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16. Abstract

Efficient, reliable, and safe freight transportation is critical to the economic prosperity of any region. An efficient multimodal and intermodal transportation system reduces transportation and supply chain transaction costs and increases connectivity, reliability, and accessibility to local and global markets. An efficient freight transportation system, therefore, supports economic development and the expansion of international trade, increases national employment and growth in personal income and the Gross Domestic Product of a region, and improves the quality of life of its citizens. Intermodal and freight concerns have thus received increasing attention in the wake of globalization, increasing congestion, and changes in the logistics structure of shippers to facilitate just-in-time production. Both the Intermodal Surface Transportation Efficiency Act (ISTEA) of 1991 and the subsequent reauthorization of the Transportation Equity Act of the 21st Century (TEA-21) have identified an understanding of the needs of the freight transportation sector as a critical component of transportation planning.

This study sought to (a) improve the understanding of the size, scope, and type of commodities that are produced, consumed, and moved through different regions in the Texas, (b) gain an insight into the business and transportation system factors that shippers and receivers consider when making shipping decisions, (c) identify and describe factors that impact the competiveness of multimodal freight modes operation in Texas, (d) provide commodity data regarding origin and destination flows that will facilitate updates to various Texas freight models and studies, (e) identify and document significant multimodal freight system trends, needs, and issues in Texas, (f) recommend freight policies, strategies, performance measures, and infrastructure improvements that TxDOT can consider for implementation and funding, and (g) explore the interest, feasibility, and requirements for forming a Freight Advisory Committee in Texas.

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Freight Planning for Texas—Expanding the Dialogue

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CD Contents

A Relational Multimodal Freight Database software populated with available freight data is available on an attached CD with a user guide. The database contains freight data from numerous sources such as the Freight Analysis Framework; North American Transborder Freight Data; Annual Coal Report; Border Crossing Data; Maritime Administration Data; Fresh Fruit and Vegetable Shipments by Commodities, States and Months; National Transportation Statistics; USA Trade Data; Waterborne Commerce Statistics of USA; and the Carload Waybill Public Use File.

A second CD provides extensive documentation of freight stakeholder input and analysis.

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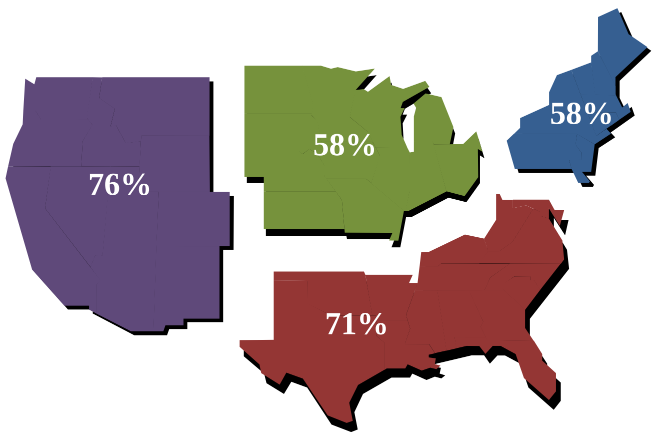
Chapter 1. Introduction

> "Continued development and efficient performance of the nation's freight transportation system is vital to maintaining a strong U.S. economy and sustaining our nation's competitive position in the global economy. Yet increasing congestion on our nation's roads and rail lines threatens to undermine the efficiency of our freight transportation system" (Government Accountability Office, 2008).

Freight movements are derived from the need to move intermediate inputs and final products to production and consumption industries and centers in Texas, the U.S., and internationally. Efficient, reliable, and safe freight transportation is thus critical to the economic prosperity of any region. An efficient multimodal and intermodal transportation system reduces transportation and supply chain transaction costs and increases connectivity, reliability, and accessibility to local and global markets. An efficient freight transportation system, therefore, supports economic development and the expansion of international trade; increases national employment, growth in personal income, and the Gross Domestic Product (GDP) of a region; and improves the quality of life of its citizens. However, dramatic increases in freight volumes have also resulted in concerns about the growing disparity between demand and the capacity of the freight transportation system, resulting in, for example, bottlenecks and landside access concerns to ports and airports. Already, certain transportation corridors are having difficulty accommodating the growing freight transportation demand. For example, the Federal Highway Administration (FHWA) estimates that the tons transported on the U.S. transportation system will increase by 35% from 18.6 billion in 2007 to 25.1 billion in 2035. By value, $16.5 trillion of commodities was transported in 2007, and is estimated to increase by 52% in 2035 to $34.3 trillion (Freight Analysis Framework, 2007). Furthermore, international shipments are expected to grow even faster than domestic shipments (Kim et al., 2007). Figure 1.1 illustrates the anticipated growth in U.S. domestic freight tonnage between 2000 and 2020 for four geographic areas in the U.S. Clearly substantial freight demand growth is forecasted for all the U.S. regions. Although these forecasts have been tempered because of the recent economic recession, the expectation is that the U.S. economy will recover, resulting in increased freight demand.



Source: AASHTO, 2007b

Figure 1.1: U.S. Domestic Freight Tonnage Percentage Growth: 2000–2020

For these reasons and others, the current U.S. freight transportation infrastructure is expected to struggle to meet this growing freight transportation demand at existing service levels. The literature has revealed that *"highways are overwhelmed by truck freight traffic far beyond what it was designed for back in 1967"* (AASHTO, 2007a). This increased demand contributes to the poor level of service (E or F) on many urban Interstate Highways during peak periods (Schrank and Lomax, 2007). A lack of capacity, as evidenced by increased congestion and reduced service levels, affects the flow and cost of transporting freight goods. Figure 1.2 illustrates U.S. urban areas that experience over 1 million hours of annual freight travel delay. Capacity constraints also occur on rail lines (see Figure 1.3) and waterways in the form of chokepoints, or at major trade gateways, such as ports and border ports of entry.

Source: Horsley, 2007

Figure 1.2: Major Freight Trucking Bottlenecks, 2004

Source: Horsley, 2007

Figure 1.3: Major Freight Rail Chokepoints, 2006

Freight capacity needs to be addressed if the U.S. is to maintain, let alone advance, its economic standing in the world economy. Progress requires an improved understanding of the factors impacting freight demand, as well as robust models and data to estimate future freight demand.

1.1 Understanding Freight Demand

Freight demand is a function of regional, national, and international economic and demographic characteristics, operational factors, infrastructure, public policy and regulations, and environmental factors. As such, changes in any factor within these categories can cause changes not only in some or all of the other factors, but also impact the quantities and method of transporting freight demand (Cambridge Systematics, Inc., et al., 1997). Among the categories of factors, the infrastructure, public policy, and environmental factors have an indirect impact on freight demand. The economic, demographic, and operational factors, on the other hand, have a more direct impact on freight demand. Figure 1.4 illustrates the relationship and interactions among the identified categories of factors and freight demand.

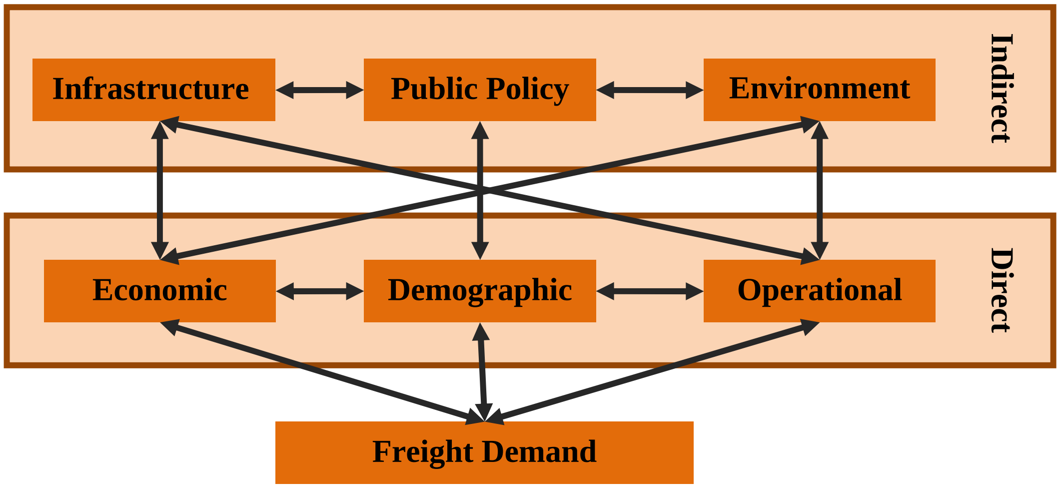


Figure 1.4: Categories of Factors Influencing Freight Demand

1.1.1 Economic Factors

As indicated earlier, freight transportation is derived from the need to move intermediate inputs and final products to production and consumption industries and centers in the U.S. and internationally.

> "As a derived demand, freight demand is [thus] primarily influenced by volume of goods produced and consumed. Expansion in the national economy, or the economy of any region, results in increases in overall demand for goods and services, while economic contractions result in demand reductions" (Cambridge Systematics, Inc., 1996).

The freight transportation sector of a region or country can also have an important role in facilitating regional and national trade and development. Freight transportation investments that increase system efficiency, for example by reducing travel times and costs, can translate into increased economic productivity, as well as enhanced labor and market access. The latter could contribute to increased economic competitiveness and growth (Horsley, 2007). On the other hand, increased congestion and reduced reliability would increase transportation and logistics costs with potentially negative impacts to the regional and national economy. Broader economic factors also include just-in-time inventory practices, carrier shipper alliances, fuel and energy costs, international trade partners, and others. Changes to any of these factors could potentially have a direct impact on the amount and movement of freight in a region or at the national level.

Examples of Economic Factors
Fuel price, economic activity as measured by state GDP, shipment values, specific market locations, specific market competitiveness, employment by sector, value and tonnage of production by industry (e.g., agriculture, manufacturing, and mining), carrier-shipper alliances, logistics practices (e.g., centralized warehousing, just-in-time inventory practices), economic regulation and deregulation, trade agreements, intermodal operating agreements, manufacturing practices (e.g., lean manufacturing, outsourcing, and off shoring), freight mode costs, unemployment rate, sales (e.g., wholesale, retail, services, and e-commerce)

1.1.2 Demographic Factors

> **Examples of Demographic Factors**
> Population, socio-economic characteristics (e.g., education, income, and age), purchasing trends, employment distribution by industry

Equally important are demographic factors, such as the size and density of the population, education and income characteristics, age distribution, and employment status, as these factors typically influence consumption and thus the destination volume of freight moved (see Sivakumar and Bhat, 2000). For example, large urban metropolitan areas have relatively more employment opportunities and are typically major destinations for freight movements to serve the businesses and the populations of these areas. On a local or regional level, the demographic characteristics of a region can thus be a useful indicator of future freight demand moving to and from the region.

1.1.3 Operational Factors

> **Examples of Operational Factors**
> Mode characteristics, mode capacities, availability/frequency, mode competitiveness, perceptions, private/public operated, operating schedule (all day or just business hours), reliability, technology/electronic data interchange, cost, travel time, travel distance, shipment size, expected freight loss and damage, shipment values, fuel consumption by mode or route, modal connectivity, truck driver shortages, dray operations

Operational factors impact the freight volume that can be moved and the cost of freight transportation. The operational factors impact freight demand and flows directly. Although public agencies provide the regulatory framework for freight transportation operations, most of these factors are determined by private decisions. For example, even if the regulatory framework is changed to allow for the operation of long combination vehicles or road trains across the U.S., it will be up to the trucking companies to make a business decision as to whether the potential productivity gains warrant the investment.

1.1.4 Infrastructure Factors

Similar to operational factors, the capacity of Texas's freight transportation infrastructure impacts not only the freight volume that can be moved, but also the cost of freight transportation and ultimately the economy of a region and the country. As opposed to the economic, demographic, and operational factors that impact freight demand directly, infrastructure factors relate to the capacity or supply of freight transportation and thus impact freight demand indirectly through service levels and costs. The challenge in building infrastructure to meet increased demand is exacerbated by the fact that construction costs are now over 50% greater than they were in 1993, and are expected in 2015 to be over 70% greater than they were in 1993 (Horsley, 2007).

1.1.5 Public Policy Factors

> **Examples of Public Policy Factors**
> Funding, improved coordination, dedicated leadership, dedicated public roles focused on freight planning and promotion, foreign policy, international trade agreements, international transportation agreements, federal/state/local environmental regulations, publicly provided infrastructure, user charges and other taxes, government subsidies, environmental policies and restrictions, safety policies and requirements, effects of changes in truck size and weight limits, interaction between public and private agencies (e.g., shippers/carriers/government agencies)

Public policy factors and the regulatory framework are interrelated and potentially impact all aspects of freight demand and transportation. NAFTA is an example of a U.S. international trade agreement that has facilitated significant trade with Mexico and Canada with associated impacts on freight transported across the U.S.–Mexico and the U.S.–Canada borders. Similarly, the subsidization of certain industries (e.g., agriculture or ethanol) can increase the level of production in certain regions to levels that would not be justified absent the subsidy or lead certain regions to produce a commodity that they would not produce otherwise. In this sense, freight flows from an area are sometimes contingent on public policy.

