8, which outlines the proportion of road pollutants attributed to trucks, is from that study.

Comparison of Heavy-Duty Truck Emissions in the Six Study Regions, 2002

Region	NOx (tons)	as % of total on-road NOx		VOC (tons)	as % of total on-road VOC		PM-10 (tons)	as % of total on-road PM-10		CO (tons)	as % of total on-road CO
Baltimore	29,081	49.7%		1,416	5.8%		734	N/A		13,232	3.9%
Chicago	96,291	57.4%		6,500	10.9%		**2,641**	**62.6%**		58,330	6.0%
Dallas-Ft. Worth	53,718	50.4%		2,174	4.1%		884	38.3%		20,229	2.3%
Detroit	**98,195**	**62.8%**		5,374	8.8%		2,382	N/A		62,805	5.6%
Houston	64,590	54.7%		2,408	5.6%		1,256	47.7%		20,117	2.7%
Los Angeles	130,341	49.4%		**14,839**	**11.0%**		2,210	31.3%		**121,776**	**9.1%**

Figure 8: Pollutants Attributed to Trucks (*6*)

Note that in Chicago and Detroit, 57% and 63%, respectively of the road-derive NOx is attributed to trucks. In Chicago, 63% of the road-derive particulates are attributed to trucks. In both cities, about 6% of the on-road carbon monoxide, a greenhouse gas, comes from trucks. So trucks are major contributors to unhealthy air.

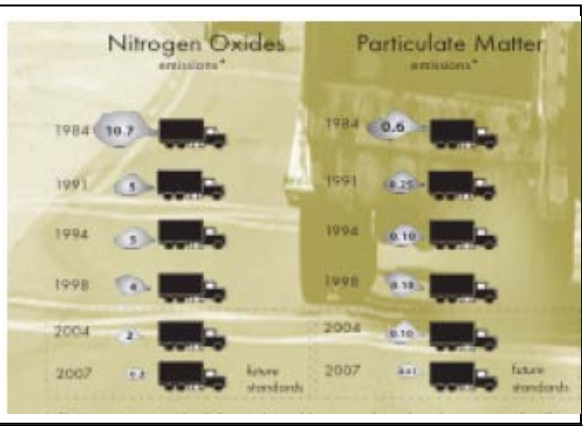

Figure 9: Truck Pollutants (*7*)

Logically we can expect more trucks operating in more congested conditions to be a greater source of pollution. Fortunately, better engines and cleaner fuels are reducing the pollution caused by trucks. Figure 9 graphically illustrates the past and projected change in pollution by trucks. By 2007, emissions from individual trucks will be only a small fraction of what they were in the

past. But more trucks, operating under less favorable conditions will pollute more than they might under better operating conditions.

We have all experienced the problem of exhaust when we were driving in a cue during rush hour or at a highway crash or work zone. The amount of exhaust in those situations is not only a function of the number of cars and trucks. It is a function of how they are operating. An engine operates most efficiently from both the perspective of fuel consumption and of emissions at slightly below highway speeds. At low speeds and at very high speeds, engines pollute much more than they do at moderate speeds. Congestion will cause more pollution.

Greenhouse gases are another type of pollutants. These gases, primarily CO and CO2 from transportation, contribute to global warming. According to the Department of Energy and the EPA, the US contributes 23% of the total World emissions of carbon. Thirty-two percent of the US total comes from transportation. (Note this is 1995 data. Current allocation will be somewhat different.) As shown in Figure 10, freight trucks account for 16% of the transportation emissions, which is larger than what is the case in the large cities, shown in Figure 8. Water and rail transport account for another 5%.

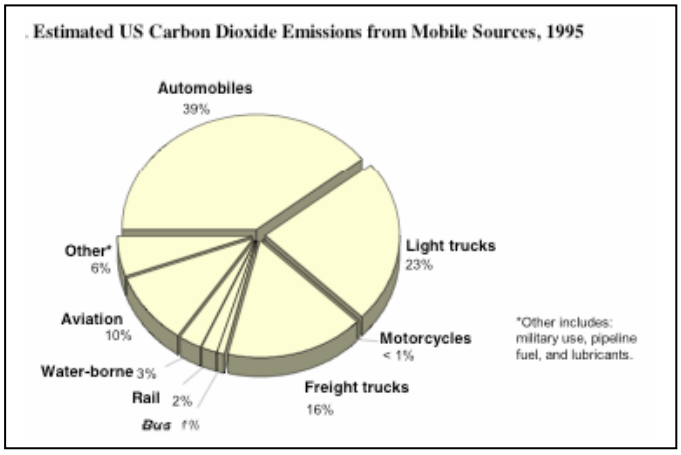

Figure 10: US Carbon Dioxide Emissions from Mobile Sources

Engines and fuels are getting cleaner, particularly as it relates to the precursors of ozone. But progress has been slower in reducing greenhouse gases. More vehicles and more congestion will serve to frustrate—not totally cancel--the progress of technology in meeting this challenge. We may not have as much gunk in the air as we might have had, but we will have more than we want to have.

Conclusions

Using the past to glimpse the future is somewhat risky, but it's the best tool we have. The region has not kept pace in providing highway capacity to meet demand in the past. Under the null alternative, we have little reason to expect a change in the future. The region has not implemented (or even agreed on what should be implemented) technologies to manage congestion. Following existing policies and processes, there is little reason to expect a change in the future.

Therefore, as truck and auto volumes of travel increase, it is reasonable to assume congestion will also increase.

Some have argued that increased fuel prices will act as an unintended congestion pricing mechanism, delaying or reducing congestion. The real price of fuel, which is within historic bounds, and the continuing decline in the energy cost of driving do not support this position, nor does the little that we know about the price elasticity of fuel. Therefore, we should expect congestion.

Motor vehicles emit toxins into the air. Nitrous oxides, and volatile organic compounds cause ozone and carbons cause global warming. Technology has reduced the amounts emitted by autos and trucks and is expected to continue to produce cleaner vehicles into the future. Unfortunately, more vehicles operating under more congested conditions will tend to offset much of the advances to technology.

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Creating Highway Capacity

Mary Ebeling, Midwest Regional University Transportation Center

The challenge of creating capacity to move the growing volume of freight in the Upper Midwest will remain one of the primary preoccupations of shippers, haulers, and policy makers for the foreseeable future. Because the current transportation infrastructure, including highway, rail, air, and water, is reaching or exceeding capacity and is difficult to expand, decision makers and planners will likely look towards innovative new programs as another way to increase capacity without adding new infrastructure. This white paper will focus on federal programs, as established in the SAFETEA-LU legislation, that provide opportunities to create and/or expand freight capacity throughout the Upper Midwest region. Information on funding levels, approval processes, and federal formula funding is also considered.

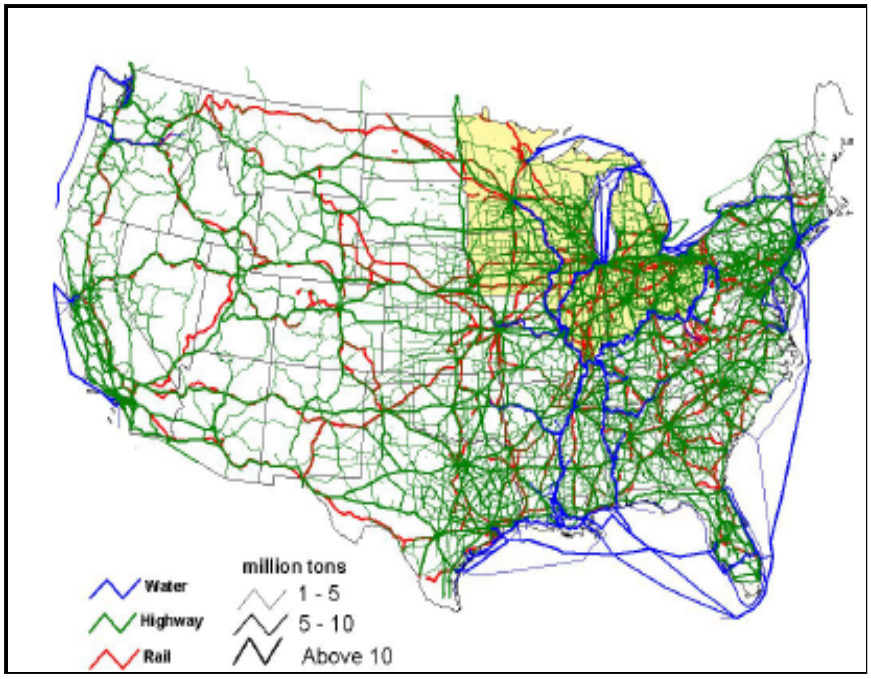

Figure 1: Link Tonnages, 1998

Figure 1 shows tons of freight transported by road, rail, and water and clearly depicts the critical importance of the Upper Midwest in the Nation's freight network. In addition to freight origination in the region, freight moving between the east and west coasts is likely to pass through the Upper Midwest. This image suggests the area is becoming a bottleneck for freight movements.

Existing Federal Programs

SAFETEA-LU includes a variety of programs and tools that could assist in creating additional capacity for freight in the Upper Midwest. A regional coalition must become familiar with funding, project approval processes, and the impact of guarantee dollars on the ability of our transportation system to meet the region's freight shipping demands.

National Corridor Infrastructure Improvement (Corridors) Program (§1302)

Capacity improvement and congestion management for the Interstate Highway System create some of the greatest opportunities for managing highway solutions that facilitate and improve the flow of freight along the nation's highways. The Corridors Program allocates funds to the states to make improvements in nationally significant corridors that are likely to promote economic growth and foster trade. States must apply to the federal government in a competitive bid process to be awarded funds through this program. Funding levels for the Corridors Program are appropriated from the Highway Trust Fund. Authorized funding levels in SAFETEA-LU are as follows:

- $194,800,000 for fiscal year 2005;
- $389,600,000 for fiscal year 2006;
- $487,000,000 for fiscal year 2007;
- $487,000,000 for fiscal year 2008, and;
- $389,600,000 for fiscal year 2009.

Project approval process

Under the Corridors Program, projects on the National Highway (Interstate) System that promote national and international trade and economic growth, and can be completed within a five-year period are given priority for funding. Selection factors considered in the legislation during the approval process include:

- The extent to which the project corridor provides a link between two existing segments of the Interstate System;
- The extent to which a project will facilitate major multi-state or regional mobility and economic growth;
- The extent to which commercial vehicle traffic in the project area is projected to increase;
- The volume of international freight traffic in the corridor;
- The extent to which the improvement will decrease congestion;
- The anticipated reduction in travel time through the freight corridor as a result of the project;
- The value of cargo moving through the area
- The extent to which federal funds are leveraged by the project.

But projects funded through this program are earmarked in SAFETEA-LU. Five projects of particular interest to Upper Midwest Freight stakeholders are:

- IL Construction of the U.S. I-80 to I-88 North-South Connector in Illinois - $152,000,000
- IL Construction of Route 34 Interchange and improvements in Illinois – $55,000,000
- IN I-80 Improvements - $10,000,000
- MN Falls-to-Falls Corridor - $50,000,000
- WI Construction and reconstruction of the U.S. Highway 41 corridor between Milwaukee and Green Bay, Wisconsin - $30,000,000

Many of the criteria noted in the project approval process portion of this discussion are met by the challenges and opportunities currently manifest in the Upper Midwest, making the region a good candidate for funding through the Corridors program Particularly, provisions to encourage capacity building in areas with significant international trade should draw the attention of states along the Canadian border. A regional freight coalition's proposed projects would be attractive under the criteria for the promotion of multi-state regional economic growth.

Projects of National and Regional Significance (§1301)

In a manner similar to the Corridors Program, this program provides funds for projects that include efforts to improve freight mobility and thus provide regional and national economic benefits. To achieve this goal, SAFETEA-LU establishes a program to award grant money to states, on a competitive basis, to address the need to complete transportation projects that result in economic benefits and improve the safe and secure flow of goods, people, and services along the National Highway System.

Project approval process

Eligible projects under this section of SAFETEA-LU include those that will incur costs expected to equal or exceed either $500,000,000, or seventy-five percent of federal highway funds apportioned to the state in the most recent fiscal year for the state in which the project is located. This program provides funding for any surface transportation project that is eligible for federal assistance and includes freight rail as well as highway freight transportation projects.

Projects are awarded in a competitive bid process; however, special consideration is given to proposals that effectively do the following:

- Leverage federal investment by incorporating non-federal funding into the budget, including monies from public/private partnerships.

- Use new technologies, including ITS.
- Help protect the environment.

In addition, funding is available over the life of a project, beginning with preliminary engineering through construction.

Projects funded through this program are already earmarked. Five projects designated through SAFETEA-LU are of particular interest to Upper Midwest Freight stakeholders:

- IL Construction of O'Hare, Bypass/Elgin O'Hare Extension - $140,000,000
- IL Mississippi River Bridge - $150,000,000
- MI Planning, design, and construction of a new American border plaza at the Blue Water Bridge in or near Port Huron, MI - $20,000,000
- VA, WV, OH Heartland Corridor Project including multiple intermodal facility improvements - $90,000,000
- WI Reconstruction of the Marquette Interchange, Milwaukee, WI - $30,000,000

As the above list displays, states in the Upper Midwest have already begun to take advantage of this program. Regional stakeholders should continue to take advantage of this program, particularly since it focuses on capacity building and congestion reduction with an eye towards economic development and freight movement.

Truck Parking Facilities (§1305)

This program addresses the shortage of long-term parking for commercial motor vehicles (trucks) on the nation's National Highway System. This program seeks to construct new parking facilities and to increase available parking at existing sites, including highway rest stops, park and rides, or other similar facilities. Funding for the Parking Facilities program comes from the Highway Trust Fund. SAFETEA-LU earmarks $6,250,000 per year from 2006 through 2009 for this program.

Increasing available truck parking on the National Highway System will benefit capacity by providing truck parking spaces for the increasing numbers of trucks that will be entering the highways in the Upper Midwest. These funds are not yet earmarked, which provides an opportunity for Upper Midwest freight stakeholders to take advantage of this program.

Freight Intermodal Distribution Pilot Grant Program (§1306)

The purpose of the Freight Intermodal Distribution Pilot Grant Program (FIDPG) is to facilitate and support intermodal freight transportation initiatives at the state and local levels to relieve congestion and improve safety and to provide capital

funding to address infrastructure and freight distribution needs, primarily at inland ports and intermodal freight facilities. SAFETEA-LU sets funding levels for the FIDPG program at $6,000,000 for each fiscal year from 2006 through 2009.

Project approval process

To receive monies through this program, states must submit a grant application to the Secretary of Transportation. Priority is given to funding projects which:

- Reduce congestion into and out of international ports in the U.S.
- Demonstrate ways to increase the likelihood that freight container movements involve freight containers carrying goods, and;
- Establish or expand intermodal facilities which encourage development of inland freight distribution centers.

By reducing congestion, increasing the number of containers actually carrying freight, and improving or constructing new distribution centers, the FIDPG program may facilitate the improvement of freight-carrying capacity for highway-system freight as well as intermodal freight. These funds are not yet earmarked, which provides an opportunity for regional freight stakeholders to take advantage of this program.

Coordinated Border Infrastructure Program (§3203)

The coordinated boarder infrastructure program seeks to distribute funds to border states to improve the mobility of freight and motor vehicles across the border between the United states and Mexico and the United states and Canada. Funding from this program can be applied to a number of eligible uses, including:

- Improvements to existing transportation and support infrastructure;
- Construction of highways and related safety facilities;
- Operational improvements (electronic data interchange, telecommunications, etc.) that expedite freight movements;
- Modification to regulatory procedures that expedite cross-border freight movement, and;
- International coordination of freight movements pertaining to cross-border movement of freight and motor vehicles.

Funding Levels and Eligibility Criteria
Funding for this program is distributed by formula. The funding breakdown by year is as follows:

- $123,000,000 for fiscal year 2005;
- $145,000,000 for fiscal year 2006;
- $165,000,000 for fiscal year 2007;
- $190,000,000 for fiscal year 2008, and;
- $210,000,000 for fiscal year 2009.

Projects funded through this program are already earmarked. Two projects, one in Michigan and one in Minnesota are of particular interest to Upper Midwest Freight stakeholders. The funding levels are as follows:

- Michigan $20,871,373
- Minnesota $3,749,666

Funding is available for projects in Canada or Mexico, if a U.S. border state proposes a project to facilitate cross-border trade. Facilities may be constructed in these countries if the appropriate local government in Canada or Mexico can guarantee that the facility will be constructed using equivalent U.S. construction standards and that the new infrastructure will be properly maintained to facilitate trade. States in the Upper Midwest sharing borders with Canada can capitalize on this program to improve efficiency and infrastructure at their border crossings.

Freight Planning and Capacity Building Program (§5204)

This new program funds research, training, and education to support freight transportation planning. Funding for this program comes through the Training and Education funds and is set at $875,000 a year from 2006 to 2009.

Research targeted towards strategic planning for infrastructure improvements, congestion mitigation needs, and technologies to enhance freight movements across the country would be of particular interest and benefit to a regional freight coalition in the Upper Midwest. This program could potentially interact with the National Cooperative Freight Transportation Research Program (§5209). The development of a national research agenda for freight offers numerous opportunities to develop recommendations for capacity-building programs.

National Cooperative Freight Transportation Research Program (§5209)

Could potentially interact with the Freight Planning and Capacity Building Program. An advisory committee chosen to represent the different stakeholders in freight transport will be selected to develop a national research agenda for this program. The advisory committee should work cooperatively with researchers involved in the Freight Planning and Capacity Program to promote programs that aid in creating capacity for the freight industry. This program is funded at $3.75 million per year for 2006-2009. The funding comes from Surface Transportation Research funds.

Impact of Formula Funding

The question of the impact of formula funding on the states of the Upper Midwest is a complicated one that is not easy to answer. In short, formula funding refers to the formula the federal government uses to determine the amount of money from the federal gas tax it returns to the states. This tax, collected in the individual states at the pump, funds the Highway Trust Fund. According to FHWA staff, a full analysis of the impact of this money on freight programs has not yet been completed but eligibility relative to freight has not changed from TEA-21. However, FHWA has issued a summary of how these monies will be distributed. Selections from this summary are included here to help in considering funding levels and options for building freight capacity. For a more detailed discussion of funding through SAFETEA-LU, please visit http://www.fhwa.dot.gov/safetealu/summary.htm.

Equity Bonus – Federal-aid highway funds for individual programs are apportioned by formula using factors relevant to the particular program. After those computations are made, additional funds are distributed to ensure that each state receives an amount based on equity considerations. In SAFETEA-LU, this provision is called the Equity Bonus (replaces TEA-21's Minimum Guarantee) and ensures that each state will be guaranteed a minimum rate of return on its share of contributions to the Highway Account of the Highway Trust Fund, and a minimum increase relative to the average dollar amount of apportionments under TEA-21, and that certain states will maintain the share of total apportionments they each received during TEA-21. An open-ended authorization is provided, ensuring that there will be sufficient funds to meet the objectives of the Equity Bonus.

Relative Rate of Return – Each state's share of apportionments from the Interstate Maintenance, National Highway System, Bridge, Surface Transportation, Highway Safety Improvement, Congestion Mitigation and Air Quality Improvement, Metropolitan Planning, Appalachian Development Highway System, Recreational Trails, Safe Routes to School, Rail-Highway Grade Crossing, Coordinated Border Infrastructure programs, the Equity Bonus itself, along with High Priority Projects will be at least a specified percentage of that state's share of contributions to the Highway Account of the Highway Trust Fund. The specified percentage, referred to as a *relative rate of return*, is 90.5% for 2005 and 2006, 91.5% for 2007, and 92% for 2008 and 2009.

Concluding Thoughts

Table 1, below, shows the range of federal programs available through SAFETEA-LU. From the perspective of creating new capacity for freight, there are a wealth of possibilities. For example, Projects of National and Regional Significance and the Corridors Program, although fully earmarked in the legislation, include projects that promise to improve capacity for freight

movement in the Upper Midwest. There is clearly a fair amount of funding available that could be used to enhance the region's freight capacity. However, the manner in which this funding is currently being used focuses on the efforts of individual states. While projects constructed by individual states may improve infrastructure, they are unlikely to address system-wide deficiencies or capitalize on opportunities across the region. Projects proposed by a multi-state coalition, such as a regional coalition of the Upper Midwest Freight stakeholders, hold greater potential for funding projects that not only get constructed, but contribute to enhancing freight movement at a regional level.

Table 1: Freight Capacity-Building Programs in SAFETEA-LU

Program	Section	Infrastructure	Congestion Mitigation	ITS/Data Management	Highway	Multi-modal	International	Research
Projects of National and Regional Significance	§1301	X			X			
Corridors Program	§1302	X	X		X			
Coordinated Border Infrastructure Program	§3203	X	X	X		X	X	
Freight Intermodal Distribution Pilot Grant Program	§1306	X	X	X		X		
Interstate Discretionary	§1113	X	X	X	X	X		
Bridge Discretionary	§1114	X	X	X	X	X		
Truck Parking Facilities	§1305	X	X		X			
Freight Planning and Capacity Building	§5204							X
National Cooperative Freight Transportation Research	§5209							X

Reference

1. Adapted from FHWA SAFETEA-LU summary: http://www.fhwa.dot.gov/safetealu/summary.htm

Applying Regular Federal Aids to Highway Freight Capacity Issues

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When the prospect of new transportation initiatives is discussed, the billions of dollars that the federal governments provide the states and the flexibility that the states have in using those aids is noted with the implication that they already have dollars that they can use for this new purpose. Indeed the states of the Upper Midwest will receive in the range of five billion dollars per year through 2009 under the recently passed surface transportation act. Figure 1 provides an overview of the amounts that will be apportioned to each of the states under the new act. The overall trend is for an increase in funding in the regular apportionments.

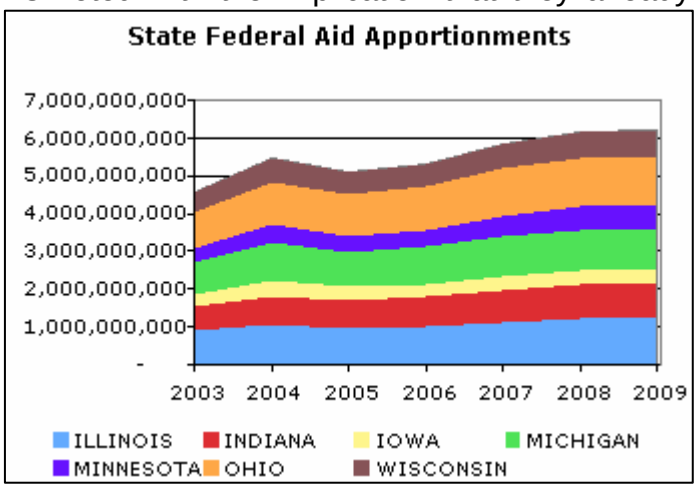

Figure 1: Federal Aid Apportionments to the States of the Region (*1*)

Two cautions should be applied to this data. First of all, apportionments are always larger than useable dollars. Typically, the appropriations process reduces the funding by as much as 20%, so Figure 1 portrays the highest amounts that might be received. Secondly, as shown in Figure 2, the purchasing power of the dollar is constantly being eroded. Even Figure 2 uses projections of the consumer price index that do not capture the impact of the recent surge in oil prices. Since construction prices, particularly for paving and earthmoving, are heavily influenced by the price of fuel and asphalt cements, we can expect the real purchasing power of future federal aids to be constant at best.

