Critical Issues Impacting the Freight Transportation Industry in the Southeast Region

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The University of Memphis

October 2009

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Introduction

The Center for Intermodal Freight Transportation Studies (CIFTS) is operated by the University of Memphis in partnership with Vanderbilt University. CIFT's mission is to address critical issues affecting the planning, design and operation of the nation's freight transportation system, with an emphasis on intermodal activities that have special significance for the City of Memphis, the State of Tennessee, the lower Mississippi Delta region, and the national and international corridors that cross and intersect in the southeastern U.S.

Given our nation's dependence on the freight transportation industry for product delivery and the significance of the industry's role in economic development, it is important to consider what is required to ensure that the freight transportation system will be able to maintain an acceptable level of performance. To address this concern, CIFTS undertook a study to identify critical safety, security and efficiency issues affecting truck, rail, marine, air and pipeline operations, and their corresponding intermodal connectivity. Information gathered from a variety of sources, including government publications, trade journals, newspaper articles and web sites, was subsequently synthesized into an assessment of existing and forthcoming challenges. The results of this study are reported herein.

Safety challenges were identified on the basis of impacts to human health and the environment. Security considerations focused on events that could cause a disruption or compromise of information, people, goods or infrastructure. Efficiency concerns were identified on the basis of the industry's ability to meet customer demand with available supply in a timely, reliable and economic manner.

The Freight Transportation Network

The U.S. economy is comprised of individuals, communities, businesses and government agencies, all of whom rely on the movement of freight to satisfy essential needs. In 2006, this corresponded to the movement of approximately 15 billion tons of freight worth roughly $11 trillion, delivered on 985,000 miles of Federal-aid highways, 141,000 miles of railroads, 11,000 miles of inland waterways, and 1.6 million miles of pipelines (FHWA, 2007, Schmitt et al., 2008).

Each mode serves an important role in the freight delivery system. Truck is the dominant mode in terms of both tons moved and freight revenue generated. This is due to a competitive advantage for smaller shipments and local distribution, and the fact that nearly three-quarters of the communities in the U.S. are served exclusively by truck (FHWA, 2007). Pipelines transport high volumes of product, moving from a limited number of sources to a limited number of destinations. Rail focuses on intermodal and bulk movements involving long distances. Domestic water shipments focus on high-volume, low cost products, while the air mode supports the movement of high-value,

time-sensitive cargo (AASHTO, 2007). Most of the intermodal activity involves cargo transfers at coastal ports or at major inland terminals.

Given the importance and size of the freight transportation system, its ability to operate in a safe, secure and efficient manner is paramount to the current and future well-being of our nation. In the discussion to follow, major threats to successfully achieving this quality of service are identified.

Critical Issues

The results of the synthesis revealed nine critical issues that could profoundly influence the present and future success of the freight transportation industry in the Southeast region. While each of these issues is discussed below, the order in which they appear is not based on priority, as each issue has in itself been identified as critical.

1. Freight demand is expected to increase significantly on all modes, causing serious congestion problems beyond those that already exist.

From 2002 to 2035, truck, rail, water and intermodal volumes are forecast to grow 98%, 88%, 49% and 101%, respectively (GAO, 2008). While these increases are attributable to additional domestic and international freight activity, freight imports and exports are expected to increase at a faster rate, much of this being tied to the growth in container use (AASHTO, 2007). Admittedly, the recent economic downturn has slowed the pace of this trend, but over the long-term, significant growth rates are still anticipated.

Collectively, this anticipated growth in freight demand across all modes will exacerbate a network that is already experiencing serious congestion at key locations. Particularly susceptible sites include ports, airports, border crossings, locks, and major domestic terminals and transfer points (Schmitt et al., 2008). Freight congestion results in increased travel times and less reliable schedules. As a result, transport and manufacturing costs increase as more operators and equipment are needed to deliver goods since shipping takes longer, inventory must be stockpiled as deliveries become more unreliable, and additional distribution centers must be established to reach markets on time. Ironically, just-in-time delivery systems add to vehicle congestion as this logistics strategy requires more vehicles hauling smaller payloads. Growing freight demand also increases the potential for greater conflict between freight and passenger service when both are sharing the same network (e.g., competition for preferential treatment), or when they intersect one another such as at highway/rail grade crossings.