1.1.6 Environmental Factors

> **Examples of Environmental Factors**
> Sustainable products and industries, sustainable packaging materials, recycling, fuel consumption by mode or route, 'green' practices, emissions by mode, fuel efficiency by mode, alternative fuels, hybrid technologies

In recent years, the U.S. has started to recognize the importance of sustainable development. A principal requirement of any form of economic activity is that it be environmentally sustainable *"from cradle to grave."* An unsustainable freight transportation sector introduces an element of "unsustainability" into every product produced and consumed in the U.S. As a result, an unsustainable freight transportation sector may provide a barrier to the U.S.'s export growth over time, as more international customers are likely to pay a premium to ensure that their imports are produced and transported in a "green supply chain." Environmental factors that can impact freight demand potentially include the use of more fuel efficient equipment, such as hybrid locomotives and trucks.

1.2 Tracking Freight Demand

One attempt to track aggregate freight movements is through the development of freight tracking indexes. Several freight tracking indexes are generated by the Bureau of Transportation Statistics (BTS). Also, industry associations have historically played a key role in tracking freight movements around the country. Both the American Trucking Association (ATA) and the Association of American Railroads (AAR) post regularly updated statistics on industry performance to inform policymakers. The ATA surveys its broad nationwide membership to assemble the truck tonnage index[1].

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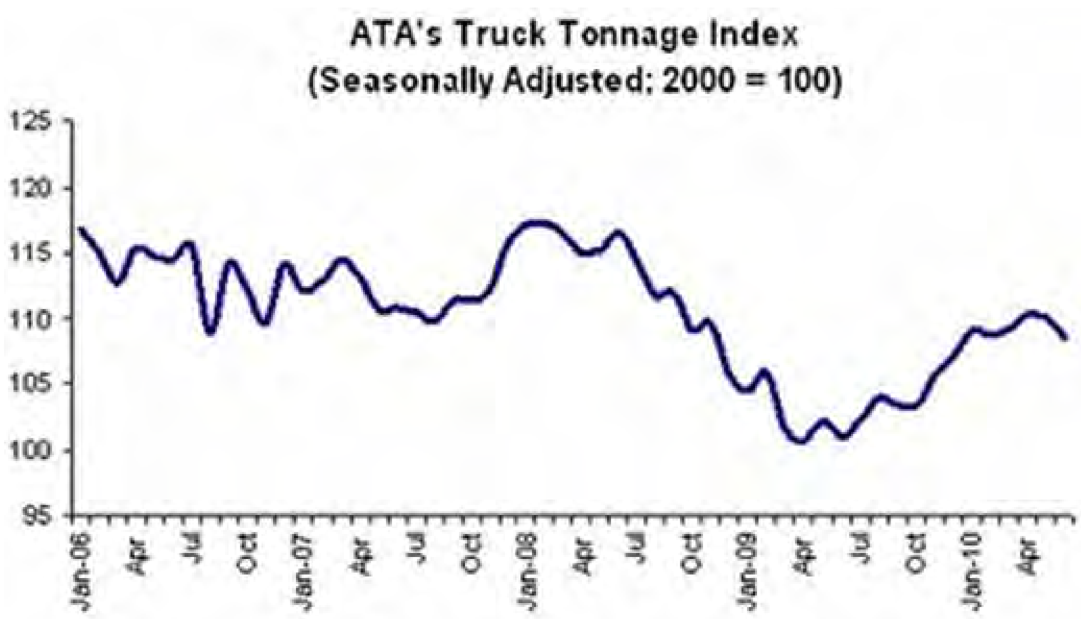
[1] ATA has noted recent difficulty in tracking total tonnage because so many of its respondents have stopped operating (ATA, 2009). *"When a company in the sample fails, we include its final month of operation and zero it out for the following month. This assumes the remaining carriers pick up that freight. As a result, it is close to a net wash and does not*

Figure 1.5 illustrates the index tracked monthly for the last 5 years, showing the relative rise or fall of truck tonnage compared with the previous month. Because the index relies on confidential data submitted to the ATA by various firms, independently verifying the index is impossible. The data collection relies on ATA members, which represent a broad but incomplete profile of the trucking community. The review of index by the BTS states that the ATA index is unique in its timeliness—providing rapid feedback to the industry that indicates, to some degree of accuracy, the direction of cargo volumes in the immediate past.

Figure 1.5 clearly illustrates the substantial decrease in truck tonnage moved that is associated with the economic contraction during the period January 2008 to April 2009. The ATA's seasonally adjusted index for for-hire truck tonnage also decreased by 0.6% in May and 1.4% in June 2010. According to the ATA, May and June marked the first back-to-back contractions since March and April 2009.



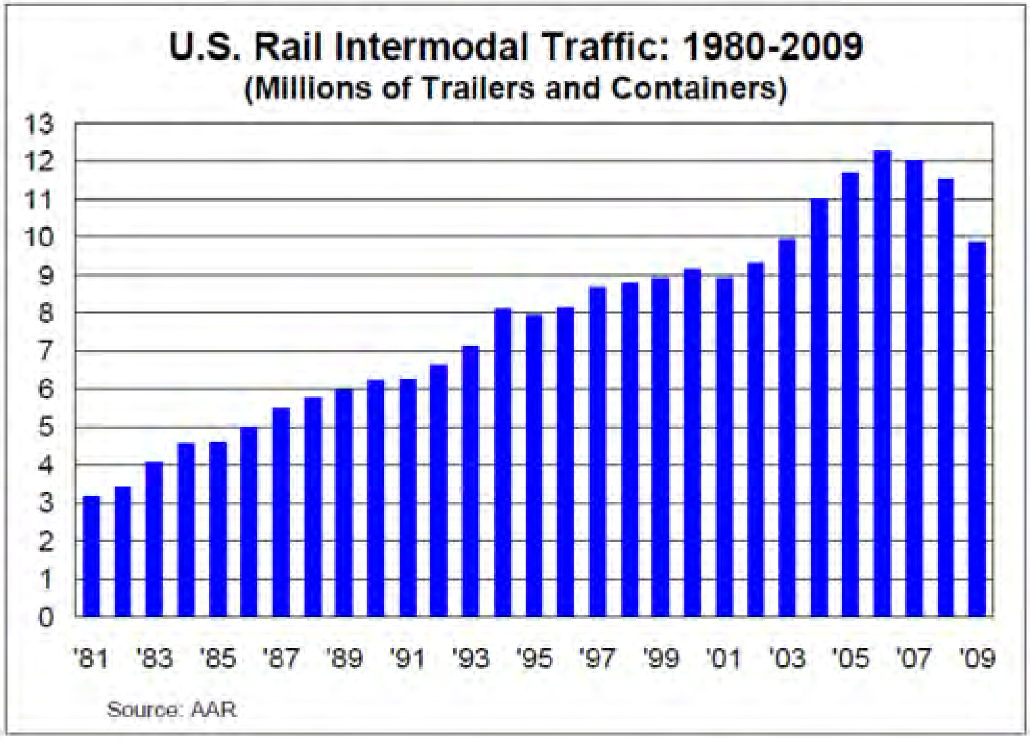
Source: ATA http://www.truckline.com/

Figure 1.5: American Trucking Association Truck Tonnage Index, June 2010

Similarly, the AAR tracks loadings by major railroads on a weekly basis. After a steady increase in annual carloads for major Class I railroads between 2003 and 2007, carload traffic (including intermodal traffic) decreased by 15% from 40.57 million in 2008 to 34.56 million in 2009 (AAR, 2010)[2]. Since 2006, intermodal rail traffic has continued to decrease, with the largest change of 14% occurring from 2008 to 2009 (see Figure 1.6).

end up in a false increase. Nevertheless, some carriers are picking up freight from failures, and it may have boosted the index. Due to our correction mentioned above, however, it should be limited" (ATA, 2009).

[2] Source: Class I Railroad Statistics, AAR, October 29, 2010. http://www.aar.org/~/media/aar/Industry%20Info/AAR%20Stats%202010%201123.ashx



Source: The Economic Impact of America's Freight Railroads, AAR, May 2010, http://www.aar.org/~/media/aar/backgroundpapers/theeconomicimpactofamericasfreightrailroads.ashx

Figure 1.6: U.S. Rail Intermodal Traffic: 2008–2009

The AAR also tracks train speed for the Class I and Class II railroads in the U.S., Canada, and Mexico. This measure indicates that as demand decreased, the average corridor speeds have increased. For example, Union Pacific's (UP) average intermodal train speed increased from 30 mph in October 2008 to 33 mph in October 2010. The average intermodal speed for 2010 as of December 1 is approximately 32 mph. Figure 1.7 shows the increase of intermodal speed from 2008 to 2009.

Source: AAR Railroad Performance Measures, http://www.railroadpm.org/

Notes: The arrow indicates the crest in diesel prices of $4.70 per gallon attained in June 2008.

Figure 1.7: UP Average Intermodal Speed, March 2008–March 2009

The above freight indexes showed the influence of the U.S. economic recession on freight movements. Truck tonnage decreased substantially from 2008 to 2009, and intermodal rail traffic decreased as well. This decrease has to be noted as it provides the context in which this study was conducted.

1.3 Forecasting Freight Demand

Freight demand can be described in terms of quantity, spatial scale, time period, scope, transportation mode, and commodities moved. *Quantity* refers to the amount of freight moved and is typically described in terms of tons, ton-miles, or value.[3] *Spatial scale* refers to the origins and destinations of freight movements and can be local/regional, national, and international. *Time period* defines the temporal dimension of freight movements, which can be seasonal, annual, short term, medium term, and long term. *Source* often refers to a single location, such as coal tonnage produced at a specific mine or the volumes moved through a port, rail intermodal terminal, airport, or border point of entry). Specific source estimates and origin-destination flows are commonly found in regional freight plans or corridor studies. Finally, *freight demand* can be estimated by transportation mode and for a given commodity.

A number of researchers and practitioners have developed freight forecasting methods that estimate future freight flows in terms of one or more of these dimensions—i.e., quantity, spatial scale, time period, scope, transportation mode, and commodities moved (see, for example,

[3] Freight demand has also been expressed in terms of truck-miles, railway-miles, number of vehicles, and number of containers.

Bhat et al., 2005, Sivakumar and Bhat, 2000). These methods include simple growth factor methods, four-step model travel forecasting that includes factors such as trip generation, trip distribution, mode choice, and trip assignment, as well as economic activity models. Simple growth factor models, which forecast future demand based on scaling current demand, use single indicator factors as scaling values. Four-step travel demand forecasting incorporates demand factors into the freight vehicle generation step, similar to passenger travel models. Economic activity models are the most sophisticated because they integrate economic, land use, and transportation models to predict future freight demand (Beagen et al., 2007).

Two main approaches to estimating freight demand have, however, become widely used in response to the different applications of forecast results. The first, represented by the Freight Analysis Framework (FAF) model constructed by the FHWA, uses survey data and iterations of matrix statistics (similar to the traditional four-step model) to forecast freight flows and network flows. These results tend to be more aggregate, and are used by federal agencies to evaluate national policy decisions (Hancock, 2008). A second approach is exemplified by the Ohio River Navigation Investment Model (ORNIM) and the Navigation Economic Technologies (NETS) program. These models estimate freight demand based on optimization techniques that balance the benefits and costs of a freight system operation. These optimization routines are composed of tiers of models that generate forecasts "from a broad regional and global geography...down to a detailed project and facility-specific level of detail" and, as such, tend to consider operational demand factors (Hancock, 2008). Results from the ORNIM and NETS models are used to evaluate specific freight operational and infrastructure improvements.

1.4 Freight Data

Finally, the understanding of freight demand and the evaluation of current and future freight transportation capacity are not only determined by sound models, but are critically contingent on the availability of accurate data. In this regard, insufficient and inferior quality data is the most commonly cited challenge in the development of freight models. The data requirements[4] of freight models can be prohibitive given the lack of publicly available freight databases since the deregulation efforts of the 1980s. State Departments of Transportation (DOTs) thus (a) rely on the limited data compiled and published by federal agencies for aggregate analysis, (b) obtain one of the private commercial sources of data related to freight movements[5], or (c) collect original data (see Chapter 3 for examples where state DOTs have collected original data to inform their "standalone" freight plans).

The principal data available from the FHWA are the 1998/1999 commodity flows by truck, rail, water, and through selected border ports of entry and marine ports. In addition, the FHWA has recently released a new and improved version of the FAF (i.e., FAF^3) that estimates commodity flows (i.e., tonnage and value) within, to, and from a state by mode for 2007 and

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[4] The data used in forecasting freight flows differ from the data required to predict passenger flows. Passenger transportation and freight transportation differ in units of measure, value of time, loading and unloading, type of vehicles, and number of decision makers (Eatough, Brich, and Demetsky 1998).

[5] The most often used database for statewide analysis of freight movements is the commercial TRANSEARCH INSIGHT database. TRANSEARCH estimates freight flows (i.e., commodity tonnage) by truck (i.e. for-hire truckload, for-hire less than truckload, and private truck), rail carload, rail/truck intermodal, water, and air at the county, Business Economic Areas (BEA), and state or provincial level (Prozzi et al., 2004; Bhat et al., 2005; Cambridge Systematics, Inc., 2007). The TRANSEARCH database is currently a unique source of detailed freight data that is available for purchase. The data sources used to compile the database are proprietary, and many of the assumptions to estimate and forecast the data are not disclosed (Prozzi et al., 2004).