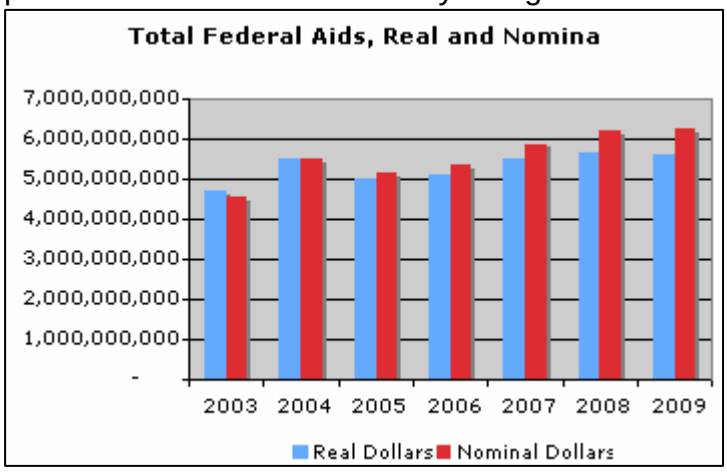

Figure 2: Real and Nominal Federal Apportionments for the Region (*2*)

While five billion seems like an enormous resource, the demands on the states of the region are also enormous and the federal resource was

anticipated in the investment planning for the region. States normally develop their investment plans, or programs, on a five to eight year cycle. They must anticipate both state and federal resources in each future budget period of the planning cycle. Rarely will they underestimate the resources that will be available, so the federal dollars have already been anticipated and assigned to projects. Those projects are associated with the needs of the region. Any use of regular federal aids for an initiative in freight will require that some existing regional needs be abandoned or postponed. Additional resource will be required if this emerging need is to be met.

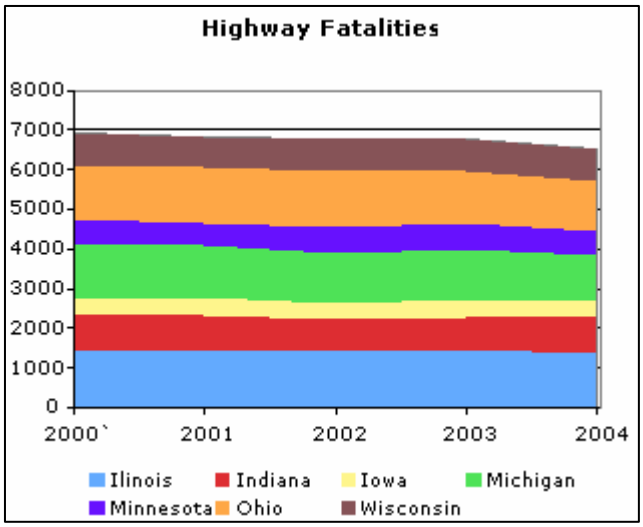

Figure 3: Highway Fatalities in the Region (*5*)

Safety is a priority of all of the agencies in the region. Yet, as shown in Figure 3, nearly 7,000 people lost their lives on the roadways of the region in each of the past five years. The trend line, such as it is, is downward; but this safety issue confronting transportation agencies in the region remains significant.

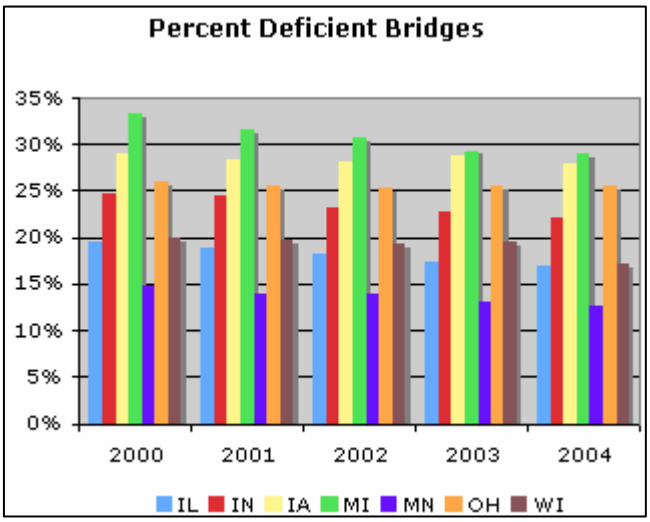

Figure 4: Deficient Bridges in the Region (*3*)

Safety is not the only demand upon the resources of the region. Despite a recent downward trend in some states, 22% of the bridges in the region remain deficient, as shown in Figure 4.

These bridges could be structurally deficient such that they cannot carry expected loads, or they may be functionally deficient because they are too narrow or poorly aligned with the surrounding roadway. In either case, they pose some safety threat to the traveler.

Figure 5 contains information on the smoothness of the rural National Highway System. The figure shows the distribution of the pavements into categories of pavement roughness, as measured by the international roughness index, (IRI). The smaller the number, the better the pavement. The bulk of the pavements are in the less than 119 categories, indicating reasonable ride quality, but about 8% of the total remain in the greater than 145 categories, the categories that probably would not pass the seat test if you drove them at the speed limit.

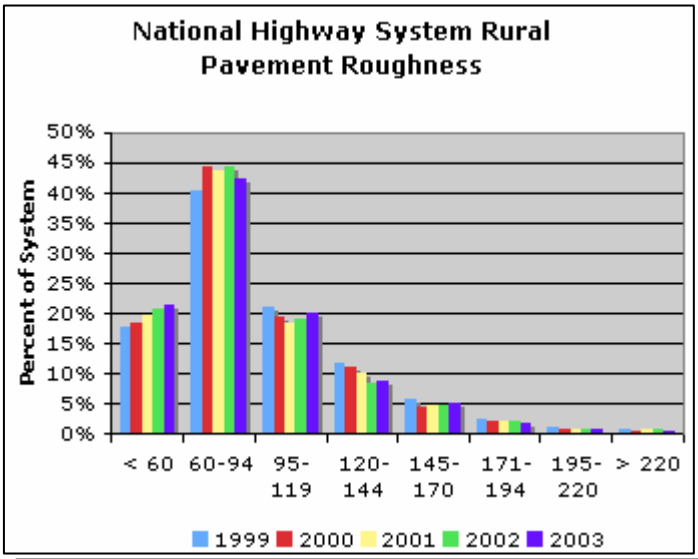

Figure 5: Pavement Roughness on the Rural National Highway System (*3*)

In addition to safety and the condition of the highway system in the region, the states must respond to ever increasing demands in the use of the system. Figure 6 gives a measure of congestion in some of the major urban areas in the region. The measure is daily freeway traffic by freeway lane mile (kilometer). This is a simple measure of the use to which available capacity is being put. All of the cities show major increases in traffic per lane. For example, Chicago had 12,600 vehicle miles per lane mile (12,600 vehicle kilometers per lane kilometers) in 1982. In 2003, it has 19,500 vehicle miles per lane mile (19,500 vehicle kilometers per lane kilometers), a 55% increase in 21 years.

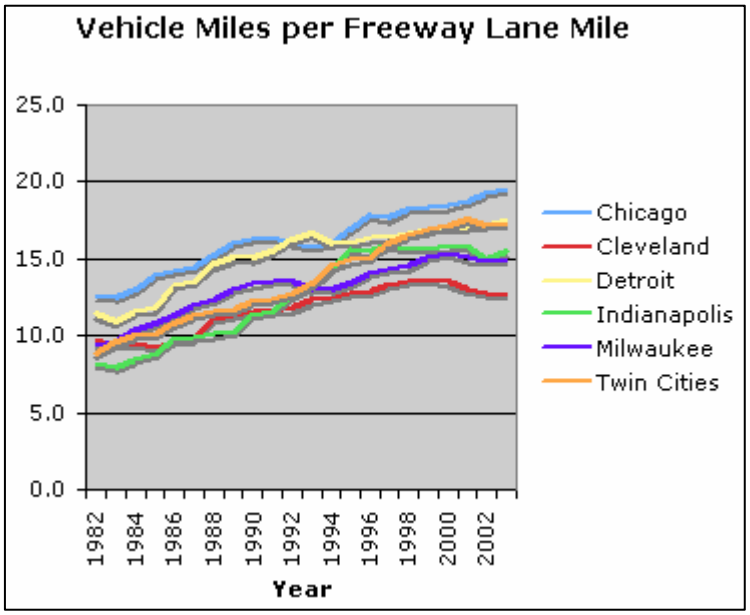

Figure 6: Urban Congestion (*4*)

In summary, the states in the region do get significant levels of funding from the federal government and they do have flexibility in how those dollars are used. Unfortunately, the states have significant needs and demands that they must

use these resources to meet. The safety of the system, its structural integrity and the growing demands placed upon it all require resources. While federal regulations would allow "regular" federal funds to be used for freight-driven initiatives, such use would come at the expense of existing activities needed to keep the entire system operating. New resources will be needed if the demands of freight are to be met.

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Using Highway Technology

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Introduction

The Upper Midwest faces a variety of problems within its transportation network. There is a growing pressure for roadway systems to operate more efficiently in the face of increased congestion, more vehicle-miles (vehicle-kilometers) traveled, and a deteriorating infrastructure. The historical response to such problems has been expansion of the roadway's capacity. This solution is no longer as feasible, and now pressure has fallen on technology to maximize the efficiency of the current infrastructure.

Various highway technologies are available to facilitate safety and security, operational efficiency, administrative efficiency, and regulatory compliance of freight transportation. Many of these technologies are already implemented in several of the Midwest states.

CVISN

The Commercial Vehicle Information Systems and Networks (CVISN) integrates existing information systems with communication technology and standards. The objective is to improve safety, efficiency, administration, and regulatory compliance of commercial vehicle operations. CVISN has three major components: safety information exchange, electronic credentialing, and electronic screening.

Safety Information Exchange

Safety Information Exchange (SIE) is a centralized database that gathers information about commercial vehicles, such as driver and vehicle data and safety history. This information is then used by state agencies and law enforcement to determine which vehicles should be inspected and which ones should receive their credentials. SIE data gets entered, updated, and made available nationwide in less than one hour. SIE helps enforcement and regulatory compliance programs become more resourceful in maintaining commercial vehicles. For example, the technology can aid law enforcement in identifying high-risk vehicles for more in-depth inspection.

Electronic Credentialing

The process of electronic credentialing includes registering operators, registering and titling vehicles, checking insurance, collecting and distributing fuel taxes, issuing oversize/overweight permits, issuing licenses and permits to haul

hazardous materials, and collecting federal heavy vehicle use taxes. The states process the applications using a combination of manual and automated systems. Motor carriers generally use some type of credentialing system software on their computer to prepare and submit applications electronically. The state agency's system then processes the data. The processing includes error checking, cross-checks with other databases, fee calculations, invoicing, payment, and issuance of the appropriate decal, sticker, plate, or paper document.

Electronic credentialing makes organizing and retrieving of credentials very efficient. In conjunction, the system promotes safer roadways for all travelers by ensuring shippers are complying with regulations. This reduces cost and time to freight carriers, taxpayers, and end users.

Electronic Screening

Electronic screening is a system that monitors the weight of commercial vehicles. It works in conjunction with Radio Frequency Identification (RFID) transponders which are mounted onto commercial vehicles. These transponders communicate driver and vehicle information to receivers at weigh stations and border crossings. Compliant carriers are signaled to bypass the weigh stations, gain entrance to a port, or to expedite border crossing.

Figure 1: Electronic Screening of a Commercial Vehicle (*6*)

Electronic screening technology saves processing time at weigh stations and border crossings, which means it promotes fuel efficiency. Actual weigh station traffic is reduced, giving law enforcement agents more freedom to focus on extreme offenders. It improves traffic flow along the highways while requiring no expansion of the existing highway infrastructure. Electronic screening technology has low costs to the user with each transponder costing an average of about $40. The cost of the electronic screening equipment, however, is about 1.5 million dollars per weigh station, which is a huge burden on state DOTs.

Weigh-in-Motion (WIM)

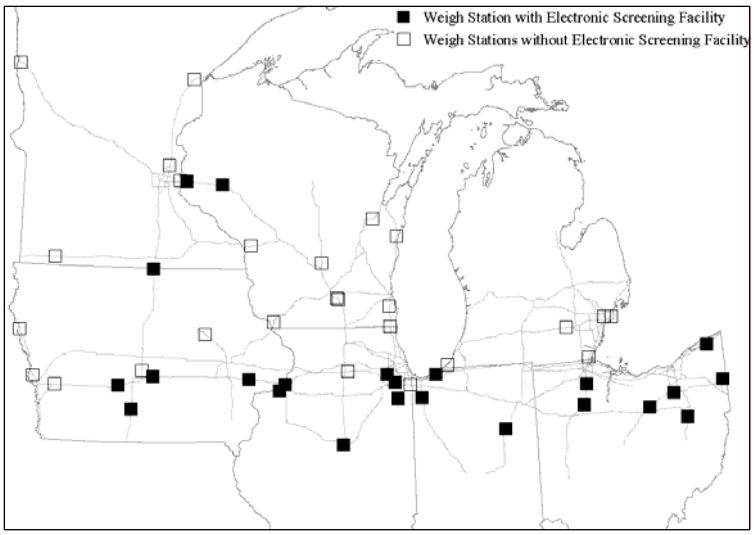

Figure 2: Weight Enforcement Facilities in Upper Midwest Region Study Corridor (*1*)

WIM systems record truck axles and gross vehicle weights as vehicles drive over a plate sensor. These sensors measure a truck's gross weight, axle weights, axle spacing, speed, and vehicle classification. This sensor is located within the road and allows vehicles to pass through without stopping. The system can handle a commercial vehicle driving at speeds of up to 55 miles per hour (89 kilometers per hour) over the sensor. WIM is used for collection of statistical data, support of commercial vehicle enforcement, roadway and bridge cost allocation, and traffic management. These systems can be portable, semi-permanent, or permanent depending on their use. Electronic screening facilities include WIM. Figure 2 shows weigh stations within the corridor, some of which have WIM capabilities.

Virtual Weigh Stations

Figure 3: Virtual Weigh Station Camera (*7*)

Virtual weigh stations have WIM scales installed along the highway mainline that are monitored remotely. An overview camera collects the vehicles license plate number. After the data and plate number are collected, the information can be sent to either a portable laptop or office computer to be monitored and/or regulated. Trucks are identified by automated images that record the USDOT number on the sides of their cabs. These images and sensor data are electronically communicated to a control center. Trucks that violate the scale requirements are stopped and inspected at portable scale inspection sites. Virtual weigh stations are being widely embraced and deployed for their cost benefits. The cost of a virtual weigh station is between $100,000-150,000, substantially less than a fixed weigh station. A major benefit of a virtual weigh station is that habitual offenders can be identified remotely, which can make the roadways safer and limit violators. Indiana is the only state in the Upper Midwest

that is currently deploying these stations, though virtual weigh station deployment is a high priority of the Gary-Chicago-Milwaukee Corridor.

Freeway Management Systems

Freeway Management Systems (FMS) are used to inform transportation agencies of traffic volumes, traffic speeds, road conditions, and other related data. The systems utilize a variety of ITS tools such as closed circuit television cameras (CCTVs) and in-pavement traffic sensors. Administrators can use the data to inform the public of road and traffic conditions through dynamic signage, web sites with real-time data, and highway advisory radio stations. A functional FMS can aid in the deployment of maintenance and police vehicles, identify areas of obstruction, direct future capacity expansion or technology deployment strategies and location, and mitigate congestion without expanding capacity. The system can also assist in informing the public of important events like Ozone Action Days.

Funding for FMS can come from a variety of sources. Urban areas designated as non-attainment regions for National Ambient Air Quality Standards (NAAQS) under the Clean Air Act often have access to Congestion Mitigation and Air Quality (CMAQ) funds. Other funding can be drawn from the Surface Transportation Program and Interstate Maintenance Federal funding sources.

FMS is one of the few areas in which states have successfully shared technology benefits and responsibilities across the border. For example, the Ohio-Kentucky collaboration on Cincinnati's FMS funding, deployment, and management demonstrates that cooperation between states in using highway technology is attainable.

Asset Tracking Applications

An asset tracking system involves an assortment of technological devices. These devices can track trucks, trailers, containers, cases, or pallets. See Figure 4 for asset tracking technology implementations for freight shipments. Asset tracking coordinates telecommunications technologies, sensors, and simple bar codes and labels. These applications ensure shipments are moved from start to end safely and securely. Asset tracking is particularly helpful for

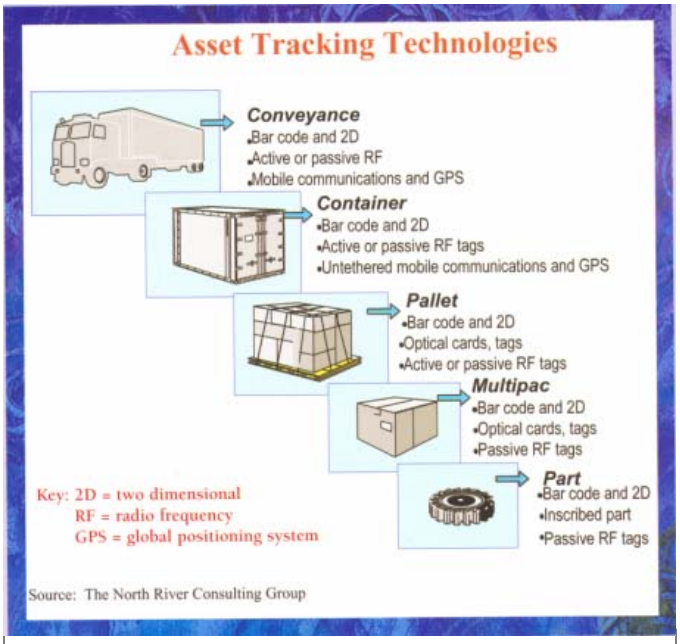

Figure 4: Asset Tracking Technologies for Hazardous Loads (*2*)

shipments that are carried by multiple modes of transport. For example, a container may be shipped from a plant on a flatbed truck and then loaded onto a rail car, and then back onto a truck for the final leg of its journey. The tracking device on the container would ensure there was no tampering of the shipment. These devices are very important for material handling and anti-theft, which protects the public from threats such as shipments of contraband or potential terrorist weaponry.

HAZMAT Tracking

HAZMAT tracking is a serious concern within homeland security. Hazardous materials have the potential to be targeted by terrorists due to the rare and potentially volatile nature of the cargo. HAZMAT tracking uses GPS and communication applications. The GPS can track the cargo or vehicle to see if they stray from the pre-specified route. If this happens, an alert is dispatched. There are other technologies such as a panic button and intelligent on-board computers. Panic buttons send emergency alerts via satellite or terrestrial communications. Lastly, an intelligent on-board computer can disable the vehicle's motor in the case of a security breach. HAZMAT tracking is often coupled with biometrics to verify operator identification. A biometric login can verify the identity of the driver.

Biometrics

Biometrics technologies are used to improve security. Unique physical characteristics such as the iris, fingerprints, retina, voice, and face are used to authenticate identity. At the Charlotte-Douglass Airport, iris scanners are used to verify the identity of airport employees, TSA, vendors, etc. through an eye-pass system. To establish this system, a photo of the eye is taken and converted into a unique digital signature. Other benefits to biometrics besides safety include are time and cost savings. Biometrics applications streamline checkpoints before the cargo is shipped, saving time and money. The system processes background and clearance checks for the operator faster through computers versus the manual paper work that was filled out and processed.

Radio Frequency Identification (RFID)

RFID uses radio waves to identify different cargo. This technology is already used at existing weigh stations for e-screening. There is an RFID tag which utilizes a microchip and an antenna. The microchip stores a unique serial number that is transmitted to a reader by the antenna. This application is used at weigh stations for e-screening and at toll booths for toll collection. The RFID tags are very inexpensive, generally costing less than $15. On the other hand, there are some disadvantages to RFID systems. The standards of RFID are still under development. The range of the RFID tag is limited to about 10 feet (3 meters) and high range tags, which broadcast farther, cost more.

E-Seals

Figure 5: E-Seal Attached to Freight Trailer (*5*)

E-Seals are disposable RFID transponders for container doors. Law enforcement and customs officials use expensive readers to track E-Seals' movements along highways, borders, and ports. The E-Seal transmits the container's ID number to a reader within an inspection station. The seals are readable at mainline speeds. If the container has been tampered with, a message will appear on the reader. The inspection station can then use the information to determine which containers should be inspected. When a container has left the country this information is posted on the internet for tracking purposes. This application can increase efficiency and security at border crossings. One application of E-Seals, used by the Department of Agriculture, is the tracking of in-transit containers of restricted foods. E-Seals, however, are not widely used within the country. A major problem with E-Seals is the lack of standardization in transponder frequencies. This not only causes problems within the US but makes it hard to coordinate with other countries.

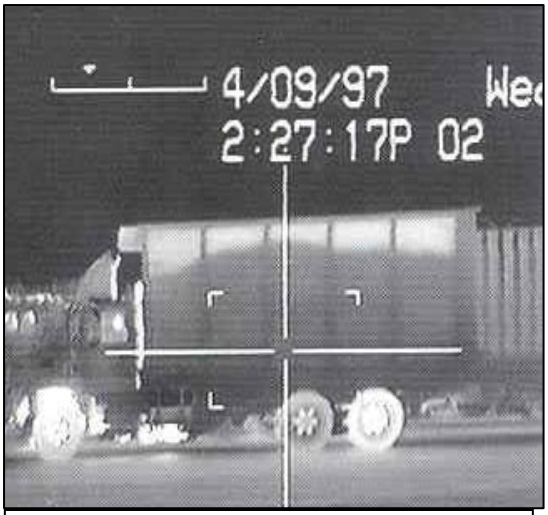

Figure 6: IRISystem Detecting Inoperable Brakes on the Vehicle (*3*)

Infra-Red Inspection System (IRISystem)

IRISystem detects disconnected brakes on commercial vehicles. This system uses heat sensors to check if the brakes of the vehicle are operational. Figure 6 shows a commercial vehicle with one axle of non-operational brakes. The white wheels are warm, which means the brakes are functional. The dark wheels' brakes are not in operation. Disconnected brakes make a commercial vehicle easier to drive and handle, which is why some drivers unhook them. The cost for one unit is about $300,000. IRISystem exhibits a significant increase in identifying problematic vehicles and out-of-service orders. This system is implemented at weigh stations and the vehicles can be screened at around 10 miles per hour (16 kilometers per hour).

Vehicle and Cargo Inspection System (VACIS)

VACIS uses a non-intrusive gamma ray imaging system. The system is mounted within a truck. Short wavelengths with high energy concentrations penetrate thicker and denser materials than x-rays. Additionally, gamma rays are more cost effective and reliable. This system is implemented through homeland security grants and is frequently used to look for weapons, contraband, and other potentially dangerous objects entering the country. Illinois is the only state in the upper Midwest that has this system implemented. The major drawback to this system is its high cost. Each system costs about $1,500,000.