Certain congestion effects are mode-specific. For example, as the number of trains per mile of track increases, average speed declines and the amount of car switching in freight yards increases, leading to a further reduction in travel time along with increased potential for routing errors and damage to shipments (CBO, 2006). A unique source of congestion in the trucking industry is the layover, detention and inefficiencies at the dock during loading/unloading operations (Food Logistics, 2008). Similarly, forecasted

continued growth will challenge an aviation system that is already characterized by frequent delays, the need for expanded landside connections, freight and passenger conflicts, and a strained air traffic control system (ICF, 2004).

Perhaps nowhere is the problem of congestion more evident, however, than in the maritime industry. In 2001, 20-25% of the top fifteen U.S. deepwater ports reported unacceptable flow conditions on landside elements of the intermodal access system, a problem often compounded by lack of landside access area for expansion. Deep draft ports also experience congestion as space for increasing volumes of import and export cargo is limited by factors such as environmental and community concerns (Schmitt et al., 2008). However, even when ports can berth and unload a ship quickly, the increasing size of container ships is moving congestion from ports to access roads and railroads. On the inland waterway system, lock capacity has remained essentially flat since 1970, while tonnage has increased by 33%; as a result, processing delays are averaging nearly six hours at the most congested locks (ICF, 2004).

2. <u>The continuity of existing and future operations requires adequate infrastructure maintenance, rehabilitation and expansion.</u>

The anticipated growth in all major freight modes will put an immense burden on an already vulnerable transportation infrastructure. This is infrastructure is comprised of durable materials that are reaching the end of their designed service lives (TRB, 2005; Rabinow, 2004). As this relates to the trucking industry, between 1980 and 2005, route miles of public roads increased by roughly 4 percent in comparison to a 96 percent increase in vehicle miles traveled. Although truckers pay taxes that help finance the infrastructure they use, those taxes do not fully cover the utilization cost (CBO, 2006). This has led the American Society of Civil Engineers to conclude that total spending on road infrastructure of $59.4 billion annually is well below the $94 billion needed to improve road infrastructure conditions nationally (ASCE, 2005).

This relationship also holds true for other modes. For example, the domestic waterway network is constrained by available capital to support dredging, lock expansion and channel maintenance (AASHTO, 2007). In the railroad industry, projected freight volumes are signaling a need for major infrastructure improvements. Yet it has been estimated that the industry will not be able to generate sufficient income from revenue growth to offset needed infrastructure investment (Cambridge Systematics, 2007).

3. <u>Private/public financing of freight transportation infrastructure is a compelling need that is being inadequately addressed.</u>

Given the aforementioned concerns about the condition of our transportation infrastructure, finding feasible methods for financing these improvements becomes paramount. With privately owned carriers operating on public and private transportation infrastructure under regulations imposed by public agencies, a rational financing strategy would be the existence of partnerships among government agencies and freight transportation providers.

Unfortunately, this has proven to be easier said than done. Public investment decisions generally rest with local and state officials, who view the benefits and costs of freight transportation from a narrow lens that often ignores the regional or national economic benefits provided outside of their area (TRB, 2008). For example, while the majority of truck freight movements are involved in interstate transport, local planning processes tend to focus on commuter and livability issues rather than on freight congestion relief (FHWA, 2002).

Even when a state or local agency recognizes the importance of freight transportation mobility to economic development, other challenges to private/public financing abound. These include: 1) reaching agreement on specific freight improvements among multiple freight stakeholders (each with their own perspectives and agendas), 2) accessing funding sources that are modally-focused to apply to intermodal initiatives, 3) competition for public financing from non-freight projects, and 4) a lengthy public planning process that is typically not compatible with when decisions need to be made by the private sector in order to remain competitive (GAO, 2008).