2040, as well as freight movements among major metropolitan areas, states, regions, and international gateways. These data are very valuable for aggregate types of analyses, but more detailed data are required for statewide freight planning. Ultimately, estimated freight demand needs to be disaggregated to modal flows that can be assigned onto the transportation network. Disaggregate modal freight flows are necessary to:

- provide a clear picture of freight movements on a state's transportation system;
- assess the impact of freight on a state's road infrastructure—bridges and pavements—and the implications in terms of funding;
- evaluate strategies for improving freight mobility;
- forecast system performance;
- price infrastructure improvements appropriately;
- mitigate the impacts of truck traffic on general mobility; and
- improve the safety performance of the transportation system (Prozzi et al., 2006).

1.5 Concluding Remarks

Against this background, the objective of this research study was to analyze relevant freight data and to start engaging Texas's shippers and freight stakeholders in a dialogue to provide insight into (a) *how, why, who, what, and where* freight moves on Texas's transportation infrastructure, (b) whether Texas's transportation system is adequate in serving business needs, and (c) any improvements deemed necessary to serve Texas businesses better. The emphasis of this study was thus on engaging the freight community in Texas and gaining insight into their perceptions of major statewide or aggregate freight issues rather than duplicating the detailed and comprehensive consultancy efforts that were already underway. Examples of the latter include the Texas Department of Transportation (TxDOT) rail freight studies[6] and the TxDOT waterborne freight study being conducted by Cambridge Systematics. Similarly, the study area excluded the IH 35 corridor, because of the ongoing work that was conducted by the IH 35 corridor segment committees at the time of the research study.

The findings of this study are documented in this report as follows. Chapter 2 documents the approach followed by the research team in engaging Texas's freight community in each of the six economic regions in the state to gain a better understanding of Texas's freight movement,

[6] The rail freight studies were undertaken by HNTB Corporation and Jacobs Engineering to better understand freight movement in Texas both by truck and rail. Specifically, the goal of these studies is to:

- inventory existing rail systems;
- conduct a study of existing operations;
- identify freight constraints;
- identify safety issues with rail interactions and roadways;
- develop alternatives for improvements; and
- model these alternatives and complete cost-benefit and economic analyses for these alternatives.

To date, studies have been completed in San Antonio, Houston, West Texas, East Texas, Corpus Christi/Yoakum, and Dallas/Ft. Worth. Phase I of the Rio Grande Valley/Laredo study is also complete, and the Phase I study for El Paso has recently started. The full reports for these studies are available on the TxDOT website (www.txdot.gov).

the adequacy of its transportation system, and improvements necessary to serve Texas's businesses better. Chapter 3 highlights how other state DOTs have described and addressed various aspects relating to statewide freight planning, as well as some of the challenges experienced. Chapter 4 provides insight into the economic and industrial factors that translate into freight movements on a state's transportation network. Chapter 5 discusses the factors that shippers consider when making mode choice decisions. Chapter 6 describes Texas's transportation infrastructure that facilitates the movement of freight, including major commodities, tonnage, and values moved. Chapter 7 provides available information on freight transportation demand that has been disaggregated into flows and assigned onto Texas's transportation network. Chapter 8 illustrates some of the concerns and needs as documented and expressed by freight stakeholders in Texas. Chapter 9 discusses a list of recommended policies and strategies proposed by Texas's freight stakeholders to address and alleviate some of the freight concerns and needs in the state. Chapter 10 discusses a number of freight performance measures that can assist transportation agencies in the development, implementation, and management of their transportation plans and programs. Chapter 11 summarizes the research team's findings on the experiences of other states that have implemented a Freight Advisory Committee or Freight Stakeholder Working Group, as well as the interest in developing a Freight Stakeholder Working Group for Texas. Finally, Chapter 12 summarizes work completed and provides conclusions and recommendations from this study. Three appendices covering the characteristics of freight movement in Texas, freight perspective on Texas's transportation system, and detailed regional economic freight profiles are included on a CD provided as part of this report. The Relational Multimodal Freight Database software, developed as part of this study, is also available on a separate CD.

Chapter 2. Study Approach

Texas has a very large and diverse economy. This diversity ranges from chicken operations and wood and paper products in the extreme eastern reaches of the state, to oil and gas refining and chemical processing on the coast, to wind energy and grain in the northwest areas, and niche food processing operations in the central region. Understanding the economic generators in the state thus required that Texas be divided in economic regions. This chapter documents the approach followed in engaging the freight community in each of eight economic regions in the state.

2.1 Developing Shipper Contact Database

In an effort to understand the major economic generators in the state, Texas was divided into eight economic regions (see Figure 2.1):

- Piney Woods,
- North IH 35 Corridor[7],
- South IH 35 Corridor,
- North Coastal,
- South Coastal,
- Central,
- Panhandle, and
- West Texas.

Figure 2.1: Texas's Economic Regions

[7] As mentioned earlier, the IH 35 corridor (i.e., North IH 35 and South IH 35) were excluded from the study area for data collection purposes (i.e., no workshops or focus groups were conducted in the corridor), because of the ongoing work by the IH 35 corridor segment committees at the time of the research study.

Upon delineating the economic regions, the first step was to identify the major economic generators (i.e., shippers) in each of the economic regions. Using the internet, the county seat and major cities in each of the counties that compose each region were further defined. A majority of counties had only one major city that also commonly served as the county seat. Thus, most Chambers of Commerce represented both city and county interests. Obtaining contact information for the Chamber of Commerce, the county seat, or the local Economic Development Council was thus relatively easy. Most county contacts fell into these two categories although a number of other contacts were established, including county courthouses (in rural counties), government councils, and cooperative extension agents in rural, agriculturally oriented communities. Once contact phone numbers for these different entities were acquired, much of the information gathering was conducted by telephone.

The objective of the telephone calls was to solicit the names and contact information of major economic generators/freight shippers in the local area. Many Chambers of Commerce or Economic Development Offices in smaller communities have reduced hours, which required phone calls prior to noon. Much of the spoken contact was also made with volunteers or administrative personnel who tended to be less familiar with terminology and sometimes had difficulty understanding the information needs. These conversations required examples of industry types, discussion of freight movements in general, and an explanation of the research purpose. This was even more pronounced in very small counties and towns, where freight traffic exists for a narrow band of commodity types. To obtain the desired information from the phone contact, a lengthy discussion of the local economy in general was often times needed. Once the structure of the local economic base was understood, it became easier to identify the most appropriate freight shippers in specific sectors. For more populated counties and cities, frequently a detailed electronic list of major local employers or manufacturers could be sent via e-mail to the study team. The shipper information solicited from the Chambers of Commerce, Economic Development Offices, and other contacts[8] were used to develop a shipper contact database that was subsequently used as the sampling frame for the shipper mail-out mail-back surveys (see Section 2.2) and these shippers were then also invited to participate in the subsequent freight shipper workshops (see Section 2.3) and freight focus groups (see Section 2.4).

2.2 Mail-Out Mail-Back Surveys

Mail-out mail-back surveys were administered to gain a better understanding of, and insight into, freight movements in Texas. The survey questions addressed (a) the characteristics (e.g., seasonal variation, and major origin and destinations) of commodities moving between, to, and from production and consumption centers in Texas, (b) how major shippers approach decisions about freight shipments, (c) their satisfaction with the freight transportation system in Texas, and (d) any concerns that they may have.

The target population for the mail-out mail-back surveys was the major shippers and economic revenue generators identified through telephone interviews with local Chambers of Commerce, Economic Development Offices, and others. The shipper list obtained through the latter means was supplemented with contact information extracted from the Texas Workforce Commission's SOCRATES database for companies employing more than 100 people.

[8] In total, the research team contacted 180 Chambers of Commerce/Economic Development Agencies in the 6 economic regions (Piney Woods, North Coastal, South Coastal, Central, Panhandle, and the West Texas Regions).

A total of 569 surveys were sent by mail to the list of shippers and economic generators identified through the telephone interviews and for which contact information was extracted from the SOCRATES database. A link to the survey was also included in the November newsletter of the Texans for Safe and Reliable Transportation Association (TSRT). Numerous e-mails were sent to TSRT requesting their participation in the internet survey.

The mail-out mail-back surveys were sent out in July 2009. Surveys were mostly returned by December 2009. Some respondents had to be contacted to complete missing information or to clarify certain responses. The internet survey was launched in November 2009 and was closed in February 2010.

Out of the 569 questionnaires that were mailed out, 50 were returned because of incorrect or nonexistent addresses. Table 2.1 lists the total questionnaires sent, the number of completed questionnaires, and the number of returned questionnaires, indicating that the overall effective response rate was 12.3%.

Table 2.1: Mail Survey Response Statistics

Questionnaires Mailed	569
Completed Questionnaires	64
Number of Questionnaires Returned (i.e., Invalid or Incorrect Addresses)	50
Response Rate %	11.3
Effective Response Rate %	*12.3*

In addition, two web surveys were completed by TSRT members. This extremely low response rate persisted after repeated reminder e-mails to TSRT members. In total, the CTR research team thus analyzed the data obtained from 66 completed questionnaires.

Figure 2.2 illustrates the regional representation of 65[9] of the respondents: 16 respondents were located in the West Texas Region, 10 in the Panhandle Region, 12 in the Central Region, 3 in the North IH 35 Corridor Region, 9 in the Piney Woods Region, 9 in the North Coastal Region, and 6 in the South Coastal Region of Texas.

[9] One respondent did not provide his/her business address.

Figure 2.2: Number of Respondents by Economic Region

The survey questionnaire comprised 30 questions that were grouped into the following categories:

- business information;
- incoming shipments;
- outgoing shipments;
- truck shipments;
- rail shipments, and
- Texas's transportation system.

The survey findings are summarized in Appendix A.

2.3 Freight Shipper Workshops

In an effort to further increase the understanding of (a) which business factors impact freight transportation decisions, (b) the decision process that underlies choices about modes and routes, and (c) how Texas's transportation system serves businesses in the state, the research team hosted six freight workshops in:

- San Angelo (August 4, 2009);
- Corpus Christi (September 24, 2009);
- Houston (October 20, 2009);
- El Paso (November 12, 2009);
- Lubbock (December 3, 2009), and
- Tyler (October 27, 2009).

Invitations to participate in the workshops were presented to a list of shippers that were compiled (a) through interviews with Chambers of Commerce, Economic Development Agencies, Metropolitan Planning Organizations (MPOs), TxDOT, the Ports-to-Plains Trade Corridor Coalition, the Houston Rail Freight District, and (b) from the contact information extracted from the Texas Workforce Commission's SOCRATES database for companies employing more than 50 people. Invitations were extended by telephone, e-mail, and fax. In most cases, more than 200 telephone calls resulted in less than 10 participants per workshop. Table 2.2 lists the number of participants in each of the freight shipper workshops.

Table 2.2: Number of Participants in Freight Shipper Workshops

Workshop Location	Number of Participants
Corpus Christi, TX	9
El Paso, TX	12
Houston, TX	16
Lubbock, TX	9
San Angelo, TX	12
Tyler, TX	4

The Freight Shipper Workshops were started with a presentation to provide the context in which states have been conducting statewide freight planning. The presentation highlighted the federal laws that require statewide freight planning, the approaches taken by other state DOTs, and some of the challenges in conducting statewide freight planning. Against this background, the research team subsequently presented the objectives of the research study. The presentations were followed by a demonstration on the usage of the Iclicker. Participants were then presented with a number of questions/statements that comprised three categories: (1) business factors that influence the size, frequency, and mode of transportation used by shippers, (2) mode choice factors impacting freight transportation, and (3) identified transportation needs in the respective regions. Appendix B summarizes the outcome of these facilitated workshop discussions and the salient findings are also incorporated in subsequent chapters of this document.

The Iclicker device was used to facilitate discussion and to record the responses of participants anonymously. The Iclicker is a type of Classroom Performance System (CPS) technology that records the responses of participants and display the summarized responses in real-time. In other words, participants are presented with a question or comment and asked to respond (i.e., vote) by selecting an option on a scale of 1 (i.e., A) to 5 (i.e., E). The responses are then displayed and discussions are facilitated by the research team. This approach proved to be effective in soliciting discussions and to gain a better understanding of the business, mode choice, and transportation system factors that impact Texas's freight community. In some instances, participants were asked to re-vote on a specific question or comment after discussing the first round of results. However, in most cases, participants were only requested to respond once.

2.4 Freight Focus Groups

The objective of the freight stakeholders focus groups was to provide a platform for freight stakeholders to (a) share information collected regarding freight trends observed in Texas,

(b) discuss any needs, issues, and bottlenecks pertaining to the freight transportation system, (c) identify any needed infrastructure improvements, and (d) explore policies, strategies, and performance measures that TxDOT can consider for implementation. The research team hosted six freight workshops in:

- El Paso (June 3, 2010);
- Tyler (June 17, 2010);
- Corpus Christi (July 15, 2010);
- Lubbock (July 15, 2010);
- Houston (July 29, 2010), and
- San Angelo (August 30, 2010).

Invitations to participate in the workshops were presented to participants of the 2009 Freight Shipper Workshops as well as other interested stakeholders in the regions. Invitations were extended by telephone and e-mail. A webinar was also setup for participants who could not be physically present at the TxDOT district offices where the focus groups were held. Table 2.3 lists the number of participants in each of the freight focus groups.