Identification and Monitoring of Radiation in Commerce Shipments (IMRicS)

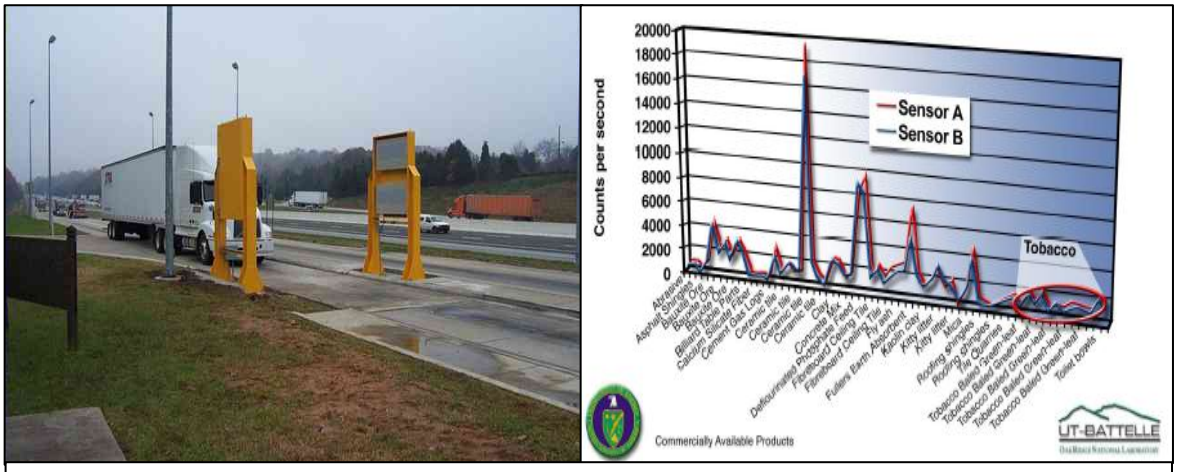

Figure 7: IMRicS System and Cargo Representation of Radiological Signatures (*4*)

IMRicS systems send commercial vehicles through radiological sensors prior to stopping on a static scale. The cargo within the vehicle is detected by a radiological signature. Some of the signatures trigger alerts indicating potential illegal goods. Vehicles that are flagged are then subject to further inspection. This system is still within the development stage at Oak Ridge National Laboratory. Figure 7 shows a truck entering the IMRicS system. The graph to its right shows the radiological signatures for different types of cargo. State law enforcement officers can use IMRicS to crack down on shippers who are transporting illegal freight.

Fatigue Management Technologies (FMT)

Every year many drivers get injured or die due to fatigue-related accidents. It is difficult to validate this problem, because it is difficult to determine if the driver involved in a crash was fatigued or drowsy. FMT consists of many different types of technology applications to alert drivers and detect possible fatigue. One system detects eye closure by using infrared monitoring. The camera sits on the

dashboard and is directed at the driver's eyes. It gives continuous feedback on the alertness level of the driver and sounds an alarm when eye closure is detected. Another application tracks lane markings along the roadway. The system alerts the driver when the vehicle moves from the lane center. There are many other devices that measure sleep needs and control center steering.

Implementation of Technology

Figure 9 shows a distribution of the implemented technologies in each state. The Upper Midwest is a leader in transportation technology usage with some states deploying technology beyond electronic screening.

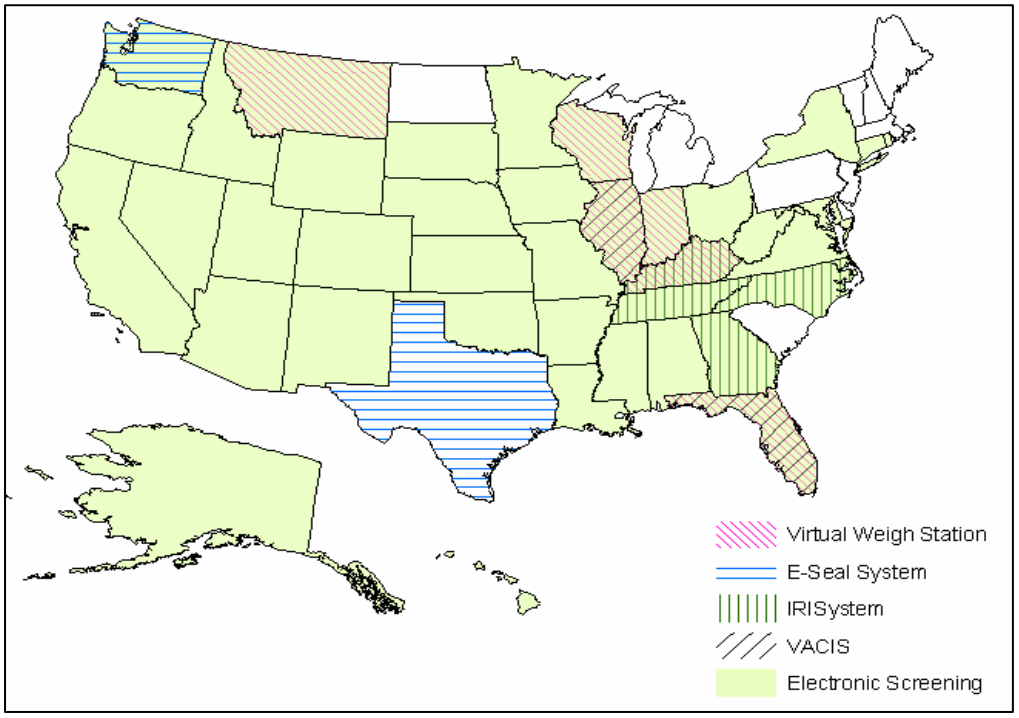

Figure 9: Technology Application Implementation (*1*)

Table 1 shows a quick recap of the technologies status in development and the area of focus.

Table 1: Maturity and Focus Areas of Technology (*1*)

Status	Technology	Driver	Vehicle	Cargo
Widely Tested and Deployed	GPS & Wireless Communication		X	X
	Hazmat Tracking	X	X	X
	WIM		X	
	RFID		X	
	Electronic Screening		X	
Tested by Limited Deployment	Virtual Weigh Station		X	
	Biometrics	X		
	VACIS			X
	IRISystem		X	
Under Development or in Testing	Fatigue Management Technology	X		
	E-Seal			X
	IMRicS			X

Each technology focuses within an area of safety, security, and/or enforcement. Table 2 displays the different technologies within these categories and lists an approximate cost with each.

Table 2: Highway Freight Technology Applications and Cost (*1*)

Technology	Safety	Security	Enforcement	Fixed Cost
Fatigue Management Tech.	X			$
E-Seal		X	X	$
RFID		X		$
WIM			X	$
Virtual Weigh Station			X	$
Biometrics		X		$
GPS/Wireless Communication		X		$
Hazmat Tracking	X	X		$-$$
IRISystem	X		X	$$
Electronic Screening			X	$$$
VACIS		X	X	$$$
IMRicS	X	X	X	$$$
$=<$300K $$=$300-1M $$$=>$1M				

Barriers to Regional Coordination

There are many significant barriers to regional coordination in technology deployment and management. Interviews with Commercial Vehicle Operations (CVO) experts highlighted several obstacles that need to be effectively confronted in order to create an atmosphere in which regional cooperation can work.

- *There are limited clear benefits to regional cooperation.* Most transportation agencies are concerned primarily with the freight traffic within their jurisdiction. Both congestion and infrastructure damage are viewed as localized problems with localized solutions. There is logic to this mindset. As transportation administrators are called upon to maintain high levels of service despite an aging infrastructure, increasing traffic volumes, and shrinking funding, they must look to their own area of responsibility before considering the larger good of the region. Allocation of funds to regional projects with regional benefits is constantly taking the back seat to projects with easily quantifiable local benefits.

- *Agencies differ in policy directions.* Even within states, there are significant disputes that arise due to different perspectives and directions. For example, weight enforcement in Minnesota is a coordinated effort between the Department of Public Safety's Pro-Rate Division, the State Patrol, and the Department of Transportation's Freight and CVO Office. All approach the table with different agendas, different performance measures, and most importantly different priorities. Without incorporating a uniform policy direction, any plans for regional cooperation are unlikely to succeed. In addition, developing a uniform policy direction for a wide variety of stakeholders with significantly different structures is a serious challenge. There is a lack of quality plans that produce trustworthy, realistic assessments of the benefits that regional cooperation can foster.

- *Regulations are not standardized across borders.* In order to utilize regional technologies, states must agree on what they desire from their transportation system. Regulations reflect differing ideologies that would be sources of conflict in regional cooperation. On an operational level, differing regulations create problems with enforcement, credentialing, and licensing. While it may be a huge efficiency boost to issue one permit to a freight hauler for the entire Upper Midwest, this is impossible if every state in the region has different regulations on when, where, and at what weight the driver can operate.

- *The current culture of transportation management does not foster cooperation.* Several CVO experts mentioned that one of the biggest challenges to regional cooperation was simply finding people willing to try it. Locating agency champions for regional deployment of technology with support from their upper management will be essential for overcoming barriers. Unfortunately, there is a significant opposition to the notion of change within transportation agencies. Cooperation beyond one's borders has never been part of the job for most transportation administrators. It has been viewed as unrealistic, ineffective, and extracurricular. In order to foster the long term vision and dedication that a regionally deployed technology infrastructure would demand, the culture of transportation

management must adapt to incorporate a broader view of the transportation system.

- *Agencies lack the trust necessary to share information and technology management responsibility.* For a public agency, sharing of responsibility has traditionally meant losing direct control. This is one reason why transportation agencies are hesitant to trust other agencies. One state DOT has no guarantee that another state DOT is applying the appropriate standards and scrutiny to data. States frequently disregard data that comes from sources they have little experience with. Unfortunately, other state DOTs typically fall into this category. This lack of trust is not limited to public relationships. Private firms are also resistant to cooperative efforts due to trust concerns. The desire of private firms to protect proprietary information mandates caution. Additionally, a tradition of overestimating the benefits of transportation improvements has created skepticisms amongst private firms that must be addressed to gain their trust.

Interestingly, there are few technological hurdles that arose during conversations with CVO experts. The challenges that must be overcome in order to effectively share information which can increase efficiency in regulatory enforcement, credentialing, and freight movement are minimal. Most barriers to regional cooperation are products of the culture, traditions, and structure of transportation administrations rather than technological limitations.

Funding is obviously of great importance when considering regional cooperation. All of the aforementioned barriers limit the amount of funding state DOTs are willing to dedicate to regional projects. Once the barriers of perspective, policy and regulation differences, culture, and trust have been effectively addressed (not that anyone is holding their breath), it is reasonable to expect to see an increase in the funds state DOTs are willing to contribute to regional scale technology deployment.

Opportunities for Regional Cooperation: The Low-Hanging Fruit

Cooperative technology management would aid the push to standardize regulations, leading to increased efficiency and lowered administrative costs. States could greatly benefit from the increased ability to share information across state lines. A regional database with real-time data would improve efficiency in weight enforcement, safety, security, and congestion mitigation. All of these advances are possible through coordinated efforts. Regional cooperation, a perceived option now, will become a necessity. The issue is whether the Upper Midwest begins to take action now, or waits until regional coordination is no longer an option, but a necessity.

There are several possibilities of how to proceed in developing a regional technology deployment and management strategy. Listed below are several ideas intended to foster discussion and thought.

- *Discussion between CVO experts throughout the Upper Midwest should be a regular component of technology planning.* CVO experts within the Upper Midwest region frequently interact at conferences and other professional gatherings. Yet there is rarely a defined component of technology planning that promotes communication between states as an essential element for effective deployment and maximum results. By fostering interstate communication, the benefits to regional cooperation will become clearer and the barriers to coordination will lower. For example, weight enforcement facility sites are frequently located at state borders, rather than dispersed evenly along corridors. This pattern leads to concentrated weight enforcement and delays at borders and long stretches of highway without any enforcement. The placement of weigh stations at borders is often unneeded, particularly when the neighboring states have similar weight regulations. Communication between CVO experts prior to deployment could help prevent inefficient allocation of resources before they are fixed in place.

- *Involving freight companies can promote the benefits of a regional perspective.* It is important for state DOTs to understand that political boundaries are of far less importance to freight carriers than they are to the government. By bringing freight companies into policy development forums, the interests of the users of the transportation system can begin to take precedence over the interests of the administrators. Freight companies are motivated, efficient, and often have access to the latest technologies. For example, Fatigue Management Technologies (FMT) will likely move from the Federal government into the hands of private freight carriers. If individual states in the Upper Midwest wish to encourage the use of such technologies because of their impacts on highway safety, the states will benefit from a regional approach. It is harder for a single state to enact and enforce a regulation on FMT usage than it would be for a region. By involving freight companies, state transportation administrations can learn about the latest technologies and methods and, through dialogue with the private sector, identify reasonable and effective regulation strategies. Engaging freight companies is not an easy task, given the reservations and skepticisms they frequently have with the public sector. But counting freight carriers' interests and input will ultimately help the Upper Midwest to remain a competitive region for freight movement.

- *The Upper Midwest should solicit the Federal government to play a stronger role within the regional plan.* The Federal government has the potential to provide the states of the Upper Midwest with a regional vision.

This vision can be backed by funding that ensures the effective implementation of a regional technology program. The Federal government provided states with a strong vision of the potential for CVISN. They are frequently praised for their role in getting the program off the ground. Yet their failure to provide the necessary funding throughout the development of CVISN is one of the reasons behind the lackluster adoption of the second phase of the program. States in the Upper Midwest need to recognize that the Federal government's involvement can be crucial to large-scale programs. The states should actively pursue Federal involvement in areas of concern such as security and safety. If the Federal government can perform with endurance in both the visioning *and* funding of a regional technology program, the program will have a far better chance of seeing the light of day.

- *Freeway Management Systems should operate on a corridor scale.* By extending metropolitan ideas about traffic management along interstates, the benefits that are realized on a local level for local trips can apply to the longer trips typical of freight carriers. The compatibility of technology should not be an obstacle to gathering information. Standardized databases can easily adapt data into a usable format. Most importantly, this regional coordination opportunity can use currently deployed technologies as a platform, limiting the need for capital start-up funding. Information that is collected from an FMS informs state DOT monitoring centers of traffic accidents, traffic flows, and congestion along the roadways. This information could be shared between state DOTs to notify them of other states' problems. Issues of congestion and traffic flow interruption impact a corridor. They do not stop at a state border. When state DOTs receive such data from other states, they can then warn their drivers of upcoming delays and possible detours through dynamic signage and other advisory tools.

- *The consistency of CVISN components within the Upper Midwest states should be enhanced.* By improving communication between states through CVISN technology, states will be able to strengthen law enforcement, safety, and security. In addition, by incorporating electronic credentialing and screening within all the states, the Upper Midwest's roadway system could gain a significant advantage. Other transportation networks unable or unwilling to integrate their technological communications would operate less efficiently, giving a competitive edge to the Upper Midwest. CVISN technologies could be extremely helpful in maintaining security, obtaining better safety and operational efficiency of the roadways, and achieving better regulatory compliance across state lines. One benefit is that freight carriers would face fewer delays for unneeded inspections. A compliant vehicle that was inspected in Indiana could be waived through Illinois without inspection delays. This would create more time for enforcement officers to target genuine offenders.

Additionally, consistent CVISN components would provide a platform to integrate regional electronic credentialing. Commercial vehicles would benefit from time and cost savings under such a program. Reduced paperwork, lower administration fees, and fewer processing delays would be the greater result of regional electronic credentialing. All in all, both private and public stakeholders would profit from an increase in CVISN consistency.

- *Improving regional shipping integrity could provide better homeland security while at the same time protecting shippers.* Intelligent freight technologies can help protect freight carriers against theft, shipment of contraband, and terrorism. Increased security can generate significant economic advantages for freight carriers in the form of lowered insurance costs, higher consumer confidence, and increased reliability. In order for surveillance to be effective, it must operate on a regional scale. Non-compliant and potentially dangerous shipments do not remain within state lines. Interstate coordination can ensure that if a shipment attracts suspicion for any reason within a state, the shipment will not escape scrutiny the moment it crosses a state border. If the Upper Midwest has communication protocols and procedures to coordinate the tracking of suspicious or potentially dangerous shipments (similar to those tracked under HAZMAT), the entire region can monitor its roadway networks collectively. Intelligent freight technologies have received increased attention following the events of 9/11, particularly those which prevent shipments from being tampered with. For example, E-seals ensure that the container has not been tampered with. RFID can track packages to ensure shippers have not deviated from assigned routes.

- *A regional vehicle-based surveillance system could benefit the Upper Midwest by providing detailed road network traffic flows.* Through coordination with state and local law enforcement, freight carriers, and cellular phone companies, state DOTs may be able to cooperatively establish a regional information-sharing, real-time database of the movements of commercial vehicles. Existing technology can connect law enforcement officials through use of their 911 database, freight carriers through GPS-linked cellular phones, and state DOTs who monitor commercial vehicle movement. This vehicle-based surveillance system could provide accurate, real-time travel data. This data could supplement existing strategies to identify and manage congestion problems. The GPS data would easily integrate with Geographic Information Systems (GIS) for a variety of administrative and analytical functions. This standardized surveillance system could use technologies already deployed under the CVISN program as a platform, making regional cooperation possible. By operating the system on a regional scale, states would lower the barriers to information-sharing across borders and gain access to accurate, real-time data for the entire network.

Conclusion

The possibility of regional cooperation in technology deployment and management is one that the region could benefit greatly from exploring. The progress of ITS and other transportation technologies has significantly lowered the barriers and costs to regional cooperation. By working to create a system-wide technology deployment strategy, every transportation agency in the region could see improved efficiency. As usage and congestion of the current national highway system increases, any efficiency progress can be a competitive boost to the Upper Midwest's transportation system and economic well-being.

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The Role of Tolls in Moving Freight

Mary Ebeling, Midwest Regional University Transportation Center

Introduction

If one accepts the conclusions of recent studies predicting an increase in congestion on the national highway system then it becomes apparent that new strategies must be developed to manage freight's impact on the country's transportation system.

Tolling strategies are a possible mechanism to relieve congestion caused by freight traffic. They can also facilitate freight movement, thereby providing economic benefits. If the region chooses to employ these tools it must be done on a region-wide basis to help improve the flow of freight through the region. In other words, to get a regional benefit, toll strategies should be deployed at a regional level.

Federal Rules and Tolls

Federal rules and programs for toll roads are delineated in the new transportation bill, SAFETEA-LU. This discussion gives a brief overview of existing federal rules concerning tolling as codified in SAFETEA-LU and investigates different tolling strategies that the Upper Midwest states should consider to benefit regional freight movement.

SAFETEA-LU (§1604) provides states with increased flexibility to use tolling not only to manage congestion, but also to finance infrastructure improvements and maintenance. Tolling programs in SAFETEA-LU, while not freight specific, can be used to manage freight as well as motor-vehicle traffic.

SAFETEA-LU provides the following programs for states to launch tolling projects on a pilot or demonstration basis.

- *Interstate System Construction Toll Pilot Program.* Under this program, the Secretary may permit a state or compact of states to collect tolls on an Interstate highway, bridge, or tunnel for the purpose of constructing Interstate highways. This program is limited to three projects in total (nationwide).

- *Interstate System Reconstruction and Rehabilitation Toll Pilot Program.* Established in TEA-21 and continued in SAFETEA-LU, this program allows up to three interstate tolling projects for the purpose of reconstructing or rehabilitating interstate highway corridors that could not be adequately maintained or improved without the collection of tolls.

- The *Value Pricing Pilot Program* is continued in SAFETEA-LU. The program supports costs of implementing up to fifteen variable pricing pilot programs nationwide to manage congestion and benefit air quality, energy use, and efficiency.

- The new *Express Lanes Demonstration Program* will allow a total of fifteen demonstration projects through 2009 to permit tolling to manage high levels of congestion, reduce emissions in a nonattainment or maintenance area, or finance added interstate lanes for the purpose of reducing congestion. Automatic toll collection is required. This program encourages the use of electronic tolling that is compatible across regions and states. Developing this type of system will be a great improvement in efficiency for all road users, including freight shippers. The Upper Midwest Freight coalition can benefit from this type of interoperability in tolling to reduce freight congestion on highways.

These programs can be used by the Upper Midwest Regional Freight Coalition to both manage congestion on the highway system through road pricing and raise funds for highway maintenance and improvements. Funding for express lanes with electronic toll collection promises to establish infrastructure that will offer significant efficiencies for shippers and could benefit freight movement through the Upper Midwest.

The Upper Midwest states can use these programs to their advantage if they choose to implement tolling programs *(1)*. It is imperative that the Upper Midwest Freight coalition plan any future toll projects jointly. Only by planning projects with an eye to current and future regional congestion issues will a complete and fully functional freight tolling program be established in the region.

Creative Uses of Available Tolling Opportunities

Now that these programs are in place and road pricing is gaining more attention in highway planning circles, what should be done in the Upper Midwest to capitalize on the new opportunities for road pricing made available through SAFETEA-LU? How can the states in the Upper Midwest region use what is being learned through these new programs to improve freight movement through the region? Should the Upper Midwest states convert existing lanes to toll lanes or construct new, dedicate toll lanes? The following are some suggestions of ways the Upper Midwest Freight partners could use tolling to manage congestion and increase freight flows through road pricing.

Figure 1: New York's E-ZPASS System (*2*)

Electronic Toll Collection

This tool is an automated way to pay tolls without stopping at a toll booth through the use of an electronic transponder. It is most often implemented on existing highway lanes, rather than through construction of new lanes.

Electronic toll collection technology has been available for more than ten years. In the past few years this time-saving tool has gained increasing acceptance and the benefits of this technology are being realized. The **New York State Thruway**, which is funded through users' tolls, has been a leader in implementing electronic tolling technologies. The E-ZPASS program provides truckers with incentives to use the E-ZPASS system through offering discounts on the necessary transponders that allow trucks to use the electronic tolling system.

The Thruway further encourages use of electronic toll collection by offering reduced toll rates for vehicles using the E-ZPASS system. Commercial vehicles get a five percent discount over the standard toll rate for using E-ZPASS. Volume discounts further decrease Thruway tolls for truckers.

Open Lanes

With open lane, or open road, tolling, drivers do not need to pass through a toll booth and do not need to slow down to pay their toll. Like electronic toll collection, open lanes can be used with existing infrastructure or with newly constructed toll lanes.

The **Illinois State Toll Highway Authority** is currently in the process of constructing an open-road tolling system that holds great potential for reducing congestion and therefore providing time savings to shippers. Open-road tolling allows truck drivers with an electronic transponder (e.g. I-PASS or E-ZPASS) to use the new open lanes *and* benefit from an

Figure 2: Ariel View of Open Lanes on Illinois Toll Highway *(3)*

agreement with the Illinois Trucking Association to give these truckers preferential toll rates. Truck drivers using Illinois' I-PASS receive discounted congestion pricing during the night time and off-peak daytime hours. The goal of this system is to simultaneously facilitate movement of freight while managing traffic congestion during peak periods.

It is important to note that tolls for trucks on the Illinois Tollway vary not just with distance traveled and time of day, but also by axle. Table 1 displays the breakdown of tolls for shippers based on both number of axles and time of travel.

Table 1: Toll Table for the Illinois Tollway *(5)*

TRUCKS & TRAILERS			
PEAK	2 AXLE 6 TIRES	3-4 AXLES	5+ AXLES
I-PASS & CASH 6 AM - 9 AM 3:30 PM - 6:30 PM	$1.50	$2.25	$4.00
DAYTIME NON-PEAK			
I-PASS WEEKDAY NON-PEAK & DAYTIME WEEKENDS	$1.00	$1.75	$3.00
CASH	$1.50	$2.25	$4.00
OVERNIGHT			
I-PASS & CASH 10 PM - 6 AM	$1.00	$1.75	$3.00
*Rates reflect typical mainline toll plaza rates that can vary by location.			