Clearly financial planning and other institutional mechanisms are needed to facilitate an integrated approach to public and private investment in freight transportation infrastructure (Schmitt et al., 2008). There is some indication that public agencies are beginning to understand the importance of moving in this direction. For example, there is growing awareness at the state and metropolitan levels of the need to link state and local transportation freight investment to economic development (FHWA, 2007). Many state departments of transportation have also established freight offices or designated freight coordinators, and several have initiated statewide freight plans (Schmitt et al., 2008). While measurable progress has been made, unfortunately the majority of state and local agencies have yet to act, and there has been little to show so far in the way of tangible projects.

4. Fatigue continues to be a human factor that plagues the safety of most major freight modes.

Arguably the greatest threat to freight transportation safety is operator fatigue. This human factor is a prevalent risk across most major modes. The problem is so significant that the National Transportation Safety Board has identified the need to reduce accidents and incidents caused by marine, aviation and pipeline operator fatigue to be among their “most wanted” list (NTSB, 2009). While this list does not include truck driver fatigue, it does include preventing medically unqualified drivers from operating commercial vehicles, which may be indirectly tied to fatigue.

Specific personnel within the cited modes are particularly susceptible to the potential for operator fatigue. For example, data has shown that air cargo pilots can log up to 40 percent more hours per year than pilots of larger passenger airlines (Clark 2006). Similarly, within the marine industry, studies have shown that sleep disruption and fatigue is a particular problem among watchstanders, with the presence of critical fatigue levels as often as one-quarter of the time (Smith, 2006).

Certain strategies are being recommended to mitigate freight transportation operator fatigue as a safety risk. Some of these are directed at setting work hour limits that consider optimal schedules based on fatigue research, circadian rhythms and sleep rest requirements. Other strategies are focused on using technology in the form of fatigue management systems as a sleep prevention aid (Maritime Executive, 2009).

5. Security measures imposed on ports of entry and border crossings are compromising the ability to efficiently process imported goods.

Ports of entry (airports, seaports) and border crossings are vulnerable points in the transportation network where heightened security is essential. This has led the Transportation Security Administration (TSA) to inspect all cargo traveling on passenger planes and use a risk-based screening process for inspecting commodities moving on air cargo carriers.

Similar considerations are in effect at U.S. seaports, where more than nine million marine containers arrive each year (CRS, 2005). Here, the Bureau of Customs and Border Protection analyzes cargo and utilizes other information to target specific shipments for closer inspection. However, tests of the screening system have demonstrated that existing devices have been unable to consistently detect containers carrying dangerous goods (Bolvi, 2008; Cochran, 2008), suggesting that an even tighter screen protocol is required.

While the need to impose strict security measures at points of entry is not disputed, these practices can have a detrimental effect on freight mobility. Port and border security delays are known to impede operational efficiency by causing congestion and cost increases (AASHTO, 2007). With the forecasted increases in international goods movement, demands on security screening are also expected to grow. This will likely increase the size of the bottleneck problem experienced at the points of entry unless a suitable solution is found.

6. Cargo security during domestic freight transport operations, particularly in the trucking industry, has become more than a nagging problem.

Law enforcement and insurance companies estimate that $15 billion worth of freight is stolen each year in the United States and trucks represent nearly $11 billion of this total (Hoffman, 2007). Truck transportation has witnessed an increase in cargo theft due to organized gang activities. Thieves often target truck stops, wait for trailers to be parked and left unattended, and then unhitch the trailer from its rig, attach it to another cab, and pull the trailer to another location to unload its contents (Logistics Management, 2004). Criminals have also demonstrated an ability to overcome many of the security measures (e.g., seals, locks) that shippers normally take to ensure cargo safety. Equally disturbing is the expectation that as trucking activity continues to grow, law enforcement agencies will remain understaffed at the same time that organized crime becomes more sophisticated (Hoffman, 2007).