Table 2.3: Number of Participants in Freight Focus Groups

Focus Group Location	Number of Participants
Corpus Christi, TX	8
El Paso, TX	18
Houston, TX	13
Lubbock, TX	8
San Angelo, TX	21
Tyler, TX	10

2.5 Concluding Remarks

This chapter documented the approach followed by the research team in engaging Texas's freight community in each of six economic regions in the state to gain a better understanding of (a) how, why, who, what, and where freight moves on Texas's transportation infrastructure, (b) whether Texas's transportation system is adequate in serving business needs, and (c) any improvements deemed necessary to serve Texas's businesses better. The next chapter highlights how other state DOTs have described and address various aspects relating to statewide freight planning, as well as some of the challenges experienced.

Chapter 3. Public Policy Framework and Approaches for Conducting Freight Planning: *How Does Freight Move?*

To evaluate present and required future state freight transportation capacity, policy makers have started to recognize the need for statewide freight transportation plans. However, the development and understanding of statewide, multimodal freight movements have generally lagged behind that of passenger movements. As pointed out before, this lag is partly attributable to an insufficient understanding of the factors that influence freight demand, as well as a lack of timely data and models to estimate and disaggregate freight demand into flows on the transportation system. This chapter highlights the federal laws that require statewide freight planning, and the approaches taken by other state DOTs in conducting statewide freight planning, and provides extracts of the various "standalone" and regional freight plans to demonstrate how different states have described and addressed the various aspects relating to freight movements.

3.1 Legislative Background

Statewide freight transportation planning is considered critical to ensure an efficient and effective intermodal transportation system to facilitate freight movements within, to, from, and through a state. However, prior to the passage of the Intermodal Surface Transportation Efficiency Act (ISTEA) of 1991 few states, if any, conducted statewide freight planning. ISTEA required states for the first time to develop statewide multimodal transportation plans. The Act listed 20 statewide factors that state DOTs should consider in their transportation plans. Two of the factors were directed at freight movements.

The Transportation Efficiency Act for the 21st Century (TEA-21) enacted in 1998 consolidated ISTEA's 20 statewide planning factors into 7 broader areas. Similarly, two of these areas set efficient freight movement as an important planning goal. TEA-21 also added that shippers should be given the opportunity to review and comment on a state's transportation plan (FHWA, 1998). Neither of these Acts, however, provided clear guidance as to how to perform freight planning nor defined the level of detail to be included in a freight plan (Cambridge Systematics, Inc. 2003).

Different states have thus adopted different approaches to comply with the freight planning requirements of ISTEA and TEA-21. Examples include:

- incorporating the freight plan into the overall statewide transportation plan,
- creating a standalone freight plan, and
- funding local freight studies for a major corridor or region in the state (Cambridge Systematics, Inc. 2003).

When the freight plan forms part of the overall *statewide transportation plan*, it means that the transportation plan consists of two broad categories: the movement of people and the movement of goods. The goods movement section typically includes financing and policy initiatives to respond to changes in freight demand, and any needed improvements based on selected performance measures (Cambridge Systematics, Inc. 2003).

A number of states have performed "*standalone freight plans*" to clearly focus on statewide surface freight planning. These states generally argue that transportation plans are too broad to sufficiently detail freight planning issues. Standalone freight plans usually adopt either a "bottom up" or a "top down" approach. In the "bottom up" approach, state DOTs collaborate with stakeholders (e.g., through the formation of Freight Advisory Committees) to identify needs and recommend improvements. In the "top down" approach, the state DOT does not collaborate with stakeholders and performs the necessary analysis to identify needs and make recommendations (Cambridge Systematics, Inc. 2003).

Freight planning has also been conducted through a series of *freight studies*, which may include separate analyses of regional mobility, corridors, or bottlenecks to identify areas of freight need within a state. Freight studies may either be a state's best effort at a freight plan or the result of a freight plan that requires more detailed analysis in a region (Cambridge Systematics, Inc. 2003). In the former case, the state DOT typically does not have the resources available to perform a detailed freight plan or a freight study is a precursor to a more comprehensive plan. In the latter case, the state may want a more detailed report on the issue in question or want to investigate different improvement options.

Finally, a number of U.S. states do not conduct any type of comprehensive freight planning. The literature has revealed numerous reasons for this, including (1) an inadequate understanding of how the private sector approaches decisions involving freight movements and the perceived difficulty working with private companies, (2) an inadequate understanding of the factors that impact the competitiveness of different freight modes operating in a region, and (3) the difficulty in obtaining quality freight data to disaggregate freight flows onto the transportation network and to analyze freight system trends, needs, issues, and performance measures required to ensure informed freight policies, strategies, and infrastructure improvements.

3.2 What is Happening in Other U.S. States?

Against this background, the Statewide Transportation Plans of all 50 U.S. states were reviewed to determine how State DOTs have planned and considered freight movements in their statewide plans. The researchers found that 41 states explicitly addressed freight transportation in their statewide plans. Most of these Statewide Transportation Plans, however, included limited information on the freight sector. The exceptions were:

- New York State DOT's Strategies for a New Age: New York State's Transportation Master Plan for 2020,
- the Louisiana Statewide Transportation Plan, and
- Florida's Strategic Intermodal System (SIS) Strategic Plan.

The New York State[10] DOT's Strategies for a New Age: New York State's Transportation Master Plan for 2020 provides an analysis of the state's existing freight transportation system, including available infrastructure, current commodity flows, and projected local, national, and international trends. An important component of this statewide plan is the designation and recommendations for management of priority corridors that are most likely to

[10] Sources:

- New York: https://www.nysdot.gov/portal/page/portal/main/transportationplan/transportation-plan
- Louisiana: http://www.dotd.louisiana.gov/study/pdf/frontfinal.pdf
- Florida: http://www.dot.state.fl.us/planning/SIS/strategicplan/adopted012005.pdf

impact the state’s economy. Strategies to improve capacity and service for goods movement were also developed.

The Louisiana Statewide Transportation Plan includes a chapter summarizing the results of a literature review and primary data analysis of the state’s freight activity. Specific factors examined include trading partners, commodities, modal infrastructure, and projected traffic growth for trucks, rail, air, and waterborne freight. The report included recommended investments for improving both passenger and freight systems for each mode.

Florida’s Strategic Intermodal System (SIS) Strategic Plan was developed to provide policy direction to focus limited state resources on *“transportation facilities that are critical to Florida’s economy and quality of life.”* The SIS includes different modal hubs, corridors, and intermodal connectors. This strategic plan also provides criteria and performance measures for designating these facilities as part of the SIS. Finally, the Plan provided policy guidance for the selection and funding of priority SIS projects.

Ultimately, 10 states were identified that developed “standalone” freight plans:

1. California Goods Movement Action Plan;
2. Delaware Freight and Goods Movement Plan;
3. Maine Integrated Freight Plan;
4. Identification of Massachusetts Freight Issues and Priorities;
5. Minnesota Statewide Freight Plan;
6. New Jersey Comprehensive Statewide Freight Plan;
7. Oregon Transportation Plan Update: Freight Issues;
8. Vermont Statewide Freight Study;
9. Virginia Statewide Multimodal Freight Study, and
10. Washington Transportation Plan Freight Report.

Table 3.1 illustrates the key aspects concerning the freight sector that were addressed in the various state “standalone” freight plans. The subsequent sections provide extracts of the various “standalone” plans to demonstrate how different states have described and addressed the various aspects relating to freight movements:

- freight trends;
- issues/needs;
- freight policies/strategies;
- infrastructure improvements;
- performance measures, and
- data sources.

Table 3.1: Freight Aspects Addressed in State "Standalone" Freight Plans

State	Plan	Agency	Freight Trends	Issues/ Needs	Freight Policies/ Strategies	Infra-structure Improve.	Performance Measures	Data Sources				
								TRAN-SEARCH	CFS	Interviews/ Surveys	Traffic Counts	Other
California	California Goods Movement Action Plan	California BTHA, California EPA	X	X	X	X	X					Compiled from regional planning reports
Delaware	Delaware Freight and Goods Movement Plan	Delaware DOT	X	X	X	X			X	X	X	Compiled from modal system plans
Maine	Maine Integrated Freight Plan	Maine DOT	X	X	X	X		X		X	X	Compiled from existing plans
Massachusetts	Identification of Massachusetts Freight Issues and Priorities	Massachusetts Highway Department	X	X	X	X		X		X		
Minnesota	Minnesota Statewide Freight Plan	Minnesota DOT	X	X	X	X	X	X	X	X	X	
New Jersey	New Jersey Comprehensive Statewide Freight Plan	New Jersey DOT	X	X	X	X	X	X		X	X	
Oregon	Oregon Transportation Plan Update: Freight Issues	Oregon DOT	X	X	X				X			Compiled from literature
Vermont	Vermont Statewide Freight Study	Vermont Agency of Transportation	X	X	X			X		X	X	FAF data
Virginia	Virginia Statewide Multimodal Freight Study, Phase I	Virginia DOT	X	X	X*	X*	X*	X		X	X	Supplemental waterborne data
Washington	Washington Transportation Plan Freight Report	Washington DOT	X	X	X	X						Various state, regional, federal, and private sources

3.2.1 Freight Trends

The Delaware Freight and Goods Movement Plan (2004) listed a number of modal freight trends considered in the development of their "standalone" freight plan. For example, the following truck trends were identified:

- retailers have switched to "just-in-time" stocking, resulting in a greater demand for reliable freight delivery (usually by truck);
- an increase in online/catalog sales has resulted in an increase in the number of local delivery (e.g., UPS and FedEx) trips;
- the viability of many truck companies was affected by chronic driver shortages and increasing fuel costs;
- worsening roadway congestion is affecting trucker's ability to provide reliable and cost-effective service, and
- truck/auto conflicts are increasing due to residential development and congestion.

The identified rail trends were the following: (a) most of Delaware's rail lines were underutilized, (b) the growing adoption of heavier rail cars (i.e., 286,000 lbs) was starting to impact freight movements by rail, and (c) intermodal traffic was the fastest growing sector of the national rail industry.

The identified port trends and conditions focused on the Port of Wilmington and reported that the Port of Wilmington has room to expand and that landside constraints could be the limiting factor. It was projected that the Port of Wilmington would gain cargo if larger deeper-berth ports lacked additional capacity to expand.

3.3 Freight Issues/Needs

The Maine Integrated Freight Plan (2002) highlighted freight issues and needs indentified at the statewide level. A central goal of the plan was to define the appropriate role for the Maine DOT in freight transportation planning. The DOT was challenged to develop a statewide freight program that balances private sector concerns with economic development, multimodal efficiency, and the safety goals of the public sector. The role of the DOT in prioritizing and championing freight transportation investments was also uncertain. Other issues highlighted included truck size and weight regulations, such as the disparity between Maine's truck weight limits and federal interstate truck weight limits that result in trucks over 80,000 lbs diverting to state and local roads—often passing through town centers. In addition, Maine shippers require a permit for the operation of trailers and semi-trailers between 48 and 53 feet, creating an administrative burden not imposed by other states.

General statewide issues also included a lack of adequate rest area infrastructure, especially in rural Maine. Rail issues included a statewide lack of adequate and consistent rail service and abandoned rail sidings and short lines. Even when rail capacity was technically available, frequent complaints about the railroads being unwilling to provide specific shippers with rail service were reported. When compared with other states, Maine was found to be behind with respect to the adoption of 286,000 lbs rail cars and double stack clearances due to height and weight restrictions. In addition, there was no statewide strategy to address rail infrastructure issues.

With regards to trucking, concerns were reported that trucking companies found it difficult to offer competitive rates when serving the Maine market, because of the inability to find backhaul loads. As a result, a significant number of "deadhead" miles are traveled on Maine's transportation network. Thus a cargo imbalance exists with Maine shippers producing more than what is consumed.

3.4 Freight Policies/Strategies

The Maine Integrated Freight Plan (2002) and the Minnesota Statewide Freight Plan (2005) illustrates two approaches for considering freight policies and strategies in a freight plan. First, the Maine Department of Transportation (MDOT) identified the freight issues/needs and then identified specific policies/strategies to address the identified freight issues/needs over the short and long term. For example, the short term strategies included:

- investigate highway projects/initiatives that improve freight flow;
- continue freight education and outreach efforts;
- develop informational guide to MDOT freight planning activities;
- maintain relationships with private sector freight stakeholders;
- develop two-way communication protocol on the Office of Freight Transportation's (OFT) web site;
- coordinate transportation planning activities with Department of Economic and Community Development;
- continue to fund the Industrial Rail Access Program (IRAP);
- continue to fund the Small Harbor Improvement Program (SHIP);
- use Heavy-Haul Truck Route Network Study results to identify potential freight transportation improvement projects;
- continue Access Management Program;
- develop strategy to improve intermodal access to the port of Eastport;
- encourage Maine MPOs to include private sector on planning committees; and
- continue purchasing annual commodity flow data.

Over the long term, the identified strategies included in the Maine Integrated Freight Plan (2002) were:

- continue freight data collection efforts;
- encourage Congress to address Interstate truck weight limits;
- study trailer size limits;
- readdress existing three-port strategy;

- develop a strategy to address freight rail height and weight restrictions;
- develop a strategy for future MDOT investment in railroad infrastructure; and
- consider trade corridors during freight planning efforts.

The Minnesota Department of Transportation (MnDOT), on the other hand, developed a vision for its freight transportation system and identified six policy directions and associated policies that will enable it to materialize its vision as part of its Minnesota Statewide Freight Plan (see Figure 3.1).