Some of the additional savings to shippers using I-PASS include *(6).*

With I-PASS alone:

- Commercial vehicle operators who currently use I-PASS are reducing their travel time by up to 20 minutes for a round trip, using a trip on I-294 between Indiana and Wisconsin as an example.
- Truckers spend less time on the road in traffic, and can spend less on fueling and operating their rigs.
- Truckers save $25 for every 15-minute reduction in trip time, (The Midwest Truckers Association). For example, truckers can save as much as $333 per month if they take 10 round trips using I-PASS on the full length of the Tri-State Tollway (I-94/294) compared to operating on roads with manually operated toll booths.
- Vehicle operators experience savings due to less wear and tear on vehicles (engines, tires etc.) due to harsh braking and acceleration.

*With I-PASS funded road improve*ments (*1*):
The Toll Highway Authority anticipates that trucks will save even more with improvements included in the state's Congestion-Relief Plan. These improvements are funded through tolls collected with I-PASS. The following planned improvements will reduce travel times:

- Rebuilding/restoring 90 percent of the Tollway system
- Widening 117 miles of existing roads
- Tearing down 20 mainline toll plazas and replacing them with Open Road Tolling
- Building the long-anticipated I-355 South Extension

These time savings promise to increase efficiency and promote economic development. Illinois is a partner state in the Upper Midwest Freight Corridor Study and this effort can be expanded and built upon to create a regional approach to address congested areas that have become problematic for moving freight through the region.

Truck-Only Open Lanes

In addition to these two options, some state departments of transportation have begun planning for the construction of separated truck-only lanes on their sections of interstate in order to meet the predicted growth in truck-traffic volume. These types of projects include efforts in Texas to build the Trans Texas Corridor that incorporates existing highways and new construction to create a statewide highway network with truck-only toll lanes. In addition, the "STAR Solutions" project proposed by the Virginia Department of Transportation (VDOT) calls for construction of truck-only toll lanes on I-81 through the Shenandoah Valley. Both projects are facing significant opposition from impacted communities and environmental groups. The project proposed for I-81 in Virginia will be discussed in more detail here.

Figure 3: Ariel View of proposed I-81 Truck-Only Open Lanes in Virginia. *(4)*

Under Virginia's 1995 Public-Private Transportation Act (PPTA), which encourages Virginia agencies to enter into partnerships with private-sector interests, the VDOT has contracted with STAR Solutions to increase the

capacity of I-81. STAR has proposed creating truck-only lanes, as well as some minor upgrades to the local freight-rail system. The project will be funded initially through a package of public and private-sector funds, and is ultimately envisioned to be self-sustaining through tolls.

Virginia's I-81 project remains in the planning stages and is controversial for a variety of reasons. The proposed project is on a section of I-81 that runs through environmentally and culturally sensitive lands. The tourism industry, which is an economic force throughout the Shenandoah Valley, remains wary about the future impacts of adding four additional lanes of highway through an area marked by high-quality watersheds and civil war battlefields. Additionally, public watchdog groups question the viability of the toll revenue projects generated by STAR.

The problems VDOT has experienced should provide a caution to other agencies considering construction of this type of large infrastructure project. It is important to accurately gauge public sentiment and take federal regulations such as environmental requirements fully into account before proceeding too far with an infrastructure project of the scale of the one being planned for I-81.

Congestion Pricing

Congestion Pricing refers to variable road pricing, which charges higher prices under congested conditions and lower prices at less congested times and locations. This strategy is intended to reduce peak-period vehicle trips. Congestion pricing can be utilized with any toll-road option. It provides another powerful tool to manage congestion and free valuable space on the highway. By decreasing congestion and improving travel times freight movement becomes more efficient. Shippers can also choose to move freight at non-peak times, thereby lowering their costs.

Industry Issues with Toll Lanes

Not surprisingly, the trucking industry views the possibility of increasing numbers of toll roads with skepticism, asserting that placing tolls on highways will simply divert traffic to arterial and local roads and place an undo burden on the industry. This outcome is unlikely to occur to the extent many in the industry claim. If road prices are set appropriately, truckers will benefit through congestion management more than they would by rerouting to slower-speed roadways. Recent studies have shown that proper use of tolling can provide an appropriate incentive to the freight industry and increase productivity through enhancing the level of service on the interstate highway system (*7*).

Perhaps the lesson the Upper Midwest Freight stakeholders should take from the industry cautions is to coordinate with the trucking associations well in advance of proposing a tolling project. By including this important group in

discussions from the beginning, the industry will be able to voice concerns and perhaps come to agreements that benefit the states and improve freight movement while minimizing harm to the industry.

The Role of Privatization

Recently the private sector has become more involved in the discussion of tolls on the interstate. Private firms are showing interest in constructing and managing toll roads for states seeking to establish a toll structure for their highways. Most of the information coming from this sector has supported the use of road pricing to reflect the true cost of trip making. Different groups have also suggested this strategy would manage congestion and improve the flow of freight.

The precarious nature of our current highway funding system is yet another argument put forward in favor of implementing tolls on the interstate. States and municipalities are having difficulty maintaining existing infrastructure and funding new road projects under the current system. To address this impending funding crisis, some transportation consultants have suggested tolling highways to not only more closely reflect the true cost of using the roads, but, importantly, to help fund roadways. Many of the same consultants suggest that the improved roads should be constructed by private corporations that would then charge a toll to recoup their costs and maintain the infrastructure (*8)*. A caution should be noted in regard to this strategy. Any agreement with a private firm to construct and manage a toll road should include language allowing the contracting states to construct additional travel lanes on parallel, publicly managed roads if traffic volumes warrant. In addition, the Illinois Tollway and the New York Thruway examples discussed here suggest that states are capable of managing their own toll roads. There is no one-size-fits-all solution to who should manage a toll road, and this decision should be made based on the information specific to the state or region contemplating instituting a tolling strategy.

The opinion of the private sector is not unanimous, however. A variety of citizens and non-profit groups are questioning the benefit of the construction of additional toll lanes on the highways. Others are skeptical of the validity of any tolling scheme, citing the gasoline tax as their fare share payment into the highway system. It is clear that regardless of the need and utility of tolling congested highways, the debate concerning this practice will continue into the foreseeable future.

Environmental and Social Issues and toll lanes

Environmental surveys must be conducted for public road projects that use federal or state monies and/or involve federal or state permits. Contracting with

private firms does not eliminate this requirement. Planned projects requiring additional travel lanes, such as the I-81 project, will clearly result in environmental impacts along the highway corridor. By constructing new travel lanes there is a high probability that new traffic will be generated, increasing carbon monoxide and greenhouse gas emissions that need to be addressed. The additional lane width from adding new toll lanes, either optional or truck-only, will create barriers for wildlife, potentially further degrade waterways, and in urban areas can further marginalize neighborhoods through which an interstate highway travels. The environmental and social costs of any project proposing construction of new travel lanes must seriously consider these issues early in the planning process in order properly assess these impacts. Doing this early allows alternatives to be considered before significant time and money is invested in a particular project, and allows for the development of the best possible alternatives.

However, there are certain environmental benefits from the installation of open-road and electronic tolling systems. This technology significantly reduces wait times and bottlenecks caused by delays at staffed toll booths. This benefit cuts down on emissions from idling at toll booths.

The Debate about Tolling Truck Lanes

Despite some of the benefits, current thinking on the use of toll lanes for trucks is mixed. In general, the experience with road pricing has been inconsistent at both the state and national levels. Freight shippers as well as private citizens historically have balked at the suggestion that they pay a fee to use public roads. However, as our highway system becomes increasingly congested and funding for maintenance and construction becomes diminished, policy makers and transportation planners have turned to tolling and variable congestion pricing as a way to manage travel choices and behavior. The different perspectives on the tolling question come from several different camps: the trucking industry; the private sector; state DOTs; and the federal government. It is helpful to compare the pros and cons of tolled lanes for freight side by side.

The benefits of tolled truck lanes include:

- Safety enhancements gained with truck-only lanes safety by limiting interactions between large trucks and automobiles;
- Reduction in congestion increases productivity;
- Capacity expansion with additional highway lanes;
- Modification of highways designed for truck lanes to accommodate heavy vehicles;
- Construction, maintenance, infrastructure improvement funded through tolls;
- Management of traffic through variable pricing, and;
- Restrictions on double and triple trailer might be lifted for truck-only lanes, allowing more freight to be transported more efficiently.

Some of the negatives associated with tolled truck lanes include:

- Potential for diversion of traffic onto local roads (particularly if the toll lanes are mandatory for trucks);
- Optional tolled truck lanes could be underutilized if cost-conscious industry does not see significant economic benefit to toll lanes and therefore avoids using them;
- Potential for political opposition since much of the public resists tolls on public roads;
- Potential for Industry opposition since view as double taxation;
- Potential for significant harm to environmental and cultural resources;
- Potential to contribute to overall traffic growth through additional lanes (induced demand);
- Possible difficulty implementing projects requiring additional lanes due to significant and understandable public opposition;
- Probably high price tag of projects requiring additional lanes, and;
- Potential that most toll-lane projects will not separate automobile and freight traffic, thereby negating the safety benefit.

Recommendations

The pros and cons of tolled highway lanes tell a tale of the opportunities and barriers associated with implementing this type of road pricing on public highways. Documentation of increasing congestion, particularly in moving freight along the highways in the Upper Midwest, points to a clear need for a regional coalition to address this issue proactively, not after it becomes a crisis. Tolling highways is a viable option to help manage and improve freight flows through the region. Using electronic tolling and open lane tolling technology is probably the most viable of the options discussed here. Construction of additional highway lanes takes time and imposes significant financial, environmental, and social costs. Electronic tolling technology can be installed more quickly and at far less expense than constructing traditional staffed toll booths while providing efficiencies through reductions in trip times. Tolling in general provides additional funding to maintain and improve roadways as well as manage congestion.

Looking forward, the Upper Midwest Regional Freight stakeholders need to consider the range of tolling options available to them. By weighing the different choices, a strategy to improve freight movement in the region that includes some form of tolling may emerge as a good choice for the states. Any effort along these lines must be embarked on as a cooperative effort, between the states in the region, the freight industry, the private sector, and the public. This effort must include an objective, technical analysis of trucking industry metrics, additional research on tolling and traffic flows, and the collection of additional data to complement the list of pros and cons to tolling. By working cooperatively, the Upper Midwest has the best chance of addressing system-

wide issues with freight movements. A well functioning network throughout the region will provide benefits to all the states since movement of goods and services through the Upper Midwest will enhance the economic potential of each member of the coalition.

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4. Figure 3: Ariel view of proposed I-81 Truck-Only Open Lanes in Virginia.
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Railroads and Freight in the Future

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Railroads have been a primary mover of freight in the US for more than one hundred and fifty years. For the first one hundred of those years, they were the primary mover of freight. In the post-World War Two era, the nature of railroads and rail service began to change. In the late 1950's and 1960's, the construction of the Interstate Highway System tipped the competitive balance from rail to truck. The result was bankruptcy and merger for many rail companies. Deregulation of the rail industry occurred in the 1980s. It accelerated the already existing trend toward rationalization of rail assets—abandoning low volume lines—and permitted differential pricing, allowing rail companies to match prices to service costs. Finally, changes in manufacturing location and strategy in the 1980's and 1990's brought about a reduction in shipment lane densities and placed a premium on fast, dependable freight services. Both of these changes put rail companies at a further competitive disadvantage to truck.

As a result of these events and trends, rail has evolved from a general carrier of goods of every kind to and from nearly every location to primarily a carrier of specialized goods over long distances to and from a limited number of locations. The trends that brought about this new reality have arguably slowed, but they continue. The rail network and the services provided by it will likely be very different in 2030 than they are today. The public policy discussion that must take place is whether the rail industry and the services provided by it today, and in the probable future, are in the best interest of the economy and broader society of the US. And, if they are not, what public policy options exist for the public sector to influence that industry while maintaining its current financial integrity.

Background

Much has been made of the fact that rail now carries more freight than they ever did before. Railroads are also more profitable than they have been in many years. Despite this seemingly good news, they continue to loose market share to truck. Table 1 outlines the change in the rail share of the combined rail-truck freight market in the several sections of the US. In the five years ending in 1997, rail lost seven percent market share to truck in the Midwest. Across the entire nation, it lost fourteen percent. The loss is much smaller in the Midwest probably because of the region's more heavy use of intermodal service in the auto industry, because of its larger share of the nation's manufacturing industries and because of the large quantities of bulk commodities derived from the extractive and agricultural industries.

Table 1: Rail Share of Combined Rail Truck Freight Market (*1*)

Region	1993	1997	Change in Market Share
Northeast	8.9%	5.7%	-35.9%
Midwest	16.8%	15.7%	-7.0%
South	20.5%	17.7%	-13.4%
West	27.4%	24.0%	-12.0%
United States	19.5%	16.8%	-14.0%

The trends that bring about this loss of market share are not new. In part they are the result of the industries efforts to become more efficient. Larger cars, more powerful and efficient locomotives, longer trains and smaller crews have all joined to make trains more efficient in long haul operations, but less able to operate effectively in the smaller, shorter freight movements. Reebie and Associates, in their Interim Report for NCHRP Project 8-42 came to the following conclusions:

> As a result [of recent technological changes], railroads have become capable of handling large loads more efficiently while becoming less efficient at handling smaller loads. This has allowed them to conquer certain dense traffic markets while continuing to cede loose-car traffic to trucks.

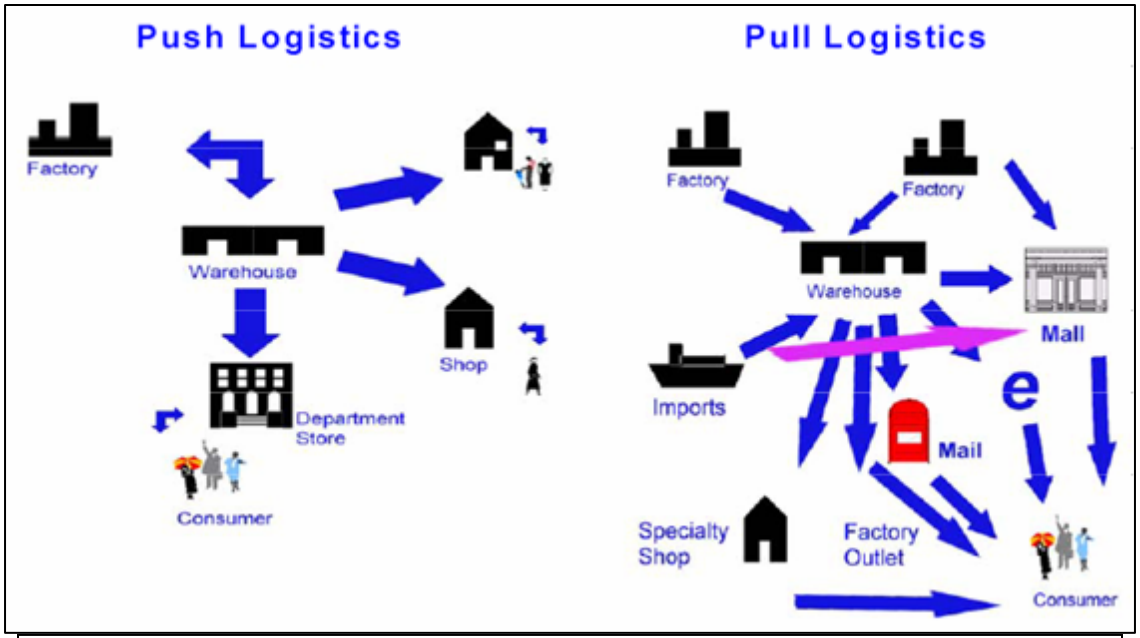

Figure 1: Push and Pull Logistics (*1*)

The change is due to alterations in industry and the resulting changes in service requirements. We have all heard, probably more than we would like, about just-in-time delivery of product, which has reduced warehousing costs and caused a demand of greater reliability in shipping. A similar and complimentary change has happened in how inventories are maintained and replenished through the distribution system. The old system, the "push system" had the manufacturer producing a product, sending it to the wholesaler and the wholesaler sending it to retail outlets. Each hoped that it would sell. The "pull" system uses information technology to coordinate the entire distribution chain to pull products from the factory or the importer as they are needed. Figure 1 provides a graphic representation of the two systems. The arrows clearly depict the more, smaller and more varied movements required to make the pull system work. Smaller, more varied and more frequent movements place rails at a real disadvantage when compared to truck.

Finally, a basic institutional issue tends to place rail at a competitive disadvantage in many situation. Rail companies are most efficient when they are not forced to interchange traffic with other companies. Interchanges between short lines and class ones or interchanges between class ones take time, increase cost, and degrade reliability. The geography of the Upper Midwest dictates that a large share of rail movements in the region require an interchange between railroads. In many cases, shippers find it faster, more dependable, and less costly to truck their product to the final rail company rather than using rail for intermediate distances. The result is that products that might be shipped by rail if they originated in the far West or East move through much of the Midwest on truck.

The sum of all of this is that growth in the rail industry will not keep pace with the growing freight market. AASHTO, in its Rail Freight Bottomline Report concluded that:

> With minimal Class I investments accomplished by the railroads from revenue alone and from investments in short-line improvements and safety enhancements, the freight-rail system could carry the same volume of freight in 2020 as it carries today, but little more. Freight that could not be handled by the railroads, much of it heavy commodities, would move to trucks and the highway system. This would shift almost 900 million tons (816 million metric tons) of freight and 31 billion truck VMT (50 billion vehicle kilometers traveled) to the highways, costing shippers $326 billion, costing highway users $492 billion (in travel time, operating, and accident costs), and adding $21 billion to highway costs over the 20-year period. This $21 billion is a conservative figure that does not include the costs of improvements to bridges, interchanges, local roads, new roads, or system enhancements. If these were included, the estimate could double. This scenario

illustrates how insufficient investment in our nation's freight-rail system could negatively impact highways and the overall transportation system.

Why Should We Care?

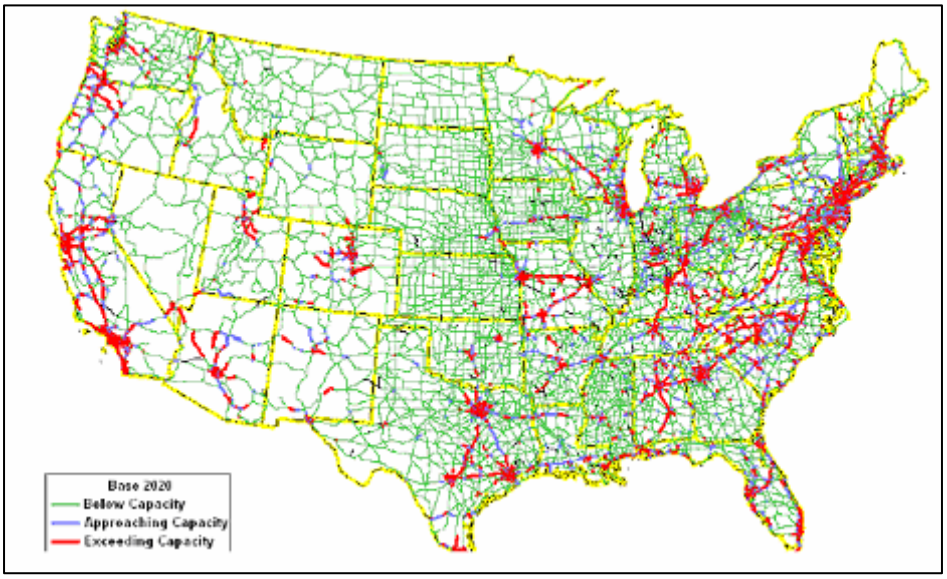

Figure 2: Total Traffic and Congested Segments (Shown in Red and Blue)-Forecast 2020 (*1*)

Some would argue that the market will determine what gets shipped and how, so why should public agencies care if rails continue to loose market share. Figure 2 provides a graphic outline of why we should care: We do not have the highway capacity of absorb significantly more trucks. Figure 2 supports one of the key findings of the Phase One portion of the Upper Midwest Regional Freight Study. By 2020 major freight moving corridors throughout the region will be congested, operating near or beyond designed capacity. Each of the major urban

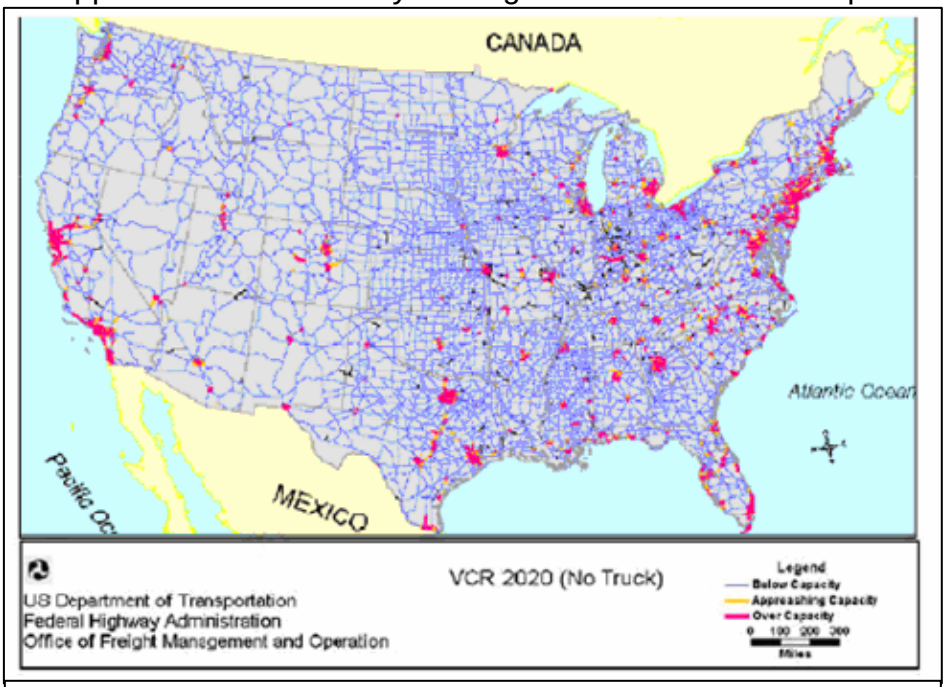

Figure 3: 2020 Congestion without Trucks (*1*)

areas will be even more congested than it is now. And many of the more rural links will also be operating beyond design capacity.

The causes of congestion may be debated. How much do trucks actually contribute to congestion? Figures 3 and 4 contain the answer to this question. Figure 3 illustrates congestion that will exist in 2020 without any trucks. Figure 4 adds trucks to the mix. The comparison of the two clearly illustrates that trucks will make a major contribution to congestion in 2020.