7. As a large contributor to greenhouse gas emissions, the onus is on the freight transportation industry to become a better manager of its carbon footprint.

Air emissions attributed to freight transportation accounts for approximately one-half of all nitrogen oxide emissions from mobile sources and 27% of all nitrogen oxides at the national level. The principal offender is diesel use in heavy trucks, ships and locomotives (Schmitt et al., 2008).

Greenhouse gas emissions, also referred to as carbon emissions, are a function of fuel economy, type of fuel used, vehicle miles traveled, and traffic operations. One method for achieving lower fuel consumption is through the use of more efficient routes, those characterized by shorter travel and/or idling times. Another strategy is to utilize mode shifts to leverage more fuel efficient transport operations. Waterway transportation has been cited as an environmentally friendly mode of commercial transportation for this reason, although it has also been asserted that railroads are even more fuel efficient than water carriers (AWO, undated; CBO, 2006).

Government agencies are showing greater interest in imposing greenhouse gas restrictions on the freight transportation industry. For example, the Environmental Protection Agency has recently issued a regulation on emissions controls for tractors, the fallout of which has been higher costs for new equipment and increased maintenance costs for existing equipment. These controls are also resulting in lower fuel economy and less power in the engines (Food Logistics, 2008). In anticipation of further restrictive legislation unless more sustainable practices are put in place voluntarily, some shippers and carriers are instituting their own policies. For example, Federal Express has set a goal by 2020 of reducing carbon dioxide emissions on its aircraft by 20% and improving vehicle fuel efficiency by 20%.

One logistics consideration that could be compromised by these actions is the strategy of just-in-time delivery. As mentioned previously, because this strategy generally leads to more shipments of smaller size, it is not considered an environmentally friendly option. As a result, customers may have to revert to accepting fewer, larger shipments, resulting in the need to stockpile inventory at their facilities, which subsequently increases their cost of operation.

Beyond attempting to operate in a “green” manner with better utilization of traditional energy sources, the transportation industry will need to assume a leadership position in the development and use of diverse vehicle fuel systems. Attractive alternatives include ethanol and biodiesel, as these sources reduce greenhouse gases by emitting less carbon dioxide for every unit of energy produced (AASHTO, 2008).

8. Work force development poses both short-term and long-term challenges to the freight transportation industry.

The freight transportation industry relies on a qualified work force to offer safe, secure and efficient service. However, there is already an acute shortage of the work force in some modes. This is compounded by the fact that many modes are confronting the

need to replace operating and management personnel who will soon be reaching retirement age.

Of immediate concern is a sizeable driver shortage in the trucking industry, estimated to be currently at 20,000 operators, with the gap anticipated to increase to 111,000 by 2014 (Food Logistics, 2008). This problem can be attributed, in part, to stricter commercial truck driver licensing standards, which has weeded out unqualified drivers from entering or continuing in the industry (FMCSA, 2006).

Longer-term work force development problems are also on the horizon. For example, by 2013, over one-third of the railroad work force will be eligible to retire. This presents a challenge in recruiting and retaining employees to replace these workers, along with meeting the forecasted increase in demand for rail freight service (FRA, 2008). The pipeline industry is facing a similar succession planning dilemma. Many retirements are expected over the next decade, at a time when there appears to be a small pool of qualified candidates (Rabinow, 2004).

9. Long-term climate change is a real and serious problem, one that may significant impact the viability of freight transportation operations.

Climate change is gaining acceptance as a real and serious situation, regardless of its origin, and its potential impact on the freight transportation industry is becoming more apparent. Of concern to the industry are warmer overall temperatures and greater weather extremes (more frequent and violent storms interspersed with drought conditions) that will afflict the entire Southeast region. Moreover, coastal and low-lying areas can also expect rises in sea level and higher storm surges.