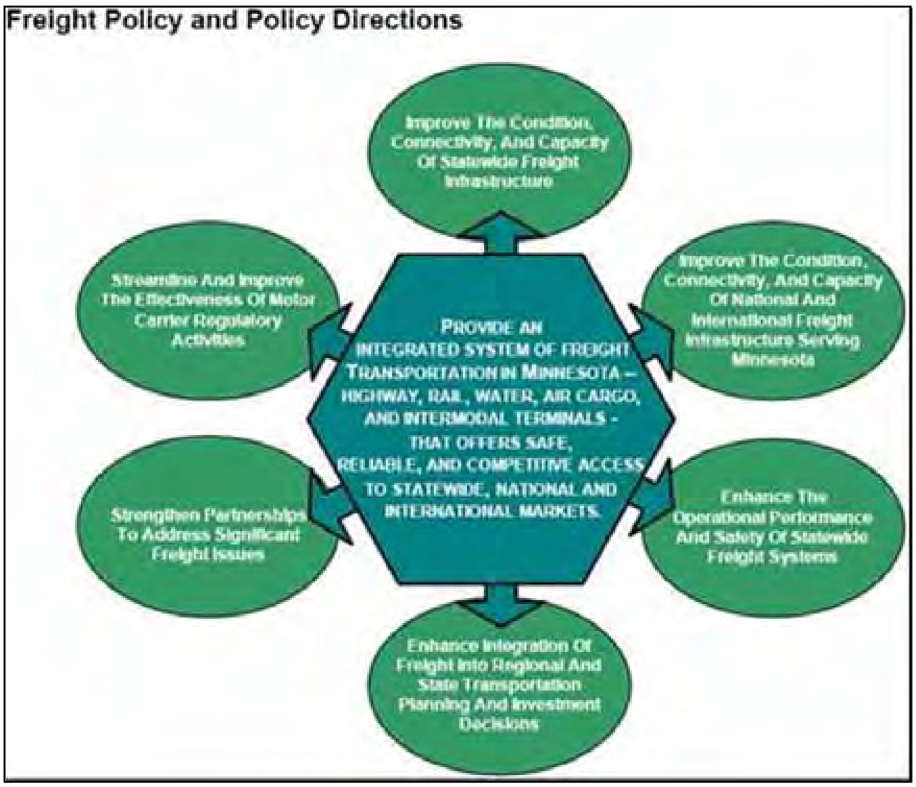

Figure 3.1: Minnesota's Freight Vision and Policy Directions

As can be seen from Figure 3.1, Policy Direction 1 was entitled *"Improve the Condition, Connectivity, and Capacity of Statewide Freight Infrastructure."* The freight policies associated with this direction were to:

- support improvements needed on roadways with significant truck volumes—in particular, bridge and pavement deficiencies affecting trucks;
- structure MnDOT's freight assistance programs to achieve performance targets and assess benefits and costs;
- improve the efficiency, condition, and capacity of intermodal terminals (ports, truck-rail terminals);
- support efforts to develop a statewide interconnected 10-ton roadway system to serve major freight facilities;

- pursue National Highway System Intermodal Connector designation for significant connectors; and
- evaluate railroad shuttle train trends to determine impacts on shippers and railroads; structure rail assistance and road system strategies to respond, as appropriate.

The Minnesota Statewide Freight Plan (2005) is also noteworthy in that it was the only plan that looked at enhancing freight movements beyond the statewide borders of Minnesota. Policy Direction 2 entitled *"Improve the Condition, Connectivity, and Capacity of National and International Freight Infrastructure Serving Minnesota"* lists a number of freight policies that will improve freight flows on multi-state freight corridors, such as:

- eliminate bottlenecks and improve national trade highways that serve Minnesota;
- eliminate bottlenecks on national rail corridors serving Minnesota;
- improve intermodal container service to accommodate long haul movements;
- establish an international air cargo regional distribution center to support direct international service;
- support increased capacity at Upper Mississippi River locks and the Great Lakes' Sault Ste. Marie locks; and
- support a study of the St. Lawrence Seaway and Welland Canal locks for accommodating large international ships.

3.5 Infrastructure Improvements

In the development of the Maine Integrated Freight Plan (2002), it was agreed to let private sector stakeholders identify "quick-fix" short term infrastructure projects. Specifically, plan developers felt that improvements to rest areas and other potentially safety hazards required consensus with the private sector. In terms of long term infrastructure projects, improvements to key Maine highway corridors—using the improvements to Route 9 as a guide—were recommended. In the case of port developments, it was emphasized that port improvements should not be made in isolation, but should account for landside improvements. For all types of freight, it was recommended that attention and resources be dedicated to security along Maine's freight transportation system. Finally, it was recommended that MDOT should use the preferred alternative from the Aroostook County Transportation Study as a guide for future improvements to the Aroostook County highway network.

The California Goods Movement Action Plan (2007) focused on four principal corridors that were critical for international trade. The plan listed a series of specific actions (e.g., infrastructure projects) that could be implemented in the short term (0–3 years), such as:

- State Route 47 improvement;
- Alameda Corridor Expressway (includes Schuyler Heim Bridge replacement);
- IH 710 Early Action Project: Port Terminus Improvements;
- the Port of Long Beach Gerald Desmond Bridge Replacement;
- Alameda Corridor East Grade Separations;

- Los Angeles Basin Rail Capacity Improvements;
- BNSF/UP Colton Crossing Rail Grade Separation;
- Port of Oakland 7th Street/UP Grade Separation Reconstruction;
- Port of Oakland Outer Harbor Intermodal Terminal;
- UP Railroad Martinez Subdivision;
- Oakland to Martinez, Capacity Improvement Project; and
- IH 880, 23rd, and 29th Avenue Interchange Projects.

Furthermore, the report described some proposed improvements as immediate rather than short term, because they were generally operational improvements as opposed to new capital projects.

3.6 Performance Measures

The State of Minnesota included a number of performance measures in the Minnesota Statewide Freight Plan (2005) that were considered appropriate to the state's role in domestic east-west cargo movements, as well as international trade with Canada. The performance measures also sought to capture Minnesota's multimodal competitiveness relative to the rest of the country, as well as the competiveness of the different modes within the state. The selected performance measures included:

- benefit of truck weight enforcement on pavement service life;
- percent of rail track-miles with track speeds >25 mph;
- percent of rail track-miles with 286,000 lbs railcar capacity rating;
- average delay time at river locks;
- availability of direct international air cargo freighter service;
- percent of intermodal facilities whose infrastructure condition is adequate;
- availability of container-handling capability and/or bulk transfer capability;
- shipment rates for selected commodities, modes, and regional and national markets;
- mode share—amount of freight carried by each mode, by major commodity groups;
- geographic market share—tonnage and value of shipments to/from the state, by major commodity groups, to major trading partners; and
- travel time for selected commodities, modes, and regional and national markets.

Chapter 10 of this report discusses performance measures in more detail and presents a list of recommended freight performance measures for Texas based on the input obtained during the Freight Stakeholder Focus Groups conducted as part of this research study.

3.7 Freight Data Used

As was shown in Table 3.1, most DOTs rely on the Commodity Flow Survey data, or more recently the FAF data, the TRANSEARCH database, or interviews/surveys of freight stakeholders. In the development of the Maine Integrated Freight Plan (2002), a comprehensive approach to collecting and analyzing available freight data was used, which included the TRANSEARCH[11] database, surveys, interviews, and focus groups. The TRANSEARCH data were used to (a) forecast freight flows to 2006, (b) measure commodity flows into, out of, and within Maine (1998 & 2006), (c) illustrate freight mode shares—i.e., intrastate, interstate, Canadian, and intra-county, and (d) illustrate freight flows by major commodity groups. Shipper and carrier interviews were used to:

- provide information on shipper operations and carriers;
- assess perceptions on the strengths and weaknesses of freight infrastructure;
- determine views on freight flow improvement projects;
- illustrate MDOT's commitment to involving freight stakeholders in the planning process; and to
- establish and expand relations with the private sector.

Mail-out surveys were also conducted to inform the development of the freight plan. In total, 169 completed shipper questionnaires were received from all areas in Maine. An analysis of the results revealed that 75% of the shippers who responded rely on "truck only" to move freight. The responses also revealed that 85% of the respondents have internet access, which suggested the potential for greater use of the internet to disseminate information to the freight community. In addition, mail questionnaires were sent to municipalities located along major freight corridors in Maine. In total, 17 completed surveys were received from key municipalities located along the major freight corridors. The responses revealed concerns about (a) increased local truck traffic, (b) a lack of paved shoulders, and (c) a lack of rail service in their area. Finally, the responses also highlighted the important role that the OFT plays in problem resolution.

Finally, focus groups were hosted that were attended by (a) shippers and receivers, (b) carriers and providers, and (c) government, interest groups, and trade organizations. These focus groups explored the factors that influence freight movement. In addition, the focus groups sought to determine the service characteristics seen as most important by various stakeholders. Then, the workshop isolated the types of transportation improvements that it felt would most benefit shippers and receivers.

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[11] TRANSEARCH estimates freight flows (i.e., commodity tonnage) by truck (i.e., for-hire truckload, for-hire less than truckload, and private truck), rail carload, rail/truck intermodal, water, and air at the county, Business Economic Areas (BEA), and state or provincial level (Prozzi, et al., 2004; Bhat et al., 2005; Cambridge Systematics, Inc. 2007). The TRANSEARCH database is currently a unique source of detailed freight data that is available for purchase. The data sources used to compile the database are proprietary, and many of the assumptions to estimate and forecast the data are not disclosed. It is thus not possible to easily verify the accuracy and reliability of the data (Prozzi et al., 2004).

3.8 Concluding Remarks

This chapter discussed the federal requirements for statewide freight planning and provided extracts from the "standalone" freight plans of a number of states to highlight how different states have described and addressed the various aspects concerning freight planning: freight trends, freight issues/needs, freight policies/strategies, infrastructure improvements, performance measures, and freight data sources. The next chapter provides insight into the economic and industrial factors that translate into freight movements on a state's transportation network.

Chapter 4. Economic and Industrial Factors Resulting in Freight Movements: *Why Does Freight Move?*

As mentioned earlier, freight movements are derived from the need to move intermediate inputs and final products to production and consumption industries and centers in the state, the U.S., and internationally. In Texas, freight movements have increased substantially due to strong and sustained economic and population growth combined with Texas's optimal location along critical trade corridors. This chapter attempts to describe the Texas economy, including the structure and regional economies. The chapter starts by providing an overview of the major goods dependent sectors in Texas, followed by an overview of available data used to describe and understand the structure of the Texas economy, and concludes with a summary of the major findings of the telephone interviews that were conducted with local Chambers of Commerce and Economic Development Agencies.

4.1 The Texas Economy

Traditionally, the Texas economy has been dominated by the oil, gas, and petrochemical industries. Today, however, Texas has a diverse economy[12] with a Gross State Product (GSP) of $934 billion in chained 2000 dollars (see Table 4.1). Overall, the state's economy grew 222% from1990 to 2010, as measured by the growth in GSP. Furthermore, robust growth is expected in the future, with total GSP reaching $2 trillion by 2035.

The emphasis of this research study is on the goods-dependent sectors as these are the sectors primarily responsible for the movement of intermediate inputs and final products to production and consumption industries and centers in the state, the U.S., and internationally. On average, the goods-dependent sectors accounted for 29% of the Texas GSP in 2010; by 2035 the goods-dependent sectors are expected to account for 21% of the Texas GSP.

[12] In 1993, an economic analysis of all 50 U.S. states found that the Texas economy was the 18th most diverse in the U.S. at that time (Wagner and Deller, 1993). A clear test for the Texas economy's dependence on oil and gas in the recent past was how it responded to the sharp fall in oil prices in the late 1990s. Prior to 1990, Texas employment tracked closely with the price of oil. In the late 1990s, however, employment surged at the same time that oil prices fell to historical lows. This suggested that the Texas economy of the late 1990s was less vulnerable to fluctuations in the price of oil (Federal Reserve Bank of Dallas, ND). It thus appeared that the Texas economy was more insulated from fluctuations in a single industry until the tech collapse of 2001. The latter proved in some ways even more devastating to the economy than oil collapses had been in the past. Texas entered a severe recession that proved difficult to recover from as unemployment rates remained high through 2003, despite the fact that overall economic growth had resumed. One theory is that the jobs failed to return to Texas when GSP growth resumed, because many industries were experiencing structural change (Federal Reserve Bank of Dallas, ND). Industries are defined as undergoing structural change if they continue to contract after the overall economy resumes growth. This scenario is opposed to a cyclical downturn in which lower demand simply compels employers to put jobs on hold until demand resumes. In 2003, computer manufacturing and telecommunications were undergoing structural change (Federal Reserve Bank of Dallas, ND). Two other factors can slow job growth: above-average productivity gains and a decrease in outside investment. Both of these factors persisted in Texas's last recession and were likely contributing factors to the severity and duration of job losses.