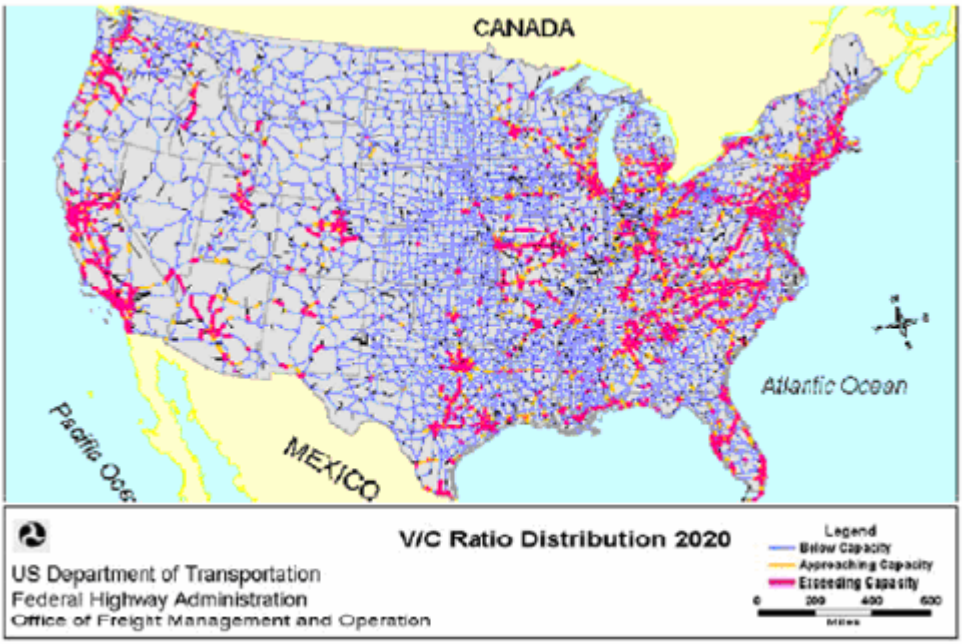

Figure 4: 2020 Congestion with Trucks Added (*1*)

More congestion will cost the economy of the region; our products will be more expensive as they hit the market. This is acutely important to the Upper Midwest since our economy continues to be dependant on manufacturing. Figure 5 outlines the change nationally and by region in manufacturing between the years 1992 and 1997. The Midwest grew more than any other region, and it continues to be the major manufacturing region of the nation.

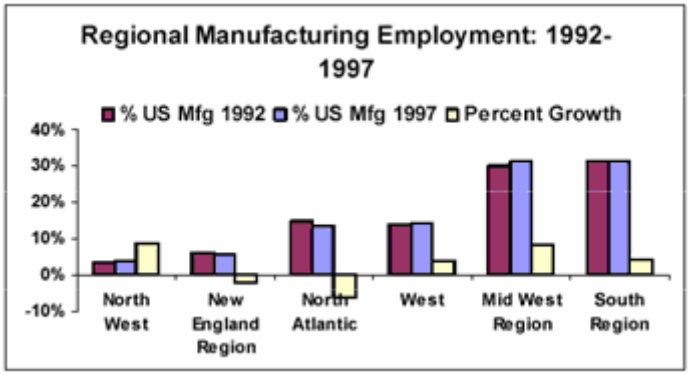

Figure 5: Manufacturing Employment (*1*)

Increased congestion will also cost all of us who use the highway system and pay the fees that support it, as AASHTO illustrated. To the extent that rail could at least maintain market share, the density and number of red lines on the maps could be reduced and our region's economic health maintained.

Issues in Rail Competitiveness

The potential rail market can be divided into three basic parts:

- Unit trains: Think of the coal trains from the Powder River Basin as the primary example of this. Rail does very well in this market. Except for barge in a few situations, it really has no competition.
- Carload: Think of the sidings at a smaller industrial facility where cars are dropped and later picked up by the rail company. Increasingly this has become a short line business dependent upon interchange with a class one. Since increasingly few businesses have rail sidings, this market is diminishing.
- Intermodal: Think of the truck trailer on flatcar or containers stacked on rail cars, either could be intermodal.

Figure 6: Trailer on Rail (*1*)

Figure 7: Container on Rail (*1*)

Table 2 outlines 2002 rail activity by length of haul, size of train and the three categories listed above. Longer distances clearly carry the largest volume.

Table 2: Volume by Miles and Class by Operation (*1*)

RAIL VOLUME BY RAIL MILES & CLASS OF OPERATION								
Source: 2002 CWS; no rebill adjustment								
TONNAGE (000's)	TOTAL	UNIT TRAIN > 50 CARS	CARLOAD < 50 CARS	INTER-MODAL	TOTAL	UNIT TRAIN > 30 CARS	CARLOAD < 30 CARS	INTER-MODAL
All Tons	2,090,835	982,644	935,778	172,413	2,090,835	1,061,617	856,805	172,413
% of Tons	100%	47%	45%	8%	100%	51%	41%	8%
< 100 Miles	260,929	149,343	109,187	2,399	260,929	174,449	84,082	2,399
% of Tons	12%	15%	12%	1%	12%	16%	10%	1%
< 200 Miles	456,647	240,722	212,331	3,594	456,647	282,738	170,315	3,594
% of Tons	22%	24%	23%	2%	22%	27%	20%	2%
< 500 Miles	927,566	443,100	460,476	23,990	927,566	508,278	395,298	23,990
% of Tons	44%	45%	49%	14%	44%	48%	46%	14%
> 500 Miles	1,163,269	539,544	475,302	148,422	1,163,269	553,339	461,507	148,422
% of Tons	56%	55%	51%	86%	56%	52%	54%	86%
UNITS (000's):								
All Units	33,366	9,187	12,641	11,537	33,366	10,014	11,814	11,537
% of Units	100%	28%	38%	35%	100%	30%	35%	35%

Intermodal, since it tends to provide the highest service level, also is the fastest growing element of the rail business. Figure 8 provides a comparison of different modes and different types of rail service including the rate of growth and the service levels provided.

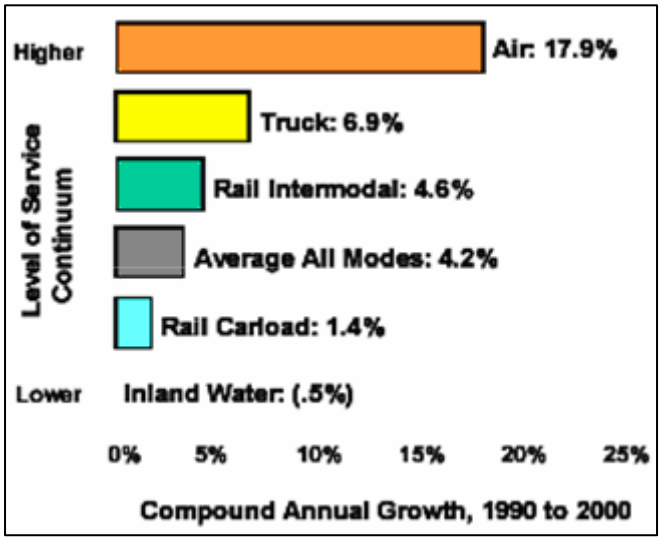

Figure 8: Rate of Growth and Service Loads (*1*)

Service expectations have a major impact on the viability of rail service. Shippers list service as the number one consideration before cost. Service can be defined as dependability and speed. Because of pull logistics and just-in-time delivery, reliability is very important. This is the aspects of service that public sector most often thinks about. Speed is also important because of the costs that are involved with greater time. Manufacturers, distributors and retailers have all made an effort to reduce the "cash-to-cash" time period, that is the time between paying for a good or service and the time they collect for their product or service. More time in transit or in warehouse increases that time, costing the company money.

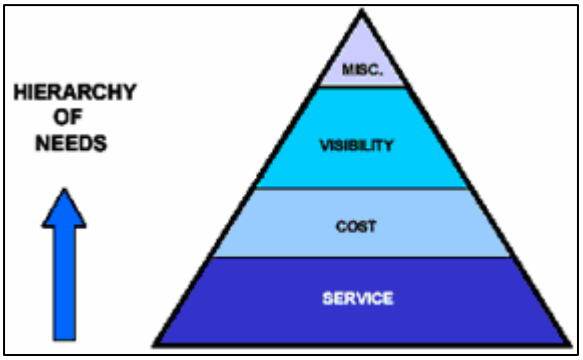

Figure 9: Hierarchy of Needs (*1*)

Service brings another challenge to rail providers. Figure 9 illustrates the place of service in the minds of shippers. Using the structure of Maslow's hierarchy of needs, the graphic illustrates that service requirements must be met before other factors can be considered, just as human safety and security issues must be met in Maslow's hierarchy before higher level needs can be met.

This hierarchy presents a challenge to rail service since shippers must develop a comfort level with a carrier over time. If one trucker fails to meet service expectations, another trucker will be found. If a rail provider fails in service, another rail company is rarely found. Therefore, trucking as an industry tends to hold a competitive edge. For this reason, trucking companies may be the best source of expanding intermodal service. As congestion and fuel costs increase and drivers become harder to find, trucking companies are turning to rail to move long haul product. But for them, cost and service remain issues.

The cost of intermodal is found in the transfer between modes. Figure 10 outlines this issue. Most intermodal moves require drayage at both ends. These transfer costs tend to be fixed regardless of the haul length. Therefore, short haul intermodal is not competitive.

Another issue to be evaluated in intermodal, and other, rail service is line density: How much tonnage (metric tonnage) moves in a corridor? As Table 3 illustrates, rail is most competitive in corridors with high density. This follows logically, since each train movement carries much more freight than each truck movement. Therefore, higher density allows more trains, more frequent service and better service.

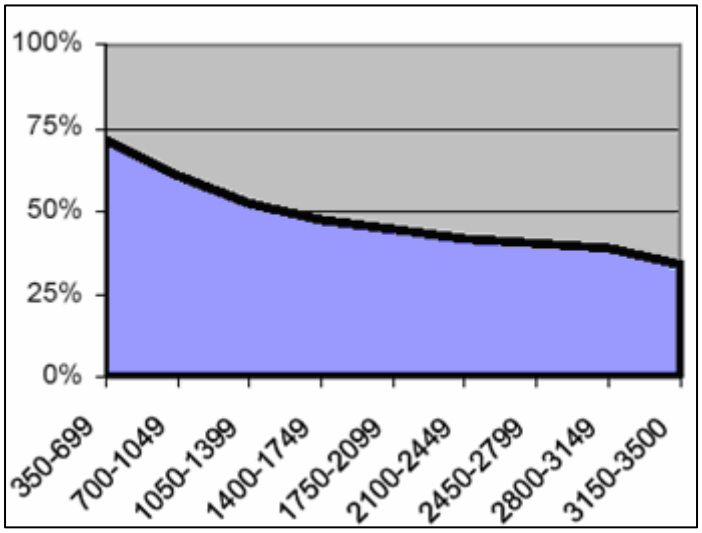

Figure 10: Percent of Transfer Cost in Intermodal by Length (*1*)

Table 3: Corridor Density and Mode Choice (*1*)

MODAL MARKET SHARE BY LANE DENSITY & DISTANCE
RAIL INTERMODAL (IMX) Vs OVER-THE-ROAD (OTR) DRY VAN TRUCK
Source: TRANSEARCH 2000

HIGHWAY MILES	LANE DENSITY (Annual Tons [000] by IMX+OTR)							
	< 100		100 - 400		> 400		Total	
	IMX	OTR	IMX	OTR	IMX	OTR	IMX	OTR
1-100	0.1%	99.9%	0.1%	99.9%	0.4%	99.6%	0.4%	99.6%
100 - 299	0.3%	99.7%	1.1%	98.9%	1.4%	98.6%	1.3%	98.7%
300 - 499	0.8%	99.2%	2.3%	97.7%	3.6%	96.4%	3.0%	97.0%
500 - 699	1.3%	98.7%	5.8%	94.2%	11.1%	88.9%	6.6%	93.4%
700 - 999	1.3%	98.7%	8.3%	91.7%	27.2%	72.8%	12.6%	87.4%
1000 - 1499	2.6%	97.4%	8.7%	91.3%	28.1%	71.9%	11.4%	88.6%
>1500	7.3%	92.7%	24.8%	75.2%	62.0%	38.0%	37.1%	62.9%
Total	2.4%	97.6%	6.6%	93.4%	8.2%	91.8%	7.0%	93.0%
Total > 500	3.0%	97.0%	10.8%	89.2%	33.8%	66.2%	16.8%	83.2%
Total < 500	0.6%	99.4%	1.5%	98.5%	1.5%	98.5%	1.4%	98.6%

MARKET SHARE KEY:
OTR TRUCK ≥ 80% | BOTH < 80% | IMX RAIL ≥ 80%

Public Policy Options

Rail companies are private enterprises that must make a profit to stay in business. Profit can be made either by increasing revenues, which is very difficult to do in head-to-head competition with trucking, or by reducing costs. Railroads have generally opted for the second alternative. Facilities that do not return the desired rate of return, even if they are profitable, are phased out. After decades of this sound basic business logic, rail companies are profitable, but their capacity is limited. Low volume tracks are gone and medium volume tracks are now on the block. Low volume terminals are also gone or going.

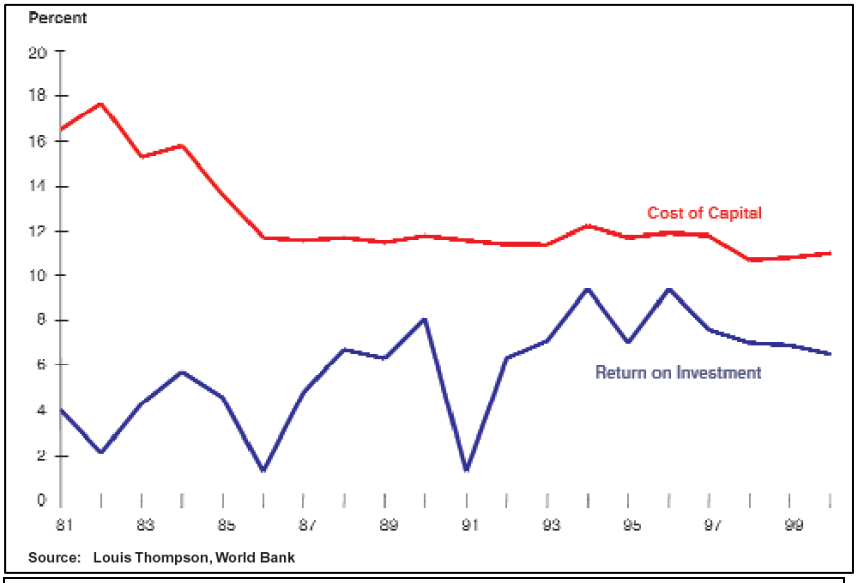

Figure 11: Cost of Capital and Return on Investment (*2*)

Figure 11 illustrates the basic reason for this change. Rail companies have a very low rate of return. When the return is lower than the cost of capital, outside capital will be used very sparingly. Therefore, investments will be made only with internally generated funds and only for projects that bring the require rate of return. Rail companies have become cautious in their investment strategies. While they continue to invest a much larger proportion of their revenues in capital and maintenance projects that other industries, they cannot address many projects that might seem attractive to public sector decision-makers. To illustrate this point, one state reports having public funding in the amount of one million dollars turned down by a railroad, even though it would have reduced the cost of the desired project by one-third.

Figure 12 illustrates why the situation is not likely to change soon. Real revenue for each ton-mile (metric ton-kilometer) of freight moved continues to decline in both constant and current dollars.

The only way that rail as an industry can be more competitive and continue to carry near its historic share of freight is if the economics of the industry are changed, either by broad market

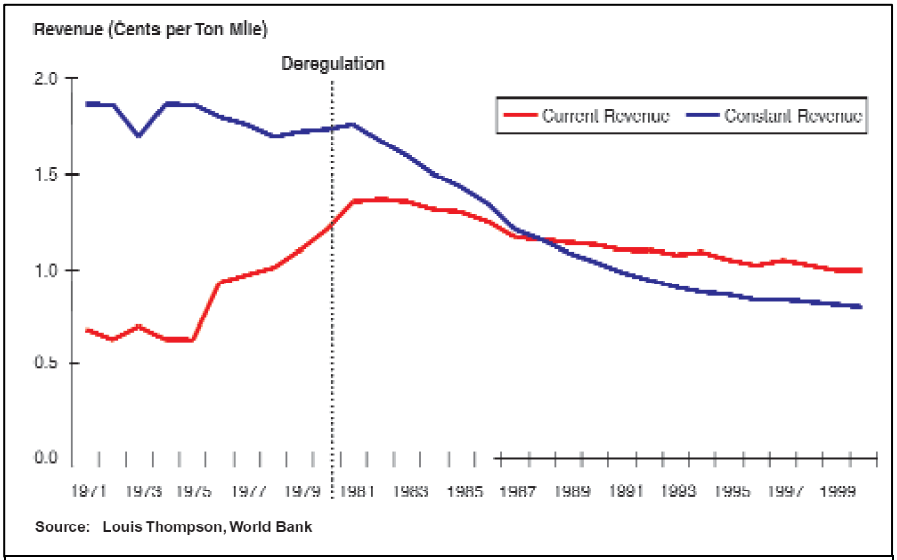

Figure 12: Rail Revenue per Ton Mile (*2*)

forces or by public intervention. Figure 13 may help to illustrate some of the options that might be considered.

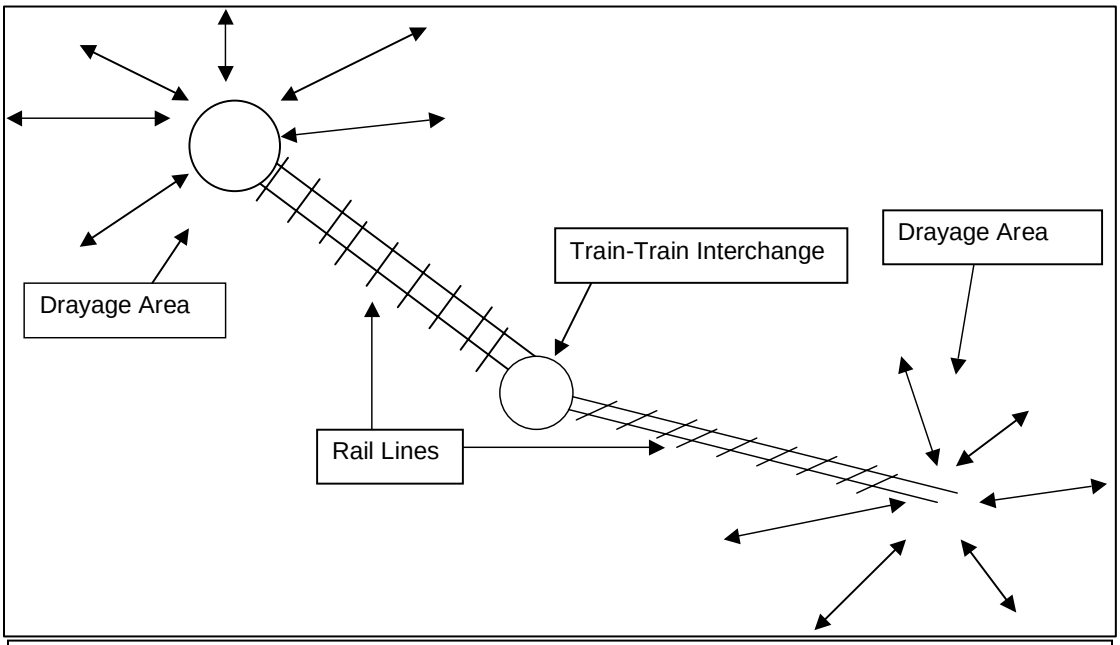

Figure 13: Areas for Public Policy Options

Figure 13 illustrates a simple rail configuration: Two rail lines, with drayage areas at both ends, and a rail-to-rail interchange. Some of the options that might be considered include:

- Reducing the costs of the transfer at the end of each rail line. Remember that Figure Ten pointed out the cost structure of intermodal relative to haul length. If we want intermodal to work in shorter distances, those costs have to come down. Approaches could include:
  - Technology improvement at the transfer—better ramps or lifts.
  - Public investments in terminals or terminal equipment.
  - Public ownership of terminals.
  - Public facilitation of intermodal equipment standards. The range of equipment now in use makes some intermodal movements nearly proprietary. Standard equipment could facilitate competition and reduce the costs.
- Increasing the density of the rail corridor. As noted in Figure 11, rail lines are most competitive when density is high and service frequency can be enhanced. Facilitating shippers associations, locating hubs regionally, and not building highways that parallel potentially viable rail routes and raising the visibility of intermodal hubs might help to increase density.
- Increasing the efficiency of rail line operations. Speed is important, and the public sector could help to improve speeds. Some options:
  - Limiting the number of permitted rail-highway crossings.

    - Increasing the protection level at existing crossings.
    - Investing in rail rehabilitation or expansion.
    - Investing in train control systems.
- Increasing the efficiency of rail-to-rail interchange. Some options to consider include:
    - Facilitating equipment standardization.
    - Investing in interchange facilities.

As noted earlier in this section, market or public action will have to change the economics of the industry if they are to change the actions of the participants in the industry. Ultimately, this will require public investment in any of a number of ways, or it will require actions that have the impact of relieving rail companies of cost. Relying on market forces is simply waiting for highway congestion, driver shortages, or fuel prices to hamper the trucking industry. While in the very long run this might bring about changes in rail service, the method of change could be very traumatic for our regional and national economies.

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Great Lakes Marine Transportation System

Richard D. Stewart, Great Lakes Maritime Research Institute

Historical Perspective of the Great Lakes Martine Transportation System

The Great Lakes Marine Transportation System (GLMTS) has been a commercial trade route for thousands of years. Routes established by the Native Americans were used in the early fur trading days to link together a vast inland network that predates today's hub and spoke distribution centers. The importance of the trade route resulted in three wars being fought for control of the Great Lakes.

Prior to the advent of the railroad the GLMTS was one of the primary routes in the westward expansion of the United States. The opening of the Erie Canal in 1824 provided an all water route to the rapidly growing port of New York and maritime trade on the Great Lakes flourished. Other canals were built that allowed maritime commerce to enter the Ohio River system through: Toledo, and Ohio, the Mississippi river system at Green Bay, Wisconsin. As the population in the regions around the lakes expanded maritime trade was the primary method of transportation. When railroads were introduced they were linked through ports to the GLMTS. The Chicago ship canal built in 1900 linked the GLMTS to the Mississippi river system creating the largest all water route to the inland river system.

To this day, the movement of vast storehouses of natural resources in the heartland of the US and Canada relies on an efficient GLMTS. Thousands of ships have been built and operated on the Great Lakes. Transportation efficiency is a hallmark of the vessel operators on the GLMTS with two examples being self-unloaders and the use of mariner for line handling. Fleets of ships have been built to carry all varieties of commerce and the GLMTS has a long history of world cruise and day passenger ships. During World Wars I & II Great Lakes shipbuilders made major contributions of merchant and warships to the services of US and Canada.

The two nations had created lasting maritime agreements on the use of the GLMTS addressing cross border trading, environmental issues, and vessel safety. The vessel operators were responsible for actively promoting safe efficient operations including the introduction of the traffic separation lanes, off season maritime educational programs, and other world renown ideas. Future improvements and expansion of the GLMTS will rest on a legacy of innovation, efficiency, environmental stewardship and safety.

Current Operations

The Great Lakes Marine Transportation System (GLMTS) includes Lakes Ontario, Erie, Huron, Michigan, and Superior, their connecting waters, and the St. Lawrence River. It is one of the largest concentrations of fresh water on the earth. The system, including the St. Lawrence River above Iroquois Dam, has a total shore of about 11,000 statute miles (9,559 nautical miles, nm), a total watersurface area of about 95,000 square statute miles (24,600,000 hectares). With the opening of the St. Lawrence Seaway, the system provides access by oceangoing deep-draft vessels to the great industrial and agricultural heartland of the North American continent. From the Strait of Belle Isle at the mouth of the Gulf of St. Lawrence, the distance via the St. Lawrence River to Duluth, MN at the head of Lake Superior is about 2,340 statute miles (2,03nm) and to Chicago, IL near the southern end of Lake Michigan is about 2,250 statute miles (1,955nm). About 1,000 statute miles (870 nm) of each of these distances is below Montreal, the head of a deep-draft ocean navigation on the St. Lawrence River.