Among the anticipated effects of more intense heat and drought conditions are the thermal expansion of bridge joints, softening of asphalt in roads, and rail deformation. An increase in the frequency of more violent storms, combined with sea level rise and storm surge in coastal areas can be expected to cause widespread flooding (Schmitt et al., 2008). The impact of these climate changes on our nation's freight transportation infrastructure could be severe, threatening to completely disrupt the delivery of goods to entire regions for extended periods of time. Even more modest climate events could exacerbate the challenge of delivering goods on time and at an affordable cost. Complicating matters is the expectation that these climate changes will become more prominent at a time of increasing international trade and growing congestion on our existing transportation network (Karl et al., 2009).

Responding to climate risk will require careful thinking about feasible mitigation and adaptation strategies. Consideration will need to be given to changes in infrastructure construction, maintenance and operations, as well as the possibility of relocating highways, railroads, pipelines and airports away from coastal areas to prevent inundation by flooding. Harbor and port improvements will also be necessary to handle higher tides associated with sea level rise as well as threats from episodic events, such as hurricanes and other violent storms.

Unfortunately, little research has been conducted to identify the extent of climate risks or what steps should be taken today to ensure transportation system safety and resilience (Potter et al., 2008). Adding to the growing concern is that today most transportation managers are not including climate change projections in long-range planning, infrastructure design or siting decisions. This is despite the fact that Federal transportation planning processes generally span 20-30 years.

The Role of Advanced Technology

While the freight transportation industry faces an array of challenges as previously discussed, technological advances are being made that offer the potential to help address some of the aforementioned concerns. Much of this technology innovation focuses on devices that can collect and communicate valuable information in real-time (ICF, 2004).

Asset tracking, utilizing electronic tags, global positioning systems and mobile communications, is becoming increasingly popular in the freight transportation industry (FHWA, 2005). Besides the power unit itself, cargo is often monitored, motivated by carriers desiring to track their operations more closely and shippers seeking to improve the visibility and management of their supply chains. From a security standpoint, one attractive application of tracking systems is route adherence monitoring, which can recognize when a vehicle has deviated from its assigned route, and notify commercial dispatchers and law enforcement officials of an upset condition to improve response effectiveness. Emergency call buttons are also available, utilizing a wireless remote device that, when activated by the operator, provides responders with the precise location of the vehicle. Additional emergency support technologies include automatic vehicle shutdown via the engine governor, fuel line, or air brake system.

Another promising technology area is the use of sensors and detectors that can monitor both vehicle performance and cargo status. For example, the trucking industry is using sensors to collect data on engine revolutions, highway speed, tire pressure and brake wear. This information can be used to anticipate maintenance problems, and reinforce safe and efficient driver behavior. Temperature, pressure and toxic sensors are improving the safety of hazmat shipments and other fragile cargo. Intrusion detection is being addressed through the use of e-seals that monitor the integrity of closure devices, a technology that could be used separately or in conjunction with remote locking and unlocking systems.

Operator authentication is another area where advanced technology is being applied. Biometric identification tools, such as fingerprint and iris recognition, are being incorporated into smart identification cards and integrated with on-line access to manifest, vehicle, and driver databases. This technological concept is the foundation upon which the Transportation Worker Identity Card (TWIC), required of all U.S. transportation workers, has been implemented.

Promising technologies are also being applied to cargo inspection. Of particular interest are non-intrusive inspection devices because they enhance security inspections by imposing smaller efficiency and cost penalties than traditional manual methods. For example, x-ray and gamma ray scanners are assisting law enforcement officials in searching for contraband, illegal aliens, and threats to homeland security. More integrated systems are being utilized to manage compliance and enforcement. One such concept integrates RFID transponders aboard trucks, pre-registration of load and shipment information, regulatory databases, and networked readers, sensors, and inspection stations to achieve this result. RFID readers pull truck-mounted transponder information from which the system immediately checks on-line databases and flashes no-stop green lights to known compliant vehicles.

Finally, advanced technology is being used to mitigate congestion. Two popular techniques are electronic toll payment and congestion alert systems. The "Pre-Pass" program, operating in the Southeast, is an electronic toll payment system that involves several states and toll authorities who have reached an agreement on procedures for recognizing vehicles passing through toll booths and settling financial accounts. Congestion alert systems typically consist of information collected from cameras, sensors and other sources that can compiled to determine where congestion is (or will be) occurring, with the results distributed via web portals and other communication media.