Table 4.1: Texas Nominal Gross State Product by Industry 1991 to 2035 (Billions of 2010 Dollars)

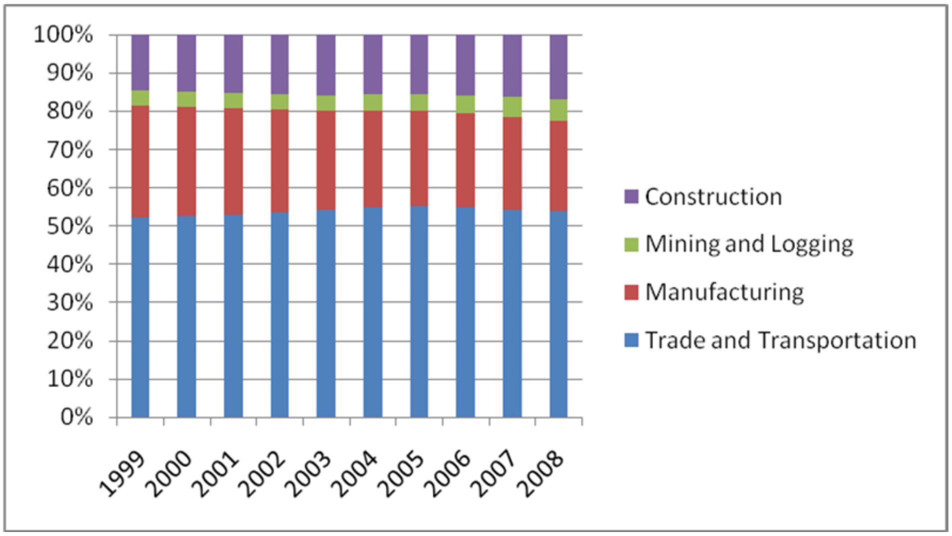
Industry Sector/Year	1991	2000	2010	2020	2035
Total Gross State Product (Current Dollars)	**$392.92**	**$711.95**	**$1,266.42**	**$2,045.79**	**$4,277.49**
Goods (Current Dollars)	**$109.09**	**$173.97**	**$361.27**	**$556.12**	**$884.87**
Agriculture	5.81	6.65	9.42	9.73	11.13
Mining (Oil and Gas)	26.47	39.39	137.2	184.28	193.35
Construction	15.88	35.86	58.59	112.96	258.96
Manufacturing	60.94	92.08	156.06	249.15	421.43
Services (Current Dollars)	**$283.82**	**$537.97**	**$905.15**	**$1,489.67**	**$3,392.63**
Trade, Transportation and Utilities	80.63	153.94	241.57	382.4	768.3
Wholesale	25.68	53.71	79.76	123.79	245.84
Retail	28.26	51.39	75.15	109.49	217.62
Transportation and Utilities	26.69	48.83	86.66	149.12	304.83
Information	14.95	35.3	45.77	69.94	196.5
Financial Activities	61.98	115.02	174.51	261.79	550.69
Professional and Business Services	31.6	72.64	151.34	303.29	814.36
Educational and Health Services	22.91	41.6	85.12	146.05	349.46
Leisure and Hospitality	12.11	22.86	39.64	65.8	154.34
Other Services	9.94	17.34	26.06	39.65	81.51
Government	49.71	79.28	141.16	220.74	477.47

Note: Because of the method used by the U. S. Bureau of Economic Analysis in calculating real chained dollars, chained-dollar data for historical years do not necessarily sum to category totals.

Source: Texas Comptroller of Public Accounts, 2009–2010 Forecast and IHS Global Insight, Inc. (http://www.texasahead.org/economy/forecasts/fcst0910/ngspfiscal.html)

Table 4.1 illustrates that the agriculture, mining, construction, and manufacturing industries are major goods-dependent economic generators in Texas. Furthermore, these industries are expected to experience growth between 2010 and 2035: 18, 41, 342, and 170%, respectively. Also evident is that an efficient transportation system, aside from facilitating the competitive operation of many industries in the state, is in itself an important economic generator, contributing 19% of the GSP (together with trade and utilities). Furthermore, the trade, transportation, and utility sectors are anticipated to grow 218% between 2010 and 2035.

The importance of these goods movement sectors are also reflected in the employment shares of these industries. Figure 4.1 illustrates the changes in the employment share of four of Texas's largest goods-dependent sectors—i.e., construction, mining and logging, manufacturing, and trade and transportation—between 1999 and 2009.



Source: Bureau of Labor Statistics

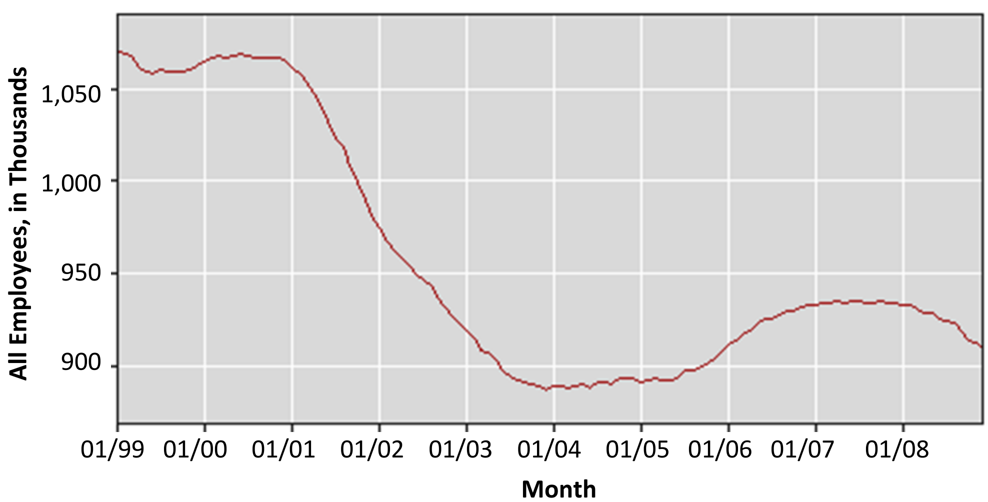
Figure 4.1: Employment Shares of Texas's Major Goods-Dependent Sectors

The figure illustrates that trade and transportation and construction have seen a slight increase in total employment shares, while manufacturing and mining have seen a reduction in employment share.

4.2 Texas's Goods-Dependent Sectors

4.2.1 Manufacturing

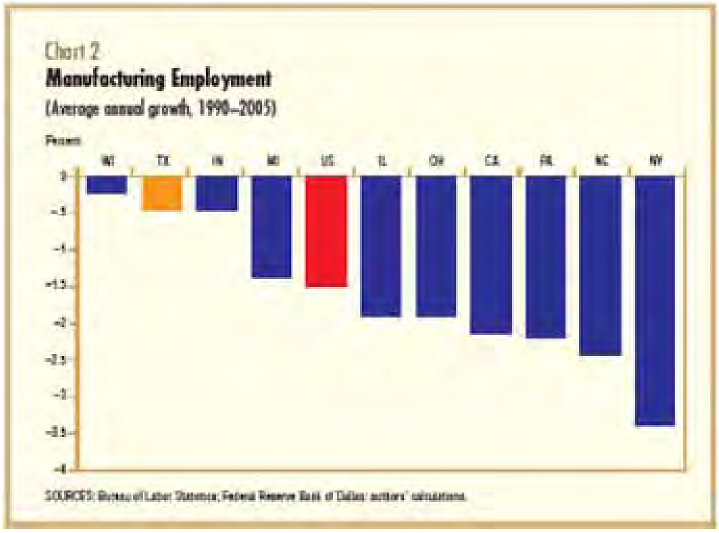
As is the case in most states, the percentage of the population directly involved in manufacturing in Texas has consistently fallen. Figure 4.2 shows the number of employees engaged in all types of manufacturing in Texas from 1999 to 2008. The figure indicates that between 2005 and 2007, the trend was partially reversed.



Source: Bureau of Labor Statistics

Figure 4.2: Manufacturing Jobs in Texas: 1999–2008

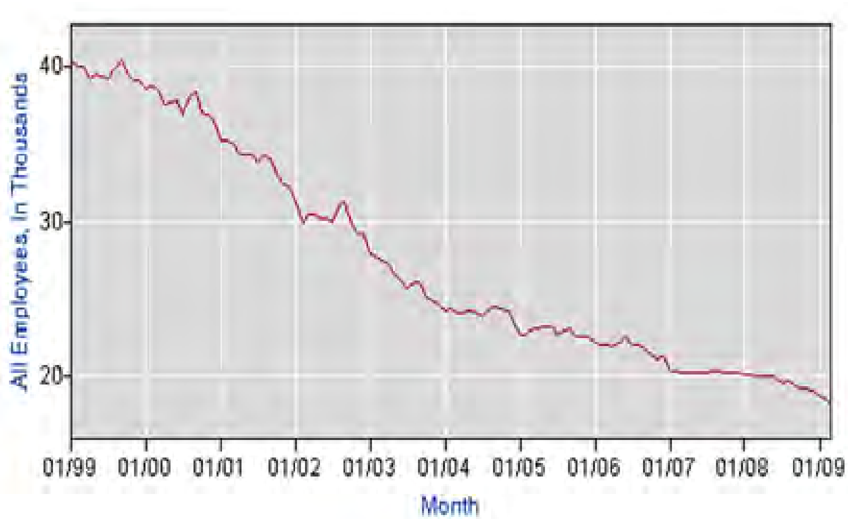
While manufacturing jobs in Texas have consistently declined, this trend has not occurred at the rate that has occurred in other states. Figure 4.3, produced by the Federal Reserve Bank of Dallas, shows that the rate of decline in manufacturing jobs in Texas has been lower compared to several other important manufacturing states.



Source: Federal Reserve Bank of Dallas

Figure 4.3: Change in Manufacturing Employment by Selected States

In Texas, however, different regions of the state have experienced different manufacturing employment impacts over the past decade. For example, El Paso has seen a constant job loss in the manufacturing sector without the temporary reprieve seen in the state overall (see Figure 4.4). The same is true for McAllen-Mission.



Source: Bureau of Labor Statistics

Figure 4.4: El Paso Manufacturing Employment: 1999–2008

As of October 2008, Waco had 13.6% of its civilian workforce engaged in manufacturing, Houston 8.5%, Dallas 4.8%, Austin 6.5%, El Paso 6.4%, Brownsville 4.8%, and Lubbock 3.4%. In most urban economic regions within the state the percentage of the population directly employed in manufacturing is, however, small. The percentage of the population directly employed in manufacturing may, however, understate the importance of manufacturing to the economy given that many of Texas's most productive manufacturing industries are capital intensive and thereby require few labor hours per unit of output. A more complete picture of the status of manufacturing in the state is generated by the Dallas Federal Reserve Bank through their monthly "Texas Manufacturing Outlook Survey." Since 2004, each month approximately 80 manufacturers from a variety of industries respond to the survey. The survey responses are used to track monthly output, inventory stocks, delivery time (a potentially useful index[13] for measuring freight performance), capacity utilization, employment, and average workweek, which shows cases in which firms do not lay off workers but instead respond to lower demand by reducing staff hours.

Few entities have performed more extensive research into the Texas economy than the Federal Reserve Bank of Dallas. The Bank conducts regular assessments of different industries and trends within the state to better understand how the state economy has changed and may change in the future. The Bank researchers consult with economists at the Federal Reserve Bank to ensure that the methodology used for regional economic analysis is consistent and transferable.

4.2.2 Mining Sector

Oil and Gas

Mining is defined as the extraction of unfinished product from the earth; therefore it excludes the movement of refined product. The transportation impacts associated with the production of oil and gas differ from other types of mining in that a significant share of the final product is moved by neither truck nor rail. Yet, the extraction process itself is quite freight intensive. As a high cost oil and gas producer, thousands of wells for oil and natural gas production are continuously mobilized and de-mobilized in both urban and rural Texas. Site preparation is a freight-intensive process that involves bulldozers, as well as the construction of temporary access roads. Trucks are used to move equipment and drilling fluids, and to haul away soil and rock extracted during the drilling process. Large amounts of saltwater are also produced during operation. In this case the water must be transported to an area where it can be safely disposed of. The amount of brackish water produced typically dissipates as the well matures. Offshore drilling requires similar inputs yet the material and waste product must be transported by means of offshore service vessels to and from the drilling site and then by truck to and from the ports at which these vessels dock.

13 The manufacturing delivery time index, developed by the Dallas Federal Reserve Bank, shows whether manufacturers report that delivery times are increasing or decreasing in a given month. The index does not quantify by how much delivery times increased in a given month, only if they increased or decreased from the previous period. An increase in delivery times does not necessarily mean that the transportation network is becoming more congested, but can mean instead that shippers are choosing less time-sensitive delivery options. Survey respondents are also asked to estimate whether they expect delivery times to increase or decrease in the next 6-month period.

About 5% of the natural gas production in the U.S. is moved by truck. Most of the natural gas in the U.S. (95%) is, however, moved by pipeline. Crude oil transported from well sites to refineries and the transportation of the refined product to consumers, however, generates truck traffic. Most of these oil-associated movements are, however, over relatively short distances. Currently only two oil refineries serve the Permian Basin. One is located in Big Spring, Texas and the other in Artesia, New Mexico. The Big Spring refinery, owned by Alon USA Energy Inc., purchases crude oil from all over West Texas and processes approximately 65,000 barrels of crude oil per day. According to the president and CEO, 30,000 barrels of crude oil is processed into gasoline, while another 20,000 is processed into diesel. The remainder is processed into jet fuel and asphalt (The Permian Basin Petroleum Association Magazine, 2009). The final product of the Big Spring refinery is distributed along a network of pipelines, connecting Fort Smith, Arkansas to Phoenix, Arizona and all points in between. Alon Energy also owns 160 gas stations throughout West Texas that sell the final product to the consumer. Gasoline and diesel is delivered to these gas stations by truck from collection points on the Alon Energy pipeline.