The GLMTS serves 15 major international ports and some 50 regional ports on both sides of the border. Maritime commerce on the system supports domestic and international trade, and provides a competitive advantage to a wide range of industries. A recent economic impact study of the St. Lawrence Seaway System estimated the revenue benefit to the US economy to be $3.4 billion, personal income and consumption benefit of $4.3 billion and federal state and local tax revenue of $1.3 billion per year *(1).* The study examined growth patterns for the system from 1991 to 2000 and found constant expansion in jobs, revenue, tonnage, and economic indicators for the decade.

Marine transportation on the system involves three general trade patterns:
Seaway Trade: traffic moved on the Seaway, much of which is overseas import/export trade.
Great Lakes Trade consists of interlake (between lakes) or intralake (within one lake) domestic or bi-national trades contained within the Great Lakes.
Lake -River Trade is traffic that moves to and from the Great Lakes via the connecting Inland River System.

Seaway Trade

The current Seaway lock system was completed in 1959 and provides an all water route direct to the head of lakes ports of Duluth/Superior in the US and Thunder Bay, Ontario in Canada. The route offers significant savings in distance and cargo handling for products that originate in the heartland bound for European or North African ports. The distance advantage is, to a degree, offset by the slow speed of passing through the lock system and also the diseconomies of scale due to the relatively small ships that the locks can accommodate. As world trade and ship size grew, the number of vessels that could use the seaway

declined never reaching its potential. The Seaway trades have lately been in the range of 50 million tonnes a year. Seaway cargoes are borne both by Canadian-flag and foreign-flag ocean vessels. The U.S.-flag laker fleet is almost exclusively employed in the interlake trades however the grain trade from the head of the lakes ports uses part of the seaway system to reach Buffalo, NY. Current Seaway trade patterns include:

- Upbound (westward) movements of general cargo, including semi-finished steel in the form of slabs, coils, structural forms, and other products from overseas producers.
- Upbound movements of iron ore from mines in eastern Canada.
- Downbound (eastern) shipments of export grain by Canadian bulkers to transshipment points on the St. Lawrence River and by ocean vessels for direct export overseas.

The Seaway also handles project cargoes, forest products, petroleum products, containers, chemicals, edible oils, coal, salt, cement, fertilizers, ores, nonferrous metals, and other bulk commodities. Tolls for use of the Seaway locks are charged for Canadian but not US locks.

Great Lakes Trade

The interlake and intralake trades, approaching some 200 million tonnes a year, are dominated by the dry bulk commodities of iron ore, coal, stone and grain. Also moved within the Lakes are salt, cement, potash and liquid bulk cargoes such as petroleum products, asphalt and industrial chemicals. This commerce is handled by U.S. and Canadian-flag fleets in the Great Lakes. Some of the larger movements within the Lakes are:

- Iron ore, in the form of taconite pellets, moving from the Minnesota Iron Range and Michigan's Upper Peninsula to steel mills around Lakes Michigan and Erie.
- Low-sulphur coal mined in the western U.S., railed to Great Lakes loading ports and moved on water to electrical generating stations on the Great Lakes,
- Coal mined in the eastern U.S. moved to steel mills, generating stations, and other industries.
- Stone moved from quarries to steel mills and taconite plants for flux, and to all major markets for construction.

Lake-River Trade

The GLMTS currently has direct, all water connection to two major river systems. Vessels can travel from Lake Michigan to the Illinois and Mississippi river system via the Chicago ship canal. Vessels can also move from the Great Lakes to the Hudson River system via the New York State Barge Canal (Erie Canal).

New York State Barge Canal

The Erie canal route has significant size restrictions and is primarily used for the delivery of vessels, recreation, and some minor movement of aggregate products. Barges and small vessels can travel from New York Harbor via the Hudson River and New York State Barge Canal System to Lake Ontario at Oswego, NY a distance of 340 statute miles (295.5 nm), or to the Niagara River at Tonawanda, NY; a distance of 496 statute miles (431 nm). All Erie Canal System lock dimensions are 328 feet long, 45 feet wide. The area available for vessels within a lock is 300 feet (91.4 meters); long, 43.5 feet (13.2 meters); wide and controlling draft of 12 feet (3.7 meters); but the most significant restrictions are bridge clearance (air draft) limit of 15.5 feet (5.8 meter) and speed restriction of 5 mph *(2)*

Chicago Ship Canal and Illinois Waterway System

The Chicago ship canal was originally created in 1900 to divert sewage away from the growing metropolis's supply of fresh water from Lake Michigan as well as provide a marine connection. The canal also currently provides fresh water to communities outside the Great Lakes basin. The basin is the land in which all precipitation, rivers, and streams flow back to the lake. A 1967 U.S. Supreme Court decree allows Chicago and its suburban communities to divert up to 2.1 billion gallons a day from Lake Michigan. The Water Resources Development Act of 1986 requires unanimous approval from the eight Great Lakes governors for any city that lies outside the Great Lakes basin to receive water and it is unlikely that other communities around the lakes will in the future be allowed to build canals that divert water from the Great Lakes.

The diversion of water lowers Lake Michigan's lake level by about 2 inches and is also a pathway for exotic species. The Chicago diversion enabled the zebra mussel to move from the Great Lakes into the Mississippi River. There are real concerns that the Asian carp, a voracious eater, will find its way into Lake Michigan from the Mississippi via the canal.

Barges and small vessels can travel from the Gulf of Mexico via the Mississippi River and the Illinois Waterway to Lake Michigan at Chicago, IL, a distance of about 1,530 statute miles (1,329.5 nm) The canal, has limits of depth, 9 feet (2.7); width, 80 feet (24.38 meters); length, 600 feet (182.88 meters); and vertical clearance 17 feet (5.18 meters). There are no tolls on this route.

GLMTS Capacity

The primary measures that are used to determine the capacity of the GLMTS are the number of vessels that transit locks, call at ports and tonnage carried. The waiting time, number of vessels locked through and the historical comparison with past shipping clearly indicate that the system has significant upward

capacity potential. GLMTS is part of a very competitive transportation system. Rail, truck, the inland river system and the St. Lawrence Seaway system are often competing for freight. Finding methods to improve the GLMTS's efficiencies, streamline the system, and reduce costs will make the GLMTS more competitive and expand its use.

Governance and Regulation of the GLMTS

The GLMTS cuts across local, state, and national borders. More than any other mode it is a joint private and public sector enterprise. The private sector owns virtually all of the vessels and most of the terminals on the GLMTS. Governmental agencies are responsible for keeping the waterways open and functioning at optimum efficiency. By its nature and operation the GLMTS is intermodal which means it interacts and depends on access to and interaction with the other modes.

Operating, maintaining, and constructing transportation systems within state boundaries are very difficult tasks. The complex regulatory and governance structure of the GLMTS greatly increased the difficulty of these tasks. A GLMTS marine carrier in cross border trade will have to comply with approximately thirty sets of US and Canadian regulations that are administered by ten different departments on the federal and provincial level alone. In most cases the interaction will result in a fee, tax, toll, or tariff being paid to one or more of the agencies. When construction, maintenance and regulation are considered the US has at least 18 different federal agencies with responsibilities relating to marine transportation systems *(3).* Jurisdictions between agencies often overlap with differing objectives further complicating the process.

As the oldest transportation system for the two nations, there is significant legacy legislation and regulation that has not been well coordinated. Unlike air or highway transportation the GLMTS does not have, even at the US federal level, a single agency to direct and coordinate activities. The institutional goals and divisions of responsibility of the dispersed federal government agencies do not always correspond to how the GLMTS is organized and functions today as an intermodal system. The primary US and Canadian agencies with responsibilities in the operation of the GLMTS are listed as follows.

- Transport Canada
- U.S. Army Corps of Engineers
- U.S. Department of Transportation
- The St. Lawrence Seaway Management Corporation (Canada)
- Saint Lawrence Seaway Development Corporation (United States)
- Environment Canada
- U.S. Fish and Wildlife Service
- US Department of Homeland Security

- State agencies of Illinois, Indiana, Michigan, Minnesota, New York, Ohio, and Pennsylvania
- The Provincial regulatory agencies of Ontario and Quebec
- County, state, village governments and planning commissions
- Numerous non-regulatory government agencies such as the US Maritime Administration and non-governmental agencies like The Great Lakes Commission are active in support of the GLMTS

The list is not comprehensive. Other agencies with interests and concerns about the GLMTS can be found on the Great Lakes Commissions website, http://www.great-lakes.net/links/econ/orgs_transp.html. The fifty year old Great Lakes Commission is a nonpartisan, binominal compact agency created by state and U.S. federal law and dedicated to promoting a strong economy, healthy environment and high quality of life for the Great Lakes - St. Lawrence region and its residents. The Commission consists of state legislators, agency officials, and governors' appointees from its eight member states. Associate membership for Ontario and Québec was established through the signing of a "Declaration of Partnership." Some multi-state collaborative efforts such as the Great Lakes Regional Collaboration effort have been stymied by a lack of funding *(4)*.

The cross border location of the GLMTS requires that long lasting programs be coordinated through both US and Canadian agencies. There is a long history of the two nations working together including the planning and construction of the current St. Lawrence Seaway. Bi-national initiatives such as the following example will be essential for the optimum use of the GLMTS.

Bi-National initiatives

On May 01, 2003 the US and Canadian Governments signed a memorandum of cooperation on the Great Lakes St. Lawrence Seaway System.
The Memorandum of Cooperation enhances collaboration between both governments, and helps them to:

- Assess the economic, environmental and engineering factors associated with the current and future needs of the Great Lakes St. Lawrence Seaway commercial navigation system;
- Identify factors and trends affecting the domestic and international marine transportation industries serving the Great Lakes St. Lawrence Seaway, including evolving intermodal linkages and transportation technologies; and
- Evaluate the reliability and condition of the Great Lakes St. Lawrence Seaway, including the ongoing maintenance and capital requirements of sustaining and optimizing the existing marine transportation infrastructure on which it depends.

In order to carry out the goals outlined in the memorandum of cooperation the agencies involved started a Great Lakes Short Sea Shipping Study (GLSSS)

that is due out in the fall of 2006. Canadian and American officials agreed that obtaining a baseline snapshot of existing engineering infrastructure, and current economic and environmental conditions would prove invaluable in determining what actions would be required to ensure no operational degradation in the System for the next 50 years. The study calls for an assessment of the System's current and future requirements to maintain safety, reliability, viability and efficiency at levels consistent with those present today. The scope of the study is limited to the evaluation of the existing marine transportation infrastructure. It is important to note that the focus of the study is on the optimization of the existing infrastructure based on the system's current configuration and that the evaluation of major infrastructure modifications, such as an expansion of the Seaway locks or an increase in channel dimensions is not part of the GLSSS study *(5)*.

Physical Challenges to Optimizing the Use of the GLMTS

Physical Constraints

A waterway that extends over 2,300 miles east to west and over 400 miles north to south into the middle of a continent is impacted by physical limitations. In most instances the barriers to water transportation have been overcome by technology. There are some constraints on the system that current or even future technology may not be able to change.

Winter Operations

Winter operation on the Great Lakes is restricted during the height of winter due to ice conditions and closure of the locks. Vessels that would elect to operate during this period would need an ice strengthened hull, rudder, and propeller and would be limited to operational areas not requiring locking. Air temperatures on the Great Lakes can go as low as –50 degrees F (–46 degrees C) with ice covering a large portion of the northern Great Lakes and most of the harbors.

Despite the severe weather, there have been trial year round operations in intralake service and interlake service on the Great Lakes. The Great Lakes Commission members have proposed extensions of the season *(6)*. Year round service in the Baltic and North Sea regions can provide excellent examples of effective ice operations. Foreign shipbuilders are building ice capable vessels with ballast water systems that exceed the IMO standards and are suitable for GLMTS trade. Lock repair and maintenance downtime issues need to be addressed. The building of a second Poe size lock could be a significant factor in extending the season. If global warming is a reality, the Great Lakes navigation season may steadily increase to the point of year round service. Should that occur then new supply chain options would open in the region.

Lake Levels

Lake level fluctuations occur on a cyclical basis and they can reduce or raise water level in some lakes by as much as 19.5 inches (.5 meters). These fluctuations can impact a vessel's carrying capacity and in turn the total capacity of the GLMTS. Concerns have been raised about global warming and the potential impact on Great Lakes shipping *(7)*. The NOAA study postulates that if global warming continues lake levels will drop anywhere between 2-3 feet. Such a drop could have significant impact on future GLMTS in terms of vessel cargo carrying capacity but this may be offset by an extended or year-round shipping season.

Global warming may have the impact of reducing or even elimination ice cover on many of the Great Lakes. While the phenomena may be a decade away, that is not a long time frame when considering transportation infrastructure changes. If global warming is a reality, the Great Lakes navigation season may steadily increase to the point of year round service. Should that occur then new supply chain options would open in the region. There should be studies by planning agencies and transportation academics on how an ice free GLMTS could be utilized to maximum benefit

Locks

It should be recognized that ships that want to trade in the Great Lakes system have to fit within the physical dimensions of the St. Lawrence Seaway and Welland Canal locks. Vessels that trade into Lake Superior must be able to fit through the locks at the Sault.

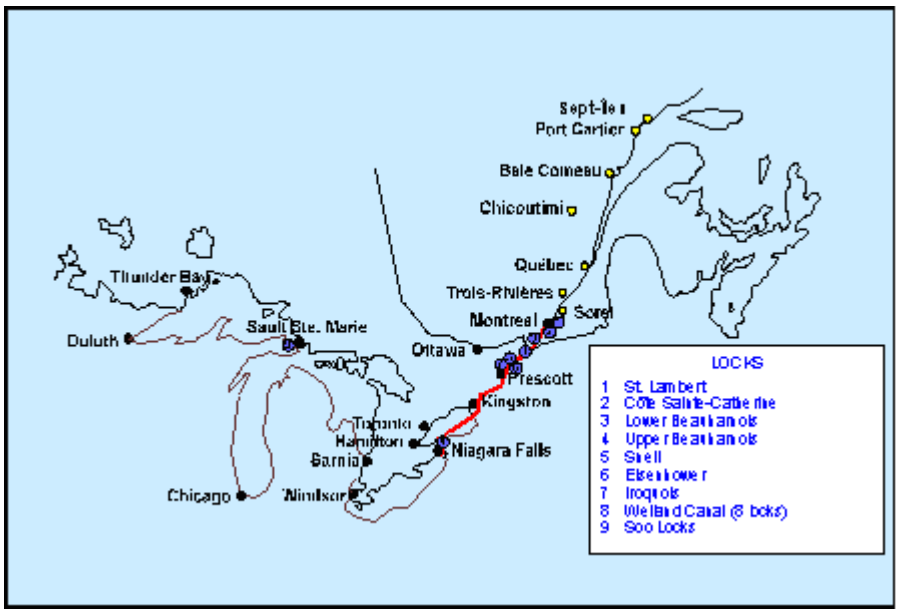

Figure 1: Seaway and Great Lakes Lock System

Seaway Locks

The St. Lawrence Seaway proper extends from Montreal to Lake Erie. The Seaway locks (fifteen in total) overcome the differences in elevation in the system. The Montreal/Lake Ontario section encompasses a series of seven locks over roughly 300 kilometers (187 miles), with five Canadian and two American locks, from Montreal, Quebec to Iroquois, Ontario enabling ships to navigate between the St. Lawrence River and Lake Ontario. The Welland Canal links Lake Ontario and Lake Erie with a series of eight locks over approximately 42 kilometers (27 miles) – all Canadian. The Welland Canal provides more than half the lift needed between tidewater and the lakehead. Figure 1 shows the seaway and great lakes lock system,

All of the seven locks of the Montreal/Lake Ontario section of the Seaway (St. Lambert, Côte Ste. Catherine, Lower and Upper Beauharnois, Bertrand H. Snell, Dwight D. Eisenhower, and Iroquois) as well as those of the Welland Canal, are 233.5 meters long (766 feet), 24.4 meters wide (80 feet) and 9.1 meters deep (30 feet) over the sill.

Responsibility for the operations and maintenance of the navigational aspects of the Canadian portion of the Seaway (thirteen locks) resides with the St. Lawrence Seaway Management Corporation, a not-for-profit corporation, under a long-term management agreement with the Government of Canada pursuant to the Canada Marine Act. The Government of Canada continues to own all fixed assets of the Canadian Seaway.

The two United States locks in the Seaway are operated and maintained by the Saint Lawrence Seaway Development Corporation, a wholly owned government corporation within the U.S. Department of Transportation.

The Soo locks at Sault Ste. Marie, Michigan, provides a vital connection between the upper Great Lakes and Lake Superior. Access to Lake Superior and the Canadian lakehead at Thunder Bay, Ontario and the U.S. lakehead at Duluth, Minnesota is gained via the locks on the St. Mary's canal. The locks are operated and administered by the U.S. Army Corps of Engineers.

The two locks currently operational for commercial navigation purposes are the Poe and the MacArthur. The Poe lock is 1200 feet long (366 meters), 110 feet wide (33.5 meters) and 32 feet deep (9.8 meters). The MacArthur lock is 800 feet long (244 meters), 80 feet wide (24.4 meters) and 31 feet deep (9.4 meters).

Challenges to the Inland Waterways System

The majority of the locks and lock chambers in place on the Mississippi and Ohio river waterways are less than 1,000 feet in length. The U.S. Army Corps of Engineers reports that 15% of the locks are 1,000 to 1,200 feet long, 60% are 600-900 feet long, while 25% are less than 600 feet long. Furthermore, about 50% of the locks and dams are over 50 years of age and reaching the end of their economic life.

Not only is age and the need to replace these aging locks and dams a constraint on the ability of the inland waterways to handle cargo in the future, but the size of the locks limit the size of the tow that can pass through the lock system. A 1,200-foot lock can accommodate a tow consisting of 17 barges, while the older locks of 600 feet or less can only accommodate tows consisting of 8 barges. Since the majority of the tows on the upper Mississippi River System, consist of 12 or more barges, the tows must be split in half in order to transit a 600-foot lock. The splitting of the barge tow results in an increase in transit time for cargo with delays as barges wait to enter the locks. Additional constraints are that the Illinois and Mississippi river system are subject to floods, ice conditions and drought.

Locks Improvements

The current Seaway Locks were built small due to political pressure from East Coast ports and the railroads that had a concern that a larger seaway would take trade from their routes. The end result of building locks that were obsolete when completed is that the majority of today's seagoing vessels cannot fit into the locks. There have been a number of studies and recommendations to expand the locks. One of the principal physical constraints to expansion is the depth of water available in channels, rivers, and other waterways that is an average of 30 feet (9.1 meters). The extensive dredging required to bring the entire GLMTS to

a significantly greater depth would be time consuming, expensive, and may have adverse environmental consequences. However the locks could be widened to 110 feet and lengthened without changing the depth and the improved locks would accommodate the majority of handy size seagoing vessels.

Efforts to build a second large lock at the Sault have been under way since the 1980s. Those efforts received significant assistance under the provisions of the Water Resources Development Acts of 1996 and 1999, in which Congress reduced the states' share of the project and allowed it to be paid over 50 years, interest-free. Approximately one-quarter of the originally estimated $225 million project is to be covered by nonfederal, cost-sharing funds from the eight Great Lakes states. The Michigan, Illinois, and Pennsylvania legislatures all appropriated in the summer of 2001 to cover their contributions toward the new lock, to be built on the St. Marys River between Lakes Huron and Superior. The remaining five Great Lakes states have also committed to supporting the project and are in the process of securing appropriations to cover their shares. After a lengthy review at the U.S. Army Corps of Engineers headquarters, a Limited Reevaluation Report (LRR) revisiting initial benefit-cost ratio calculations for the project has been forwarded to the Assistant Secretary of the Army (Civil Works) with a recommendation to proceed with construction. At last report, the LRR was still awaiting action. In Congress, the Water Resources Development Act of 2005 has been introduced with language inserted by Cong. James Oberstar (D-MN) calling for full federal funding of the Soo Lock expansion project.

The new large lock will improve shipping reliability and efficiency on the Great Lakes by replacing two small World War I-era locks. Only the Poe lock at Sault Ste. Marie, can handle the 1,000-foot lake vessel. A malfunction of this lock would require that tens of millions of tons of product would have to shipped on smaller vessels or moved by other modes through the most congested rail and highway routes in the Midwest.

Non-Physical Challenges to Optimizing the GLMTS

A vessel that is suitable for the trade and capable of providing competitive economic returns on the investment is one of the most critical components of any viable transportation mode, the marine service is no different. The ability to acquire suitable cost effective vessels in a competitive market is essential to establishing new maritime trade routes or revitalizing existing traffic lanes *(8).* Vessel selection is typically driven by legal factors, physical constraints and availability of reasonably priced vessels. Regulatory barriers exist that currently limit the optimal use of the GLMTS.

Taxation and Border Clearance

In 1986, the Harbor Maintenance Tax (HMT) was enacted by Congress to recover a portion of the cost of maintaining, not improving, the nation's deep-draft

navigation channels. The amount of tax paid by the shipper, who owns the cargo, was based on the value of the goods being shipped. In addition, a cost-share formula was implemented for improving (widening and deepening) harbors and channels, with local port sponsors paying a part of the cost and the Federal government paying a portion from the General Treasury.

Congress decided to fund 40 percent of maintenance costs from the HMT after much debate and discussion about the broad, national benefits of waterside infrastructure and concerns about the impact of a tax on trade and competitiveness of U.S. ports. An ad valorem tax, rather than a tonnage tax, was chosen to minimize the impact on U.S. exports, particularly price-sensitive bulk commodities.

In 1990, Congress more than tripled the HMT to recover 100 percent of maintenance dredging expenses. The current HMT tax rate is .125% of the value of the cargo. The HMT collected from commercial navigation also funds the roughly $80 million expended each year to dredge shallow-drafts ports used primarily for recreational purposes.

The U.S. Supreme Court issued a short, unanimous decision in March 1998 finding the HMT unconstitutional as applied to exports. The decision states that the HMT is a tax, not a user fee, because the ad valorem tax is not a fair approximation of services, facilities or benefits furnished to the exporter.

Customs fees and hours of service have proven to be a barrier to optimizing the use of the GLMTS. The Canadian Customs has limited the hours that they would clear vessels on cross border trade. US Customs charge overtime and travel expenses to clear vessels. Truck and rail operators are able to have 24 hours service with no recovery charges. The agencies in charge of protecting borders need to be able to fulfill their missions and still ensure that the GLMTS operates at maximum efficiency.

There are exemptions to the HMT including maritime trade between the US mainland and Hawaii, Alaska, Guam, and Puerto Rico. The impact of the HMT on US-Canada trade on the Great Lakes is severe. The tax impacts NAFTA short sea shipping service to a much higher degree than ocean traffic for several reasons. A vessel that carries multiple cargoes such as the Detroit Windsor Truck ferry is unable to attract additional business such as UPS trucks because each shipper in the truck will have to pay the tax creating a paperwork issue on less than truckload cargoes *(9).* A cargo shipped on a trailer shipped on a RORO vessel with a $500.000 value shipped from a Canadian port to a US port will have to pay $625 US in tax. The same trailer can be transported by a truck with no tax paid. Because there is not limit on the number of voyages that are taxed, the frequency of service of a short sea shipping vessel means taxes collected from the vessel will far exceed the cost harbor maintenance incurred by that vessel.

Cabotage Laws

Cabotage laws restrict entry into domestic transportation markets by other nations. While maritime cabotage laws are the oldest, they are not unique to the transportation industry. The US does not allow foreign flag airlines to operate on domestic routes such as Chicago to Buffalo and there are cabotage restrictions on trucking for drivers, ownership, and routes. However the restrictions imposed by maritime cabotage laws are the most arduous of all the modes of transportation.