Concluding Remarks

This synthesis is intended to aid CIFTS and other transportation stakeholders engaged in the Southeast region in recognizing and addressing critical issues affecting freight transportation safety, security and efficiency. It is hoped that by directing attention to those circumstances that warrant priority consideration, government officials, business leaders and other interested parties can work together to improve planning, design and operation of the freight transportation system to meet these challenges. This will require strategies that address both short-term and long-term considerations, leveraging promising technologies. Most importantly, freight transportation industry stakeholders must reach consensus on a set of goals and objectives that will allow them to work together with a common purpose. CIFTS intends to act as a facilitator in advancing this pursuit.

References

ASCE - American Society of Civil Engineers. Infrastructure Report Card, 2005.

American Waterway Operators (AWO). Facts About the American Tugboat, Towboat and Barge Industry, undated.

AASHTO - Association of American State Highway Transportation Officials. Primer on Transportation and Climate Change, April 2008, ISBN 978-1-56051-417-6.

AASHTO - Association of American State Highway Transportation Officials. Transportation Invest in Our Future – America's Freight Challenge, May 2007.

Bolvi, Julia. Radiation Monitors Cannot Reliably Detect Highly Enriched Uranium at U.S. Ports and Border Crossings, NRDC News Media Center, March 25, 2008.

Cambridge Systematics, National Rail Freight Infrastructure Capacity and Investment Study, September 2007.

Cochran, Thomas. "Detecting Nuclear Smuggling", *Scientific American*, 2008: 98.

CBO - Congressional Budget Office. Freight Rail Transportation: Long-Term Issues, January 2006.

CRS - Congressional Research Service. Port and Maritime Security: Background and Issues for Congress, Washington, D.C., 2008.

FHWA - Federal Highway Administration, Statewide and Metropolitan Freight Trends and Issues, October 2001.

FHWA - Federal Highway Administration. The Freight Technology Story: Intelligent Freight Technologies and Their Benefits, 2005.

FHWA - Federal Highway Administration. Freight Facts and Figures, 2007.

FMCSA – Federal Motor Carrier Safety Administration, Oversight of the Commercial Driver's License Program, Report No: MH-2006-037, February 2006.

FRA - Federal Railroad Administration, Freight Railroads Background, February 2008.

Food Logistics. "Challenges in Every Direction", July 8, 2008.

GAO - General Accounting Office. Freight Transportation – National Policy and Strategies Can Help Improve Freight Mobility, GAO-08-287, January 2008.

Hoffman, William. "Cargo Theft Rising", *Traffic World*, December 17, 2007: 1.

ICF, 2010 and Beyond: A Vision of America's Transportation Future, August 2004.

Karl, Thomas R., J. M. Melillo, and T. C. Peterson, eds. Global Climate Change Impacts in the United States, Cambridge University Press, 2009.

Logistics Management. "Action Urged to Combat Freight Theft", April 1, 2004.

Maritime Executive. "NTSB Tackles Fatigue in Transportation", March 12, 2009.

NTSB - National Transportation Safety Board, NTSB Most Wanted List – Transportation Safety Improvements, 2009.

Potter, J.R., M.J. Savonis and V.R. Burkett. Impacts of Climate Change and Variability on Transportation Systems and Infrastructure: Gulf Cost Study, Phase I, March 2008.

Rabinow, Richard A. The Liquid Pipeline Industry in the United States, April 2004.

Schmitt, R., E. Strocko, and J. Sedor. Freight Story 2008, FHWA-HOP-08-051, November 2008.

Smith, Andy. Adequate Crewing and Seaferers' Fatigue: The International Perspective. Cardiff Centre for Occupational and Health Psychology, 2006.

Transportation Research Board. "Global Warming: Impacts on the Transportation Infrastructure," *TR News*, 2008.