Non-Petrochemical

While the mining industry within Texas is typically considered synonymous with the oil and gas sector, several other resources in addition to hydrocarbons are mined in the state and impose substantial impacts on the Texas transportation system. The most important minerals mined in Texas, excluding oil and gas, are clays, crushed stone, portland cement, granite, gypsum, coal, limestone, marble, sand and gravel, and uranium[14]. Specifically, Texas is currently the fourth largest producer of clay and aggregates and the fifth largest producer of coal.[15]

Although shippers of these low value commodities, such as sand and gravel, are potentially the most important users of the freight rail network, the researchers found that the ability of the mining industry to utilize alternative modes is limited in many cases. This limitation can be attributed to shipment size and the characteristics of the commodities.

Many of the minerals extensively mined in Texas are used by the construction industry and destined for consumers. The relatively small shipments and urban destinations thus tend to favor trucking. Furthermore, most granite- and limestone-producing areas in the state have fabrication and distribution facilities located nearby. An interview with Texas Quarries[16], which is the state’s largest limestone producer, revealed that the quarry, which has been in existence since the 1950s, has never found a way to use rail—either for its raw material or finished products. Inputs to the factory cannot be delivered by rail because of a lack of available rail infrastructure and rail is typically avoided for the delivery of finished products to customers to prevent breakage. During the period of high energy prices in 2008, the company received many requests from out-of-state customers to shift to rail if possible to reduce transportation costs, yet in almost all cases the company was not able to comply. A limestone producer, American Limestone Company, based in Big Springs, also does not use rail for either inbound or outbound shipments. Each year, 3.1 million pounds of stone is brought into the facility and 1.2 million pounds is shipped out—exclusively by truck.

[14] Although new uranium deposits have been discovered in south Texas, the operation has not yet been commercialized.

[15] Available at: http://www.tmra.com/facts-figures

[16] Texas Quarries, which is a division of Acme brick, has quarries in Liberty Hill and Leuders, Texas. The current quarries have been active since the 1950s, while the fabrication facility has been in business since 1929.

4.2.3 Construction Sector

The construction industry in Texas is a natural extension of its natural resource endowments in minerals and forests. The materials used and construction costs are thus tied to the abundance of local building materials. In fact, modern lumber techniques allow Texas builders to source locally, because mills can manufacture almost all standard lumber products out of indigenous Texas pine and cedar. Distance is thus a major factor in the sourcing of construction products, with a strong bias against longer distances, except for the delivery of specialty products, such as marble and redwood. The abundance of locally sourced construction supplies thus tends to favor trucking as oppose to rail.

As indicated in Table 4.1, the construction sector is anticipated to be the third largest goods-dependent sector contributing to GSP by 2035. In 2007, construction continued to increase in Texas, although at a slower pace than in 2006. The decline in the construction of single-family houses in 2007—partly attributable to an increase in the number of housing foreclosures—was almost totally offset by an increase in the construction of multi-family houses. At the same time, the construction of pipelines and petrochemical facilities have increased substantially so that construction employment increased by 2.4% in 2007 (Texas Comptroller of Public Accounts, 2008).

Large contractors, involved in the construction of housing developments, transportation infrastructure, water systems, and industrial facilities, often procure materials at rates negotiated based on volume. In many cases, deliveries for large construction projects are made directly from the supplier to the site by truck. The transportation impacts associated with the construction of major facilities—specifically in urban areas—have to be documented in the Environmental Impact Report (EIR), detailing the estimated truckloads required for demolition and site preparation and the delivery of construction materials.

4.2.4 Agriculture

Agricultural production/farming can be categorized as:

- cash crops that are grown for market and export;
- crops grown for local consumption; and
- agricultural commodities grown for industrial purposes, such as animal feed or as feedstock for biofuels.

Farming is a very important sector in rural Texas. For approximately 50 out of Texas's 196 rural counties, farming is one of the top 3 revenue generators in the county. During the past 20 years, the application of industrial principles to agricultural production has dramatically changed the agricultural sector in Texas:

- Approximately 3% of farm operations (7,000 farms) have sales in excess of $250,000. These farm operations account for 30% of the farm land in Texas.
- In 1997, 8.6% of Texas farms accounted for 86.7% of total farm sales in Texas (Gleaton and Anderson, 2003).

These statistics highlight the fact that agricultural industrialization resulted in farm consolidations in Texas. In addition, industrialization required the move away from diversified (multi-product) farms to specialized (single-product) farms. This has resulted in fewer but larger farms and the need to move products between specialized operations. Some evidence exists that trucks are currently dominating the movement of agricultural shipments in Texas—particularly if these shipments have both an origin and destination in the state. Furthermore, a legislative mandate allows higher axle loads for agricultural produce. In northern Texas, concern has been expressed about the impact of trucks moving agricultural produce during the harvesting season.

Because agricultural shippers have come to rely on trucking to move their produce, any increase in agricultural output will result in increased truck volumes and/or loads on rural pavements. Two agricultural trends that could result in increased usage of trucks are thus worth highlighting. *First*, globalized agriculture has resulted in continuing pressure on the industry to stay cost-competitive. Because price-sensitive consumers tend to purchase the cheapest commodity irrespective of where it was produced (personal communication with Stephen Fuller, June 2003), commercial farm sizes are predicted to continue to increase in an effort to achieve economies of scale and remain cost-competitive in an increasingly global economy. *Second*, concerns have been expressed about the water pollution impact of large industrialized farming operations and about the use of hormones and antibiotics to control deceases at large industrialized agricultural facilities. Consumers are thus increasingly requiring "identity preservation." Although the trend towards preserving the identity of agricultural produce from field to consumer is currently more prevalent on the national level, it will become more important in Texas as the demand increases for meeting customers' specific food needs. "Identity preservation" and the growing demand for local produce usually involve the movement of smaller shipment sizes, careful handling to prevent damage, and reduced transit times, which taken together seem to favor trucking.

4.2.5 Trade

Interestingly, because of tariff and other trade regulations, more is known about cargo being exported or imported from Texas than is known about cargo movements within the state. A starting point when attempting to understand the diversity of the Texas economy is thus to look at export commodity statistics. Data from the United States International Trade Commission (USITC) or the Census Trade Statistics provide insight into the types of commodities that are moved from and through the state for export. In general, commodity statistics for agricultural goods are the most difficult to track and estimate. Trade statistics collected by the Census tend to represent the volume of agricultural commodities consolidated within the state rather than the amount that is actually produced. In addition, a significant amount of Texas agricultural produce is used as feed for animals rather than for human consumption. As such, it is an input that is often produced in the same region where it is consumed.

The North American Industry Classification System (NAICS) database profiles industries that are active within the U.S., Canada, and Mexico. An analysis of the NAICS codes at the 4-digit commodity level demonstrates that, by one measure, the Texas economy has continued to diversify in recent years. Between 2002 and 2008, 94 out of 109 commodity types increased in absolute value, yet the market share (or importance relative to total trade) increased for only 41 out of 109 commodity types and decreased for 68 commodity types. Measured as such, the five NAICS 4-digit commodity types that have gained the most market share since 2002 are:

- 3311 Iron & Steel & Ferroalloy;
- 3252 Resin, Synthetic Rubber;

- 3342 Communications Equipment;
- 3251 Basic Chemicals; and
- 3241 Petroleum & Coal Products.

The commodity types that have lost the most market share are:

- 3344 Semiconductors & Other Electronic Components;
- 3363 Motor Vehicle Parts;
- 3341 Computer Equipment;
- 3261 Plastics Products; and
- 3359 Electrical Equipment & Components.

4.3 Texas's Regional Economies

This section of the report provides a summary of the major economic and revenue generators in the six economic regions of Texas obtained during telephone interviews conducted with local Chambers of Commerce and Economic Development Agencies. For a more detailed economic and transportation profile of the different economic regions of Texas, see Appendix C.

4.3.1 Piney Woods

The Piney Woods Region lives up to its name, with a high number of reported wood processing industries throughout the region. Many counties in the region thus reported major economic generators involving wood products, such as lumber mills, and shippers of wood byproducts (biomass), wood fuel (charcoal), and paper products. In one example, Marion County reported five major shippers in the area, all related to wood: East Texas Forest Products, Blackburn Syrup Works, John Bradley Timber, Brooks Timber, and McDonald Lumber. In addition to the wood processing industries, the region also houses chicken and other food processing plants, as well as feed plants. These industries and the wood processors regularly utilize rail. Among the largest rail users in the region is the Pilgrim's Pride Corporation, which utilizes rail to link their operations in different towns. In addition, the larger cities in the region—i.e., Longview, Tyler, Sherman, and Paris—generally house a large number of major industrial manufacturing plants across many industries, such as food preparation, furniture and home items, metal and machine fabrication, and paper products. Smith County (Tyler) is reported to have a high number of air conditioning manufacturers, but also houses shippers in industries more common to the region, such as John Joules Food and Distant Lands Coffee Traders. Many of these larger cities also featured distribution centers for large U.S. retailers—e.g., Neiman Marcus, Lowe's, etc.—which undoubtedly contribute to truck traffic on the roads. In the case of Neiman Marcus, their distribution center located near Longview is within about 6 hours of all the company's Texas retail stores. Thus, while the eastern third of the state may be largely rural, it features a diverse economic base with wood products prevailing in the far eastern reaches of the state, and transitioning to food products, particularly chickens and feed, in the region near the IH 45 corridor.

4.3.2 North Coastal Region

The economic characteristics of the North Coastal Region appear to be defined by proximity to the coastline, which also coincides with proximity to rail. Some food production occurs in this region, specifically chicken farming and sausage production, as well as a number of smaller agricultural farms. Food production is more prevalent in the more inland section of the region, primarily along the IH 10 corridor. Moving closer to the coast, various refineries and factories for oil, gas, plastics, and chemicals (e.g., OXEA, Celanese, and Nan Ya Plastics Corp) become major economic generators. Also in the area is a significant metal fabrication industry, presumably to assist in the refining and/or oil drilling process. The counties directly on the coastline in this region are well served by rail. A number of respondents indicated that major shippers in the refining and chemical processing sectors utilize rail to serve coastal industrial plants, specifically plants near population centers in Calhoun and Matagorda counties. On the other hand, most of the inland counties indicated limited rail service and use. Finally, the extreme eastern side of this region, primarily Newton, Tyler, and Jasper counties, houses a number of wood- and lumber-related industries.

4.3.3 South Coastal Region

The South Coastal Region includes a substantial part of inland Texas north of the Rio Grande along with the coastal counties south of Matagorda Bay. Counties near Corpus Christi feature many economic generators related to oil and gas refining. In the case of Kleberg County, the mechanical manufacturing of engines and turbines is a significant contributor to the local economy. Rolls Royce, Boeing, and Raytheon serve Kingsville Naval Air Station, but also ship extensively internationally. Arguably this region is mostly defined by the industrial manufacturing that occurs in the border cities of Cameron and Hidalgo counties. Outside of the Rio Grande Valley, many of the counties in this region have sparse populations and a limited economic base. While this area was once a famous agricultural region known primarily for citrus fruit, much of that land has been transformed to accommodate industrial manufacturing. This was partly initiated by the McAllen-Reynosa Foreign Trade Zone (FTZ) and subsequently NAFTA. The major economic generators in this region thus ultimately reflect the original agricultural basis and the industrial transformation of this region. Many food production services exist, including citrus fruit and fruit juice companies, and Mexican food manufacturers of products, such as tortillas and tortilla flour. In addition, the region hosts a substantial number of plastic molding companies and metal manipulation industries. The number of heavy-duty industrial plants is, however, insignificant.

4.3.4 Central Texas Region

Central Texas may be the most difficult region to characterize in terms of a few dominant industries. In many ways, the region represents an economic “transition zone.” Areas toward the northwest section of the region feature significant wind energy operations supported by industrial manufacturing serving these operations. Some of the counties in this region are currently—and anticipated to be in the future—the highest wind energy producing areas in the U.S. The presence of Invenergy, Mitsubishi Power Systems, and GE, among others, contributes significantly to the economy of this area. In addition, cotton and grain farming and oil drilling contribute substantially to the economy of the region. Heavier industry certainly exists, but is limited to the manufacturing of furniture and steel. Many counties have cotton gins, because cotton farming is conducted in large parts of the region. Many livestock operations, feed mills, and goat and sheep processing facilities (such as wool houses) also exist in the region. The few large distribution centers in the region—i.e., Wal-Mart, Lowe's, Home Depot, and Target—are concentrated in San Angelo and Abilene. In addition, the telephone interviews revealed that much of the agricultural processing occurs near these larger cities. San Angelo and Abilene are thus often either the origin or destination of many freight shipments in the region. A number of food processing operations—specifically peaches and pecans—exist closer to the IH 35 corridor, i.e., the east and southern sections of the region. These food industries also contribute to the local economy by attracting tourist traffic to many of the Texas Hill Country towns, including Fredericksburg, Uvalde, and Kerrville.