A vessel that carries freight from one Great Lakes U.S. port to another U.S. port without stopping in Canada must fulfill the requirements of the 1920 Jones Act authored by Senator Wesley R. Jones. A vessel that carries passengers must meet the requirements of the U.S. 1896 Passenger Vessel Services Act. Both acts require that the vessel be built in the U.S., that U.S. citizens own a majority of its stock, and that it is crewed by U.S. citizens. In the global market place these constraints have placed American Flag vessels at a competitive disadvantage. The costs of capital, crews, and taxation has resulted in a U.S. shipbuilding base that produces very few large vessels and a merchant marine that carries less than 3% *(10)* of its imports and exports.

The relatively isolated location of the Great Lakes and the nature of the cargoes carried in interlake trade have allowed the existence of a relatively robust U.S. flag bulk cargo fleet. However, the Great Lakes shipbuilding industry has not built a new vessel for the Great Lakes in two decades. The building boom of the 1970s was driven not only by innovations in shipbuilding techniques that resulted in the 1000-foot (305 meter) length over all lake vessels, but was also aided by government subsidies in the form of Title XI ship financing and tax credits *(11)*. Considering the current high cost of shipbuilding in U.S. shipyards, the prospect of a new U.S. vessel built is problematic at best and then only with government subsidies. The Jones Act as currently applied stifles the ability of ship owners to start new operations, stifles entrepreneurial endeavors, and severely limits the importation of technological advances in shipbuilding.

Canadian flag operators face similar economic constraints. The Coasting Trade Act of 1992 regulates vessels that operate between two contiguous Canadian ports. The Coasting Trade Act allows only Canadian flag vessels crewed with Canadian citizens to carry freight or passengers between two contiguous Canadian ports. One critical difference from U.S. acts is that the Canadian Coasting Trade Act allows the purchase of vessels built foreign to be flagged as Canadian vessels provided permission is obtained, they meet Canadian safety regulations, and all applicable duties have been paid *(12).*.

The primary difference between the marine cabotage laws and those applying to other modes is the marine operators restrictions on vessel building

and purchasing. The necessity to maintain a shipbuilding/repair industry is not in question any more than a trucking or aircraft industry. However the building requirement in the marine laws have inhibited technological advancement in merchant shipbuilding and have raised the cost of ships to the point that the purchase price is a barrier to entry in any new markets that could be developed on the GLMTS. The US Government has recognized this fact and has subsidized shipbuilding however this fix has not resulted in a healthy merchant shipbuilding base especially in the GLMTS. The expansion of the GLMTS requires a shipbuilding/repair base as well as cost effective ships and this issue must be addressed or there can be no meaningful use of vessels for domestic trade on the GLMTS. Business models used by other modes of transportation where a significant portion of the vehicle or plane are made in other countries, the modular parts shipped to the US then assembled at US locations should be explored.

Pilotage Issues

There is the possibility to use a foreign flag vessel on some intralake route, as the vessel would be engaged in international trade. However one of the requirements that would be imposed on a foreign flag vessel on those routes is that the maritime laws of both nations would require that pilots be employed. By International agreement between the United States and Canada, the waters of the Great Lakes and the St. Lawrence River have been divided into designated and undesignated waters for pilotage purposes. In designated waters, registered vessels of the United States and foreign vessels are required to have in their service a United States or Canadian registered pilot. In undesignated waters, registered vessels of the United States and foreign vessels are required to have in their service a United States or Canadian registered pilot or other officer qualified for Great Lakes undesignated waters. The US pilots operate under the direction of the US Coast Guard *(13)* The Great Lakes Pilotage Authority Canada manages the Pilotage system for all waters in the Province of Quebec south of the northern entrance to St. Lambert Lock and all Canadian waters in and around the provinces of Ontario and Manitoba *(14)*. Pilotage in the international waters within the boundaries is shared under a memorandum of arrangements between Canada and the United States *(15).*. The cost of the pilots is several hundred dollars per day.

There is a compelling need to protect lives and the environment by using well trained certified navigation officers who have the required knowledge of the waterways. Pilotage service will continue to be needed for vessels entering from the sea. Several studies have been undertaken on the Great Lakes Pilotage system and the all conclude that there is room for improvement. An optimized pilotage system on the GLMTS would provide high quality pilots to vessels at a reasonable rate, have minimal, if any, impact on vessel schedules or routes, and minimize overhead costs not directly related to pilotage. At present, each of the districts operates as an independent business owned and operated by the pilots

who work within the boundaries of these districts. The GL MTS might be better-served by a single pilot organization that seamlessly coordinates vessel movements through the entire seaway *(16)*.

Ballast Water and Air Pollution Issues

Environmental and economic threats posed by non-indigenous species to the Great Lakes, such as zebra mussels, the round goby, and European Ruffe, are well documented. Ballast water has been the major route for the introduction of many aquatic nuisance species into the Great Lakes, including the zebra mussel. The problem of ballast water transport of non-indigenous species is not unique to the Great Lakes. On the East Coast, ships have introduced the Japanese Shore Crab; in the Gulf, the Brown Mussel; on the West Coast, the Chinese Mitten Crab along with numerous other species. Since not much can be done to control the invaders already established in the Great Lakes, policymakers are focusing attention on how to prevent further infestation.

Current U.S. regulations concerning ballast waters were brought about by the passage of the Nonindigenous Aquatic Nuisance Species Prevention and Control Act of 1990. The US Ballast Water Management Regulations are enforced by the U.S. Coast Guard Marine Safety Office in Buffalo, New York Enforcement efforts are primarily focused through USCG Marine Safety Detachment in Massena, New York, due to its location at the beginning of the U.S. waters of the St. Lawrence River *(17)*.

The State of Michigan in 2005 passed a ballast law that further restricts how oceangoing vessels can operate on the Great Lakes *(18)*. This state may spur other state laws. A fragmented and unilateral approach to transportation regulation has never been successful. Studies to address the ballast water issue are underway and should be strongly supported at all levels. This is a world wide problem and solutions should be sought wherever they can be found.

A number of studies have been done on the environmental benefits of marine transportation *(19)*. Specific studies on the GLMTS provide clear evidence that the environmental benefits of marine transportation on the GLMTS are significant *(20)*. The introduction of exotic species by ballast water is an issue just as the movement of wood pests by pallets on trucks or trains are and ballast water must be addressed.

In 2006 the EPA is starting the process of examining the levels of air pollutions from vessels. This follows from studies that have been done on air pollution from vessels calling at the US West Coast. The impact of the operations of Great Lakes vessels is unknown at this time. The University of Minnesota-Duluth, sponsored through the Great Lakes Maritime Research Institute, is studying the use of bio-diesel fuels on Great Lakes merchant ships to

reduce air pollution and provide a domestic fuel source for the vessels auxiliary engines.

Gentrification of the Waterfront

Increased use of the GLMTS will require increased investment in plant and equipment at the marine cargo terminal. The marine cargo terminals are in an escalating struggle with commercial developers who want to acquire waterfront property for non-maritime uses. There are numerous zoning codes and ordinances at the state and local level that may present barriers to expansion. In some instances state and local laws favor maritime trade. One interesting note is that Wisconsin's state constitution prohibits the use of filled land sites (land created from prior waterways) for any purposes except public reaction or maritime commerce. This effectively put off limit large tracts of harbor front created from dredge or other fill material from having non-maritime commercial development.

Planning at state regional and local levels need to consider the long term impact of removing the possibility of waterfront being used for maritime commercial purposes. Once the waterfront including rail and truck corridors is developed for housing or other non-freight uses, the possibility of returning at a future date it to maritime commerce are remote.

New Opportunities to Optimize the GLMTS

Hub and Spoke System

Except for a limited number of ferries, scheduled marine service has not existed on the GLMTS since the 1960s. Vessels have sought out freight and carried it from origin to destination. With the advent of intermodal systems and supply-chain management there is an opportunity to add a new dimension in maritime service on the GLMTS. The establishment of liner service that carries RORO or LOLO traffic similar to the models used in northern Europe and the Mediterranean has potential in the GLMTS. The majority of Great Lakes vessels currently seek long term chartered cargoes *(21)*. A new liner service would have the vessels carry trucks with trailers, trailers and or containers. The trucking industry seeks out the shippers and the marine carrier is a link in the supply chain for the trucker moving the shipper's cargo. A timely cost effective scheduled service tied to hubs would, to a degree, provide the trucker with relief from hours of service issues, fuel costs, maintenance costs and congestion. In order for such a service to be successful several parameters have to be met: reliability, minimal cargo damage, low cost of capital for the vessel, low vessel operating cost, routes that bypass congestion nodes and easy access to interstate or other high speed road systems from the ports. Studies on schedule services that could carry freight often recommend that passengers be included as an additional revenue stream *(22)*.

Dedicated Freight Corridors

One of the tremendous advantages of the GLMTS is its ability to transport heavy cargos. The different state and federal road weight limits create constraints to the efficient and economical movement of paper, wood, steel and other dense products. The creation of freight corridors that connect cluster centers to ports on highways engineered for the load would allow heavyweight trucks to connect to RORO type vessels. The freight can then be moved to another port with another freight corridor connecting that destination port with distribution centers or another production cluster. These corridors would take heavy freight off the highway system lowering pavement impact as well as freight costs

New Asian Gateway

Construction has started on the Prince Rupert, British Columbia container terminal. The $127 investment should have an operational terminal by 2007. The sailing time from Hong Kong, China to Prince Rupert terminal is 36 hours closer than sailing to Long Beach and 20 hours closer than sailing to Vancouver, BC. The rail transit from Prince Rupert to Chicago is 22 hours closer than a train from Vancouver, BC *(23)*. The new terminal has the potential to rapidly grow because of its, lack of congestion, shorter route and elimination of the US Harbor Maintenance Tax on the imported cargoes. The CN rail route passes thought Duluth/Superior creating the potential for GLMTS link.

The population base of Duluth Superior alone is not sufficient to warrant the establishment of an intermodal terminal *(24)*. However, draying cargo from the Duluth/Superior to the Minneapolis St. Paul Metropolitan region is approximately 700 miles closer and 21 hours faster than the Prince Rupert intermodal train going down south to CN's Chicago intermodal terminal then drayed back north on I-90/94 to the Twin Cities. The Metropolitan Statistical Area of the Twin Cities and surrounding region represent a market of 4.3 million people. An intermodal terminal in Duluth/Superior with a direct route to Asia would present an opportunity for containers and containerizable cargo to be moved by water from the lower lakes to the head of the lakes. There may be the critical mass of cargo to establish a cost effective GLMTS hub for RORO and container trade. Similar intermodal marine links may exist in Toledo or Chicago.

New Vessel Designs

A joint venture between privately held companies Van Enkevort Tug and Barge (VET&B) and K&K Warehousing is investing in a new shipbuilding and repair facility will be located at the Erie-Western Pennsylvania Port Authority-owned shipyard. The project was a united effort between PennPORTS, a division within the Department of Community and Economic Development, and the Erie Port Authority. VET&B has committed to build a new 780-foot self-unloading laker

(barge) and four 135-foot icebreaker certified tugs, which are scheduled to go into operation in 2008. The company has also committed to converting at least four additional 780 foot-long straight deckers and self-unloading barges in the next five years. The use of Integrated Tug Barge (ITB) systems will increase in the years to come in order to take advantage of crew size reductions and available Jones Act hulls. A 2005 survey of Great Lakes ship owners by the US Maritime Administration found that those ship owners would prefer ITB for future ships *(25)*.

The school of Naval Architecture at the University of Michigan is researching a ballast free design that uses a ballast flow through design. European shipyards are building “green ships” that are RO/ROs designed for ice service with ballast systems that have electrical shore connections, “Optimar” systems that sanitize ballast water and a ballast system that has no sediment. (26) These vessels can carry 100 trailers while operating with a crew of 12 in the highly congested Baltic & North Sea waters and these vessels are able to fit through the St. Lawrence Seaway locks. Additional vessels with out engine rooms and designed to go from lake to river to ocean are on the drawing boards.

Information Systems Applications

The growth in information systems applications continues to improve efficiencies in GLMTS. Success of this approach requires inexpensive, reliable, paperless freight handling, so that all aspects of goods transport can be arranged, tracked, and managed electronically. There are still many breaks in the chain of electronic data, including restrictions on the use of automated data systems in many port facilities and continuing governmental requirements for some paper documents including redundant overlapping forms such as multiple crew lists. Elimination of these breaks and extraneous paperwork will allow freight to be handled more efficiently, reliably, and quickly, creating a more efficient supply chain.

A reoccurring issue in GLMTS monitoring is the dispersed and sometimes difficult to access data on the system. A single location for storage, access and retrieval that would provide accurate, un-biased data is needed.

A Seamless GLMTS

It is now possible to have seamless, paperless tracking of all freight movements and transactions between parties. It is also possible to automate equipment assignments in the terminal and to optimize terminal operations in the face of complex, competing demands. Increased use of the GLMTS will result in increased rail and road traffic in the ports. In an effort to manage and reduce road truck congestion, many ports worldwide have invested in port traffic coordination systems. Coordination of transportation planning thought state and regional planning commissions so that freight traffic flows in an out of the ports

with a minimum of implementation could further reduce the environmental impacts of port operations.

The Future of the GLMTS

In order to handle the projected increased foreign and domestic trade the GLMTS partners must provide for and maintain harbors, adopt new terminal technologies, remove non-physical operational barriers, and implement state of the art information systems. A GLMTS that is not utilized to its full potential or in decline will result in present cargo being shifted from the waterways and future freight moving to land based modes, creating additional strain on the nation's rail and highway system and further adding to the deterioration of infrastructure. A GLMTS should be developed that is based on the principals of sustainable development and continues to benefit the environment as well as the economy of the Midwest. The needed infrastructure and technological investments will be achievable with a strong and committed partnership of the private sector, federal, state, provincial and local governments.

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Investing in Non-Revenue Modes

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Historically, the states of the US and the Federal government have been reluctant to invest in transportation modes that do not produce a revenue stream or in facilities held in the private sector. The result of this tradition in freight has been that the highway mode--trucking--has become the fallback mode. When rail companies or maritime fleets cannot or chose not to move a product, it will be moved by truck, with the public sector holding responsibility for providing and maintaining the facilities. Although it is difficult to prove, this tradition has probably also resulted in more costly and environmentally damaging solutions to some transportation problems than might have been necessary, had funding constraints been less severe.

Exceptions

Some exceptions to this tradition do exist. For example, public transit facilities never generate a revenue stream adequate to meet their operating and capital costs, but public policy makers have agreed that continuing public transportation is critical for many areas of the nation. Public agencies subsidize those transit service providers so that key services are maintained.

Similarly, in the wake if the terrorist attacks of 9-11, the Congress determined that continuing services from the troubled air carriers was in the national interest. Rather than allowing massive bankruptcies, the airlines were provided public funding, primarily in the form of low cost loans, to ease them over the terrorist-caused disruptions. In this case, the justification was only partially related to service needs. The larger rationale was the impact of the national emergency that was disproportionately felt by the airlines.

AMTRAK is a continuing, if reluctant, exception. In the late 1960's and 1970's, as rail companies all moved out of the passenger business, the federal government established the national passenger rail service, subsidizing both operations and capital. Each renewal cycle, the system is on the funding bubble as Congress and the President argue about the continuation of the service. To date the service continues, albeit at funding levels that continue to degrade services. But the national interest in having passenger rail service is continually reaffirmed.

Another category of exceptions deals with the interface of public and private modes. Rail-highway crossings are the primary example of this category. Within federal programs and in most states, the public benefit in assuring safe crossings has been recognized. The public often installs crossing protection devices and shares the maintenance costs with the rail companies.

Economic Rationale for Investment

Rail crossings illustrate the usual economic justification for public participation in private or non-revenue modes: The public sector should share in costs in proportion to the public and non-public benefit. This concept was recently affirmed by the Government Accountability Office (GAO) in their review of the proposed expansion of the federal role in short sea shipping:

> When public subsidization is being considered for freight infrastructure projects—which to a large degree would likely benefit the private sector—the appropriate scope of government involvement must be considered carefully. Apportioning the cost burden of freight projects among participants equitably is important not only to guard against the waste of limited public resources but also to enhance the efficiency of the transportation system by supporting only the most worthy projects. (GAO September, 2005)

In the case of rail crossings, standard benefit-cost analysis procedures can be used to define the relative benefits that will accrue to each sector, providing a basis for the allocation of costs. Items like crash avoidance and timesaving lend themselves to monetization. The process becomes more complex when the benefits considered are less direct, as is often the case with short sea shipping and other freight projects.

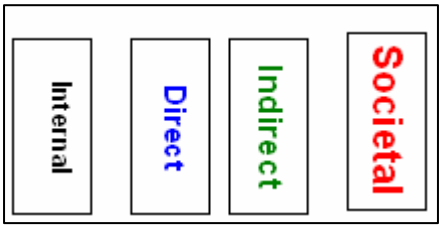

Figure 1: Types of Benefit

Figure 1 outlines the range of benefits that could be considered. At the core are those benefits that will be enjoyed internally by the agency or company funding the activity. In this case, we might think of rail capacity or operational improvements funded by the rail company from its own revenues. Or we could think of highway infrastructure funded by user fees or tolls. In both cases, a fairly direct relationship exists between those who benefit from an investment and those who provide the funding for it.

Rail-highway crossings would fall into the next level, direct. In this case, an investment causes benefits for one or more groups. Since the benefits are direct, for example accident avoidance and timesaving, they can be easily monetized and allocated to the benefiting groups.

Indirect benefits take the issues to the next levels. Perhaps a rail-highway separation project connects two parts of a city that were previously separated for long periods by train movements. In this case, a very real benefit might be an enhancement in the dependability and speed of the emergency response system. While the benefit is real, it accrues to the entire community and cannot be readily attributed to one particular group or sector.

Societal benefits share many attributes of indirect, they cannot be attributed to specific sectors of society; their benefit is widely felt; and they cannot be as easily quantified as direct benefits. They are, however, different from indirect benefits as a matter of degree. For example, a transportation investment might tend to direct urban growth in a desired direction, having a positive impact on land use and the natural environment. Like the rail-highway separation discussed earlier, the benefits will be widely felt, but in this case they may also be felt over a long period of time, future generations may enjoy the natural spaces that are preserved. Allocating the benefits and the costs will be much more difficult. Another example that could fall into this category might be the introduction of a technology that significantly reduces the greenhouse gases emitted by the transportation sector. To increase the speed with which the impact of the technology is felt, the public sector might initiate a buy-back program to speed the turnover of the fleet, or it might subsidize the creation of a new fuel distribution system. In this case, the cost would be borne by the US government, while the benefits would literally be felt around the world and into future generations.

The preservation or enhancement of a transportation mode or service that is critical to a regional or national economy might also produce societal benefit. Consider the market-driven scenario in which freight rail and maritime services continue to be marginalized, serving increasingly narrow market niches. For the highway sector, one of two outcomes would be probable. The first is increased congestion, which will increase the cost of operations for industries, reducing their global competitiveness, ultimately degrading our quality of life. The second is the major construction of new or expanded highways, which may keep industries competitive, but which may also have a negative impact on land use and air quality, also degrading quality of life. Obviously, issues of quality of life can be very personal and value-laden, but not addressing them is, in effect, deciding on them. Something will happen. The only question will be if it is the result of deliberate policy choices made by our society or if it will be the result of thousands of decisions made by individuals and companies, each trying to maximize individual benefit without consideration of collective benefit.

To a large degree the issue for consideration is how broadly we define benefit, do we consider the societal issues or only the benefits that are more closely felt and more easily measured. A case can easily be made that the continued viability of freight rail and maritime freight for more than narrow niche markets can produce major benefits to society. They each move freight using less fuel than truck or air. They produce fewer green house gases. And they can have a beneficial impact on land use patterns, when compared to highway-based transport.

Private Ownership

The issue of private ownership, particularly of rail companies, does raise a number of issues that must be addressed specifically. Public dollars should not be used to enrich private firms. Moreover safeguards must be employed to ensure that the benefit expected is actually derived, or at least is not frustrated by operating decisions made by those same private companies. Finally, care must be taken to protect rail companies from a return to the fiscal peril they endured before regulation. All of these things can be accomplished.

Assistance agreements have to clearly spell out the expectations and responsibilities of both parties and the consequence of non-performance. Of equal importance, they must be built on a base of mutual objectives and mutual benefit. For example, the discussions of the past few years on the possible expansion of passenger rail, using existing freight corridors, have begun with the assumption that public investment in rail infrastructure would leave the freight rail companies in a better condition in so far as capacity is concerned than they are now. This mutual benefit approach has kept the private companies at the table. If public funding is ever made available, agreements will be reached that provide for public investment and use of private facilities.

In the highway realm, the cry of the past several years has been "public-private" partnerships. These partnerships all originate with the desire to bring private dollars into what are normally public facility projects. They take many forms. The variation that is most relevant for this discussion is public funding in the development of a privately operated and maintained and tolled facility. The need for this arrangement exists when a desired facility will probably not produce sufficient toll collections to be viable as a purely private venture. Public involvement may take several forms, but typically it involves the use of taxpayer subsidy of the construction cost or the extension of tax-exempt bonding authority to the concessionary. Both approaches are subsidies designed to make an otherwise unattractive project work. As suggested for the "non-revenue" modes, assistance agreements in this case must spell out the expectations, responsibilities and benefits to both parties. They must also be based on a premise of mutual benefit.

Funding Source

Whenever public investment in a new area of transportation is considered, the source of the funding must be evaluated. Typically the sources considered are General Fund Revenues (GPR) and Highway Trust Fund (HTF) monies. This can be a very divisive issue. It is also an increasingly important issue.

Transportation in the US is funded from a crazy-quilt variety of taxes and fees that are not sustainable in the long run. They are not sustainable, because, despite the number of permutations that exist among the states and at the

federal level, the workhorse of transportation funding is the motor fuel tax (MFT). Over the next decade we can expect increasing numbers of vehicles fueled electricity, hybrids, compressed natural gas, fuel cells, hydrogen and other non-traditional fuels. As this happens, the historic link between use and payment, which the MFT has generally maintained, will be broken. This will reduce the acceptance of the MFT by the public. Moreover, as the available fuels grow in the marketplace, the revenue derived from the MFT will be increasingly inadequate to meet our transportation needs.

We will have to embrace new methods of funding transportation in the relatively near future. As new methods are developed, attention should be given to a wider range of modal applications than currently exist.

Conclusions

The decision to invest public money in a transportation project depends largely on the range of benefits expected from the project and the groups or individuals who will enjoy those benefits. In the case of non-highway freight modes a strong case can be made that significant benefits exist for our economy and our society.

If we chose to recognize those benefits and investment in what are often privately held modes, care must be taken to protect the public interest and ensure that expected benefits are found. This can be done with clear contractual agreements and mutually beneficial arrangements.

The issue of the appropriate source of public money—HTF or GPR—is controversial. It should be addressed over the next decade as new transportation funding methods are developed and implemented.

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Encouraging Development of Intermodal Freight Facilities

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Midwest Regional University Transportation Center

Introduction

According to AASHTO, trucks and the highway system carry 78 percent of domestic freight traffic, the rail system carries 16 percent, and the water-borne freight system carries 6 percent of shipments. The U.S. economy is projected to continue growing, increasing freight tonnage by 57 percent by 2020. *(1)* Given the current highway congestion problem and the role of trucks in causing this congestion, developing more efficient ways of shipping freight is essential. Improving intermodal freight facilities can help achieve this goal.

"Intermodal facilities are sites where freight is conveyed from one mode of freight transportation to another. Examples include water to rail or highway movements, and truck/rail interfaces." Intermodal freight operations involve highway, rail, water, and air and create opportunities to take advantage of the efficiencies and technological advances that can allow the different modes to work in tandem. *(2)* The attention given to intermodalism since the passage of the Intermodal Surface Transportation Efficiency Act (ISTEA) in 1991 has grown. Federal, state, and private sector initiatives have expanded the availability of intermodal freight terminals. Under the most recent federal transportation bill, SAFETEA-LU, research and development of intermodal facilities continues to be encouraged.

In recent years, increasing volumes of freight, growing passenger travel, and an increasing emphasis on security have strained the efficiency of freight transportation in many locations, particularly at gateways and along major transportation corridors. For example, between 1990 and 2003, U.S. international trade with Canada and Mexico, our top two trading partners, rose by approximately 91 percent, due in part to the creation of North American Free Trade Agreement (NAFTA) in 1994 *(3).*

In the face of increasing demands on the existing transportation system intermodal freight transport can accomplish several important things in states struggling to manage highway capacity issues. In particular, the strategic use of rail transport along corridors where freight shipment on highways has become congested can take pressure off the highway system. *(1)* In addition, environmental benefits can accrue by diminishing the perceived need to expand the highway system through better-utilizing existing transportation infrastructure. This paper will explore intermodal shipping options, including the capacity-building potential of intermodal freight, as well as environmental, policy, and technology considerations.

Current Role of Intermodal Freight Shipping

Intermodal shipping is gaining favor as a way to more effectively use existing infrastructure. Utilizing available modes of transportation not only eases highway congestion, but better takes advantage of available transportation assets, such as rail, air, and water shipping. Table 1 highlights the types of freight generally shipped on the different modes and helps identify their strengths. In order to use these modes optimally, existing infrastructure needs to be maintained, and in some cases, expanded. *(1)*

Table 1: Commodity Types per Transportation Mode

Mode	Commodity Types
Air	Perishables, High Value
Highway	Perishables, High Value, Trailer/Container, Dry Bulk, Liquid Bulk, HazMat, Other
Rail	Trailer/Container, Dry Bulk, Liquid Bulk, HazMat, Other
Maritime	IM Container, Dry Bulk, Liquid Bulk, Other
Inland Waterway	Dry Bulk, Liquid Bulk

Source: FHWA Office of Freight Management and Operations. January 2001. Review of Environmental Factors Affecting Intermodal Freight Transportation Facility Development and Expansion.

Terminals are the hub of activity in an intermodal freight system. They are the locations where freight is transferred from one mode of transport, say highway, to another mode, such as rail or water. Activity at the terminal is intensive and key to achieving the desired level of service and time efficiencies. It is important to remain aware of maintenance and infrastructure issues at these terminals. Basic considerations such as pavement condition ratings and wear and tear on equipment used to transfer loads cannot be overlooked without sacrificing quality of service.

Figure 1: Containers in Shipping Yard

Currently, since transfer costs are typically fixed costs, the price makes using intermodal freight prohibitive for all but longer hauls. The opportunities to expand the viability of intermodal freight shipping, particularly truck/rail, center on improving the efficiency of and the reduction of transfer costs between modes. As noted in the Railroads and Freight in the Future *(4),* the expense of intermodal freight is largely borne in the transfer costs. Efficiencies in transferring could come from technology improvements, public investment in terminals and public facilitation of equipment standards. Standardizing equipment could bring notable improvements in time costs associates with

transfers. *(4)* Reducing these costs might make intermodal shipping attractive for medium length as well as long distance hauls.

The impact of containerization on easing the transfer between modes has provided efficiency benefits at the terminal. Transferring freight loaded in containers is far less labor intensive than the traditional method of packing in pallets. Additionally containers hold more and provide better protection for the product being shipped.

Table 2: Breakdown of Freight Shipments with One or Both Trip-Ends in the Study Area

	Freight Tons %			Freight Value %			Freight Ton-Mile %		
	IS	Reg	Ext	IS	Reg	Ext	IS	Reg	Ext
Total	*70.3*	*13.5*	*16.2*	*39.6*	*23.4*	*36.9*	*15.0*	*17.0*	*68.0*
Truck	64.3	10.4	9.2	38.4	21.9	30.3	12.2	11.9	29.5
Rail	5.1	2.4	4.4	1.0	1.1	4.0	2.2	3.9	22.1
Truck and Rail	0.0	0.0	0.2	0.0	0.0	1.4	0.0	0.0	2.1
Air	0.0	0.0	0.0	0.1	0.4	0.7	0.0	0.0	0.1
Water	0.9	0.7	2.4	0.1	0.0	0.5	0.6	1.2	14.2

IS=Intrastate; Reg=Regional; Ext=External; Total does not include all modes, only the five major modes specified in the table.

Within the study area, intermodal transport, mainly truck and rail combination, is used primarily for long-distance shipping. Table 2 shows the distribution of freight shipments within the study area by mode. These different modes generally serve specific markets. For instance, much of the freight moved by water is low-value bulk commodities such as coal or gravel between the Upper Midwest and Louisiana ports. Intermodal does compete with truck and air transport for certain high-value goods, such as electronics, automobile parts, and machinery *(5).*

The Upper Midwest is well positioned as a major player in the shipping of intermodal freight. Five out of the ten largest freight-rail traffic generators in the US are located in the study area, which aids in the shipment of high value goods using intermodal (truck/rail) facilities. California is the most important destination for intermodal freight shipments originating in the Upper Midwest *(5)*.

Benefits of Intermodal Freight Shipping

Intermodal shipping helps relieve the burden large volumes of heavy trucks place on our highway system. By shifting this burden environmental benefits are realized, as has been noted. The public further benefits from reduction in highway congestion and decreased highway maintenance costs *(1)*. By using more than one mode of transportation, many opportunities become available for shippers and private stakeholders. With the help of new and increased technology, containers can be tracked throughout their routes and can indicate shipment problems *(6).* This significant increase in security promotes the intermodal shipping industry and ensures businesses that their goods will be shipped without problems or delays.

Network efficiency is another benefit of intermodal shipping. To increase efficiency, there are many strategies that can be applied or are already in place. Enhancing schedules and routing of freight can create a significant decrease in freight vehicle mileage and increase load factors that will save time and money *(6.)* With the continuing desire and need to find ways to ship goods faster, time efficiency is extremely important to companies shipping goods and to the shippers. Network efficiency makes a difference to not only the company selling the goods, but to the consumer, who is looking for products to be at their fingertips at all times.

Identifying successful ways to reduce congestion is encouraged because congestion is a concern to freight shippers. With the help of intermodalism, larger shipments that need to travel longer distances can be moved from trucks to rail or water thereby reducing congestion on roadways. Intermodal shipping might help improve community quality of life if fewer trucks are on the roadways. Trucks create large amounts of noise and air pollution, which makes neighborhoods unpleasant to live in *(7).* There could be a cost savings as well. For shipments with more flexible delivery dates or are not as time sensitive, rail or water shipment is a viable option. Cost savings accrue because it is cheaper to ship by rail or water than by truck.

Intermodalism can encourage shippers to use the mode with the lowest cost. Usually these modes are rail and water. They are more energy efficient, which promotes a healthier environment. Intermodalism is geared to obtain the optimum yield from the country's transportation resources *(3).* Businesses are able to ship goods at lower costs because of the efficiency of the system. If a product can be shipped economically and within the desired time frame, then businesses are able to compete in the global market, which expands the country's opportunities for economic growth.

Figure 2: Water Borne Freight Shipping

Intermodal Technology

Intermodal freight is constantly being moved within the country and internationally. Tracking of a shipment becomes difficult, because a container can transfer through shipping points several times before it reaches its destination. Asset tracking can enhance the surveillance and security of the container. This tool coordinates telecommunications technologies, sensors, and simple bar codes and labels. These applications ensure shipments are moved from start to end safely and securely. For example, a container may be shipped from a plant on a flatbed truck and then loaded onto a rail car, and then back onto a truck for the final leg of its journey. The tracking device on the container would allow shippers to follow the progress of a shipment and ensure there was no tampering of the shipment. These devices are very important for material handling and anti-theft, which protects the public from threats such as shipments of contraband or potential terrorist weaponry *(6).*

Security of a shipment is another problem. To reduce the possibility of the cargo inside the containers being tampered with during shipment, electronic transponders are used as tags on the container doors. These track the container's route and ensure the security of the cargo. For example, E-Seals are disposable Radio Frequency Identification (RFID) transponders. It transmits the container's ID number to a reader within an inspection station. If the container has been opened or tampered with, a message will appear on the reader. When a container has left the country, this information is posted on the internet for tracking purposes. This application can increase efficiency and security at border crossings. *(6)* These technologies improve security of freight and help promote intermodal shipping.

As US freight activity and use of intermodal shipping grows, there is a need to maintain shipping integrity and forecast traffic for planning purposes. US DOT is developing planning models to aid in stimulating activity in the intermodal-shipping industry. These models are important to the government and to shippers and can be useful to the Upper Midwest region when planning

intermodal facilities. These models can simulate border crossings. A program called Border Wizard is a model that identifies and tests possible cross-border movements of vehicles and pedestrians. It was originally developed by the General Services Administration, US Customs, and other federal inspection agencies to identify infrastructure and operational needs at the borders. Today, it is deployed at 57 US ports of entry. The US DOT is considering using Border

Wizard as a transportation-planning tool. Internationally, Canada is installing the system at the Detroit-Windsor crossing, and Mexico is interested in using the model *(3).*

Challenges with Intermodalism

Intermodalism provides attractive options to shippers, but it is not without concerns that must be addressed. These challenges include congestion and information sharing.

- *Congestion* is at the top of the list. Although shifting to intermodal shipping strategies can help ease highway congestion, this problem remains a concern for intermodal freight. In particular, challenges to the capacity of freight-rail carriers must be dealt with *(1).* Freight rail and highway freight currently operate at or near capacity. Current estimates show that by 2020 our highways will carry a 62 percent increase in freight traffic and rail will carry a 44 percent increase in traffic *(1)*. If freight rail continues to grow as predicted, and if rail capacity does not increase, congestion on this mode will become a significant problem. This in turn will overburden the highway system. Given these estimates, if nothing is done to manage highway congestion and increase freight-rail capacity there will be major challenges to the functionality of our shipping infrastructure.

  The results of this scenario are unappealing. Congestion lessens the reliability and performance of shippers. It also has a domino affect, because it then affects businesses, which in turn affects the consumer getting the goods that they need and want. The US economy runs on a tight schedule to design, make, ship, and sell goods and having on-time shipments helps keep the economy going *(3).*

- *Information sharing* among shippers is difficult to accomplish effectively. There is a gap in the system of sharing information. This gap occurs between different freight modes as well as within each mode. The problem is particularly acute because the private industries that provide freight hauling services are adverse to sharing information with competitors.

  This lack of coordination creates inefficiencies and concerns about security and safety. Even with today's new technology, such as asset tracking, the overall system is hard to implement everywhere because there is resistance to change. Additionally, there is not one standard information system that has been implemented. Different states and even regions use different applications. Additionally, private firms often use systems that are incompatible with each other. This ongoing problem works against establishing a national system and in the end benefits very

few shippers. Upper Midwest freight stakeholders should work to create a unified information-sharing system to facilitate improvements to the regional intermodal shipping system.

These barriers appear large, but two factors are already in motion to overcome them:

- The growing role of third party logistics providers tends to create a level playing field for shippers. Third party providers look for the least cost method of meeting their customer's shipping needs. If intermodal meets the cost and service requirements, it will be used.
- Driver shortages and highway congestion are leading many large trucking companies to form alliances with rail companies to use trucks or containers on rail for longer haul trips. In fact, many have argued that national trucking companies have been the biggest boosters of truck-rail intermodal.

While these factors are positive, it is in the interest of the region to adopt policies that will move intermodalism to the forefront of the shipping industry. This should be done to achieve benefits in efficiency, reduction of environmental impacts, and congestion management that can result from this type of shipping.

Available Programs

A variety of programs exist that facilitate the development of an intermodal freight shipping network. The FHWA has a department dedicated to studying and encouraging the development of intermodal freight infrastructure country-wide. The FHWA has also done significant research into the possibilities of expanding the country's capabilities in this type of shipping, particularly in the international arena (see Figure 1). Brief descriptions of the primary programs currently in place to help develop intermodal freight infrastructure are presented below. Most of the programs are included in the SAFETEA-LU legislation.

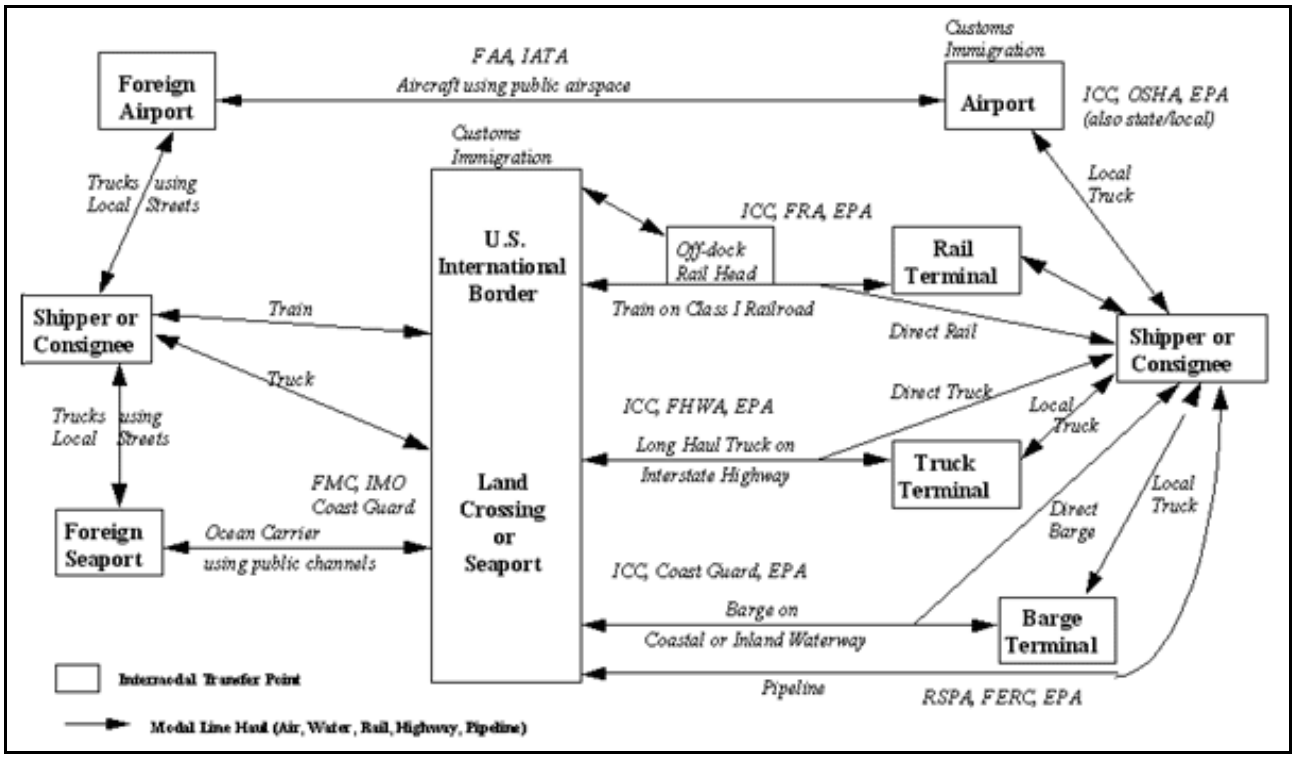

Figure 3: An Overview of the International Freight Transportation System

Intermodal Freight Technology Program

This program is independent of the SAFETEA-LU legislation and represents an ongoing federal effort to promote the development of an efficient and economical intermodal freight network. The Upper Midwest Freight stakeholders can take advantage of this research when working to improve its regional intermodal freight system.

According to the FHWA *(8)*, The Office of Freight Management and Operations promotes the deployment of technology and the adoption of best practices to facilitate the smooth flow of goods on the Nation's transportation system and across our borders. The Intermodal Freight Technology program co-operational tests of Intelligent Transportation Systems (ITS) technologies, supports the development of tools to evaluate infrastructure and operational needs at border crossings, and works with our partners to develop standards for exchanging electronic freight data.

These initiatives provide opportunities for the Upper Midwest states to further develop their intermodal freight shipping capabilities, thereby capitalizing on the existing network of highway, rail, waterway, and air transportation in place in the region. SAFETEA-LU programs designed to improve intermodal connectivity include *(9)*:

- *The Freight Intermodal Distribution Pilot Program (§1306)* provides grants to facilitate intermodal freight transportation initiatives at the state and local level to relieve congestion and improve safety, and to provide capital funding to address infrastructure and freight distribution needs at inland ports and intermodal freight facilities. The Act names six projects, funded at $5 million each. For each year through 2009, each of the six designated projects is to receive 20% of its funding ($1 million each) from this program. Projects for this funding cycle are located in the south or on the west coast. The fact that there are no projects scheduled for the Upper Midwest is a missed opportunity. Freight stakeholders in the Upper Midwest need to seriously consider taking advantage of this opportunity in the next round of funding decisions in order to increase the capacity and efficiency of intermodal freight opportunities in the region.

- *Transportation Infrastructure Finance and Innovation Act (TIFIA) (§1601)*- The TIFIA program provides Federal credit assistance to nationally or regionally significant surface transportation projects, including highway, transit and rail.

- *National Highway System [§6006]:* The National Highway System (NHS) also provides support for the development and maintenance of intermodal freight facilities, particularly for highways that provide motor vehicle access between the NHS and the intermodal facilities. The system includes the interstate system and significant rural and urban roads serving major population centers, international border crossings, highways that provide motor vehicle access between the NHS and major intermodal transportation facilities, and major travel destinations.

The Future for Intermodalism

Intermodalism will grow and change as FHWA continues to support improving global connectivity and freight security. FHWA plans to oversee some steps to bring intermodalism into the future. Intelligent Technology Systems will continue to be evaluated by cost and benefit. Research, testing, and evaluation of new technology will be explored in the movement of goods. Further work with federal agencies will advance freight mobility and security. Additionally, working cooperatively with international partners will help develop a standard for moving freight. *(3)*

Overall, intermodalism needs to become faster, better, smarter, and more profitable. It is and will be a crucial factor in the future of the supply chain. With the broadening of intermodalism, there will be a need for education and training for those who are new and old to the idea of integrating shipping modes. Information and communication systems will be needed to execute intermodalism

and its technology. Consumers will begin to demand a better shipping system as the industry becomes more efficient, meaning all modes of shipment will need to come to an understanding that intermodalism is the most efficient and profitable form of transportation to meet the US and world's needs (*10*).

The Upper Midwest region is uniquely positioned to take advantage of the benefits of intermodality and freight shipping. The region's location at the country's crossroads, location of significant sections of the interstate highway system, possession of a functioning freight rail system, ability to ship via inland waterways or the Great Lakes, and a solid airport network positions the states of the Upper Midwest to take full advantage of intermodal freight possibilities. These possibilities must be worked on using a regional perspective to garner the greatest benefit from any intermodal system that is put in place.

References:

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Trade between China and the Upper Midwest States

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Trade between China and the U.S. has grown substantially in the past decade. This has placed substantial burden on a transportation systems that already had capacity limitations and flow constrictions at critical nodes. It is important to understand the magnitude of this transportation flow and its potential impacts on the Upper Midwest States.

Currently, we have data that shows freight shipments by air and by water to China from the seven states in the Upper Midwest States (Illinois, Indiana, Iowa, Michigan, Minnesota, Ohio, and Wisconsin). These data are available by volume and by value for 1999 through 2004. (See the attached spreadsheet. Data for 2005 will be available within the next few months.) All states show a dramatic increase in trade with China from 1999 to 2004. In nearly all cases, the flows of goods from these states to China have increased by a factor of two or more.

We currently do not have data that shows shipments from China to the Upper Midwest States, although one would expect that:

- The absolute values of the shipments from China to the Upper Midwest States are greater than values of the shipment from these states to China
- The rate of growth in the shipments from China to the U.S. is at least as great as the shipment from the U.S. to China.

In short, the goods coming from China are substantial and are likely to continue to grow. Efforts are currently underway to obtain access to data on goods coming from China.

In addition, the data on trade with China are meant to illustrate the capabilities that we have to examine international trade. These same data could be presented for trade from the U.S. to Japan, Korea, or other U.S. trading partner.

Air Freight

As shown in the spreadsheet, airfreight moving to China from the U.S. (both by volume and by value) has increased dramatically. It is likely that all or nearly all of this freight was brought to the departing airport via the road network. Illinois has the largest amount of cargo, most likely because Chicago is a major hub for international air travel and a substantial amount of airfreight moves as belly cargo in passenger jets. Minnesota also has significant international connections via Minneapolis, which helps to explain its large air cargo movement to China.

Water Freight

As shown in the spreadsheet, water freight moving to China from the U.S. (both by volume and by value) has increased dramatically. Only a very small amount of this freight moves through great lakes ports or down the Mississippi to China. The freight tends to move from the Upper Midwest States to West Coast ports via truck and rail, with the majority moving intermodally with trains doing the line-haul work. Once again, Illinois is the largest point of departure, in part, because of its role as a critical intermodal connection point. Ohio and Michigan are also large trading partners with China due, in part, to their manufacturing emphasis.

Possible Alternative

Currently, inbound and outbound international freight movements between the Upper Midwest States and China and other eastern rim countries, face significant air, rail, truck, and intermodal bottlenecks in Chicago and delays at the West coast ports. These problems are likely to increase unless some relief can be found.

Air Freight

The two largest airports in the Upper Midwest States, Chicago O'Hare and Detroit Metro, have congested air space and/or congested road networks that feed these airports. In the past decade, airports in Indianapolis, Indiana and Columbus, Ohio have been selected by Federal Express as major cargo hubs for its package delivery network. There may be other airports in the Upper Midwest States that are well located, have ample room for development, and limited congestion. These could serve as alternative collection points and destinations for air cargo.

Water Freight

There appear to be four alternatives for water based transportation to the eastern rim.

- Via rail or truck to the U.S. west coast ports. Currently, this is the most heavily used route, but it is congested and adds substantial time and cost to the journey.
- Great Lakes ports through the St. Lawrence Seaway, through the Panama Canal. Even if the lock limitations on the Seaway could be addressed, this alternative is not very attractive for trade with China because of the length of the journey and the delays associated with moving through the Panama and Seaway/Great Lakes locks. This may be an attractive alternative for trade with Europe, Africa, or South America.
- Great Lakes ports through the Illinois River and locks to the Mississippi River and through the Panama Canal. This is not the most direct route,

but could be a possible alternative as the delays at the West Coast ports increase.

- Via rail from two or three points in the Upper Midwest States using Canadian National (CN) exiting at the Port of Vancouver or Prince Rupert. This route is shorter in both distance and time from the Upper Midwest States to China, Japan, and Korea, it by-passes the capacity constrained intermodal facilities in Chicago and the Port of Long Beach, and it uses rail lines that can take long, high capacity trains with fewer delays along the route.

Summary

As we collect data on trade moving from China to the Upper Midwest States, we should be thinking about strategies to move goods efficiently into and out of our region. As the spreadsheet shows, our exports to China are substantial. The faster and more efficient we are at moving products the more competitive our manufactures will be in the global market place.