4.3.5 Panhandle Region

The Panhandle Region consists of 26 counties; the largest areas (with 100,000 people or more) are Amarillo, Lubbock, and Childress. The top freight generators in the Panhandle are agriculture, livestock, oil and gas, and wind. The Panhandle Region is the one of the leading producers of cotton for the state and nation. It produces approximately 25,000 to 35,000 containers of cotton annually. One of the areas in the Panhandle, Hereford, is also known as the cattle capitol of the world with more than one million head of cattle and 100,000 dairy cows located within a 100-mile radius of the town. According to the State Energy Conservation Office (SECO), almost half of the state's corn is grown in the northwestern part of the Panhandle, and is mostly used for feed. The Panhandle is also considered to be one of the top five wind energy producing zones located within Texas. Currently, only 240 megawatts (MW) of energy are produced there (Electric Reliability Council of Texas, 2008). However, the area has the producing capability of anywhere from 1,200 to 8,000 MW of wind energy (Electric Reliability Council of Texas, 2008).

4.3.6 Western Region

Finally, the Western Region is the most sparsely populated region in the state. Industrial activity is concentrated near the larger cities in the region, primarily Odessa, Midland, Fort Stockton, and El Paso. Steel pole and wind energy-related manufacturing are present near Odessa and Midland, serving largely the wind energy region in the northwest part of the state (i.e., the Central Texas region). Otherwise, the oil and gas sector remains the dominant industry throughout much of this region. Thus, the western region is highly susceptible to fluctuations in oil and gas prices. Many towns are struggling to sustain themselves when no pumps are in operation. The El Paso area, including some towns in nearby New Mexico, has more of a manufacturing base, partly because of the region's ability to attract lower cost laborers from Juarez, Mexico. In El Paso assembly plants thus manufacture various electronic products and mold plastics and steel.

4.4 Concluding Remarks

In Texas, freight movements have and are expected to continue to increase substantially due to strong and sustained economic and population growth combined with Texas's optimal location along critical trade corridors. This chapter provided information about the size and types of industries that represent the major economic generators in the state and regional economies.

The next chapter discusses the factors that shippers consider when making mode choice decisions.

Chapter 5. Modal Choice Considerations: *Who Moves Freight?*

The reliance of shippers on multiple modes of transportation to obtain intermediate inputs and to move finished product to centers of consumption has always been an important component of product supply chains. Increased globalization, however, has increased the need for efficient supply chains (and ultimately freight transportation) to ensure competitiveness on global markets. Competition for global market share is no longer among companies but rather among supply chains, some have argued. This change has resulted in downward pressure and increased scrutiny of all the components of the supply chain, including the freight transportation component. Modal service attributes—i.e., readily available, easy to arrange shipments, fast transit time, reasonable rates, flexible service, high quality equipment, reliability, minimal loss and damage, and prompt pick-up and delivery—are thus increasingly evaluated to determine the impact on the supply chain transaction costs. These alternatives are typically a function of the capacity of the infrastructure and the underlying technologies and characteristics of the individual modes. This chapter summarizes the insight obtained from participants in the Freight Shipper Workshops on the importance of modal characteristics in mode choice decisions.

5.1 Factors Affecting Modal Choice—Literature

A review of the literature revealed a number of studies on mode choice factors that were conducted in the 1980s and 1990s. For example, Wilson et al. reported in 1982 that shippers prefer private trucks over hired trucks as the frequency of shipments increases. They also found that the choice of hired trucks can be enhanced through greater cooperation between shippers and carriers, and when pickup services are provided by the carrier. The latter was found to be the most important factor in hired truck choice. Transit time and reliability of transit time were found to be important factors in the decision to use private trucks. Unlike other studies, Wilson did not find cost, damage to goods, or commodity value to be significant factors in mode choice. However, similar to other studies (Jiang, 1999; Sivakumar, 2001), the study found transit time to be an important variable affecting the choice of all modes—inversely for truck and directly for rail. This finding implies that rail is preferred for longer haul shipments. In addition, transit time and pickup services were significant factors in rail mode choice.

Howie (1998) found that for general containerized freight, a 10% reduction in rail costs resulted in a 9% increase in market share and that price was a significant factor affecting mode choice. The study also found that transit time was not significant. But the transit time sign was wrong, indicating perhaps some errors. The study also found that price and “care of goods” were significant factors.

Danielis (1999) reported that a number of UK studies found transit time to be an important factor in freight mode choice. Other significant factors were reliability, flexibility, and intermodal connections. Danielis also reported on a study by Bolis and Maggi that found flexibility and frequency to be influential in freight mode choice decisions. More importantly, the latter study emphasized the importance of service characteristics within a just-in-time (JIT) context. Frequency was most important for firms practicing JIT, while reliability was important for firms whose clients had adopted JIT techniques.

Murthy et al. (1987) found that the truck mode dominates the movement of all commodities within the provincial boundary of Alberta, Canada under all shipment size and mode choice categories, and that the truck mode captured almost 100% of the less-than-full load market for intra-provincial commodity movements. The relatively small rail mode share (15%) of the full-load market pertained to specific commodities. Truck was also preferred for shipments up to 30 tons, whereas rail was preferred for shipment sizes greater than 30 tons.

Nam (1997) found transit time to be the most important factor in mode choice for all commodity groups, while rate was important for rail users and accessibility was important for truck users. Young et al. (1981) found that, for manufactured goods, enhanced reliability, lower freight rates, decreased damage, and improved communication were effective in increasing rail modal share, while for non-manufactured goods, enhanced capacity and lower freight rates were effective in increasing rail modal shares.

Finally, the Federal Railroad Administration (FRA) recently issued the National Rail Plan: Moving Forward report (2010). This report included informative tables about the potential modal comparative advantages by market, in terms of passengers and freight. Table 5.1 provides the potential modal comparative advantages by freight market.

Table 5.1: Potential Modal Comparative Advantage by Freight Market

		Intercity Distance in Miles				
		0-250	**250-500**	**500-1,000**	**1,000-2,000**	**>2,000**
Weight	Light: Retail Goods	Truck	Truck	Truck Rail Intermodal	Truck Rail Intermodal	Truck Rail Intermodal
Weight	Moderate: Consumer Durables and Other Manufactured Goods	Truck Rail	Truck Rail Rail Inter-modal	Truck Rail Rail Inter-modal	Truck Rail Rail Inter-modal	Truck Rail Rail Inter-modal
Weight	Heavy: Bulk Goods	Truck Rail Water	Rail Water Truck	Rail Water	Rail Water	Rail Water

Source: Federal Railroad Administration, National Rail Plan Progress Report, September 2010, page 17 [1]

Against this background, the study team attempted to gain insight into the modal characteristics that shippers in Texas consider important when procuring freight transportation services.

5.2 Modal Choice Considerations of Texas Shippers

As part of this study effort, Texas shippers were surveyed (see Appendix A) and invited to participate in six Freight Shipper Workshops (see Appendix B). Respondents and participants were asked to rank on a scale of 1 (i.e., extremely insignificant) to 5 (i.e., extremely significant) the importance of various modal characteristics or attributes. The objective was to improve the understanding of the characteristics or attributes that businesses consider when procuring freight transportation services. Table 5.2 provides a summary of the responses received and the subsequent sections summarizes some of the insights obtained during the Freight Shipper

Workshops. For a more detailed documentation of the discussions, the reader is referred to Appendices A and B.

Table 5.2: Modal Choice Considerations

	Service Availability	Customer Services	Fast Transit Time	Reasonable Rates	Flexible Service to many markets	Specialized Equipment	On-Time Reliability	Minimal Loss and Damage	Prompt Pick-up and Delivery	Shipment Value	Distance	Shipment Size	Tracking Service Provided	Relationship with Carrier
Extremely Important	61%	52%	39%	52%	20%	20%	65%	60%	67%	25%	19%	25%	32%	43%
Important	22%	31%	35%	27%	27%	21%	25%	22%	20%	34%	35%	29%	20%	35%
Neutral	9%	8%	18%	13%	29%	25%	3%	7%	6%	21%	22%	19%	28%	7%
Unimportant	2%	4%	4%	4%	16%	21%	1%	4%	1%	11%	16%	18%	10%	7%
Extremely Unimportant	6%	5%	4%	4%	8%	13%	6%	7%	6%	9%	8%	9%	10%	8%
Total of Responses	***81***	***77***	***77***	***78***	***75***	***76***	***79***	***76***	***66***	***67***	***74***	***68***	***74***	***76***
Factor Significance	***4.28***	***4.21***	***4.01***	***4.21***	***3.35***	***3.13***	***4.41***	***4.26***	***4.39***	***3.57***	***3.41***	***3.44***	***3.57***	***4.00***

5.2.1 On-Time Reliability

Table 5.2 evidences that on-time reliability was considered the most important service attribute in mode choice decisions. The results showed that 90% of the respondents and participants considered on-time reliability to be important (i.e., 25%) or extremely important (65%) when procuring freight transportation services. This result is partly attributable to the adoption of JIT principles by Texas shippers. However, also evident from the Freight Shipper Workshops is that the requirement for reliability is partly a function of the characteristics of the commodity transported. For example, chemical shippers were less concerned about a few days of variability in delivery schedules, while shippers of food and groceries operated within a very narrow delivery time window of 2 hours. Cotton shippers in the Texas Panhandle were also very concerned about the reliability of the transportation mode. For the cotton industry, reliability is critical to ensure the export shipments arrive prior to ocean vessel departure as failure results in steep demurrage charges. On the other hand, shippers that used barges were less concerned about variability in delivery times when they amounted to a couple of days.

> The *Kanban* JIT production process—pioneered by Toyota—had a dramatic impact on U.S. production and productivity. The philosophy behind JIT is the elimination of inefficiency (i.e., waste) at each step of the supply chain: supplier→manufacturer→ warehouse→retailer→ consumer.
>
> The philosophy emphasizes having "*the right material, at the right time, at the right place, and in the exact amount.*" Large stocks of inventory are thus considered inefficient (or a waste). A reduction in inventory levels requires a highly advanced and reliable freight transportation system.

5.2.2 Prompt Pick-up and Delivery

Prompt pick-up and delivery was considered the second most important service attribute or modal characteristic in mode choice decisions. Of the 66 responses, 87% of the respondents and participants rated prompt pick-up and delivery as extremely important (i.e., 67%) or important (i.e., 20%). The flexibility of the trucking mode in accommodating shipper schedules was very favorably commented upon in the discussion of this attribute. The discussions also highlighted the importance of the drayage component of intermodal shipments in ensuring that shippers' expectations for prompt pick-up and delivery were satisfied when shipping by rail.

5.2.3 Service Availability

Service availability was considered the third most important service attribute in mode choice decisions. As shown in Table 5.2, 83% of the respondents and participants rated service availability as extremely important or important. In some instances, for example, participants commented that they would consider using rail if the service was available. Trucking, on the other hand, was considered a very flexible mode that can provide service to almost anywhere.

5.2.4 Minimal Loss and Damage

Minimal loss and damage was considered an important or extremely important consideration by 82% of the respondents and participants. Participants in the Corpus Christi Shipper Workshop argued that loss and damage is a risk associated with all transportation modes. However, the loss or damage incurred due to a barge incident is always significant even if the risk of an incident is very low. On the other hand, the risk for human error is higher with trucks, but the loss and damage may be more limited. In general, though, the perception exists that loss and damage is higher when shipping by rail compared to the other modes. In the Houston Shipper Workshop, some participants argued that this perception potentially arises because two to three additional people handle rail shipments and the cargo gets jarred on rail. Several participants considered rail "too rough" for the equipment shipped by the company. This concern was particularly mentioned to be the case for the shipment of LCD projectors and floor tile. On the other hand, some participants mentioned that Dell pays a premium for trucking its commodity. This step is largely because of concerns about theft rather than damage. In this case, rail was perceived to be less secure than trucks from a theft perspective.

5.2.5 Customer Service

Customer service was considered an important or extremely important factor by 83% of the participants and respondents. In the Corpus Christi Shipper Workshop, one participant defined good transportation customer service as having these characteristics: on-schedule shipments, priced within budget, safety, opportunity for personal interaction with transportation service provider, 24-hour availability, and reliability. Participants emphasized the importance of good customer service from the transportation service provider, because a shipper can quickly lose a client if the selected transportation service is late or unreliable.

In general, participants felt that the trucking companies from which they procure service provide good customer service. On the other hand, a number of participants expressed concerns about the customer service provided by the Class I railroads. These concerns related to limited personal interaction with shippers, the fact that shipments needed to meet certain guarantees, and delays at rail yards that often impact shipment deliveries. Concerns about rail customer service pertained specifically to the Class I railroads as the customer service provided by the short line railroads was also perceived favorable.

5.2.6 Reasonable Rates

Reasonable rates were considered important or extremely important by 79% of the respondents and participants. One participant commented that the first question is always *"what is the shipping cost"* followed by *"how fast it can be delivered."* Some participants, however, argued that not only is the rate charged important, but also the additional costs that can be incurred in shipping the commodity. For example, demurrage costs on ocean containers are an important consideration in intermodal operations. Demurrage on an ocean container is imposed after 3 days, but it can take 4 to 6 days to unload a container. This delay results in an additional $100 being billed to the transportation service provider. Some of the principal ports, such as Los Angeles and Long Beach, have started to implement clean truck initiatives and Pier-pass fees for picking up containers during the day time, which have resulted in additional costs. Similarly, participants in the San Angelo Shipper Workshop mentioned the additional charges—e.g., switch charge, fuel surcharge—that are levied besides the freight rate. These charges increase the cost of transportation and are accounted for in mode choice decisions. In general, most participants agreed that transportation cost is the primary factor when deciding on a mode.

On the other hand, participants in the Corpus Christi Shipper Workshop mentioned that they are required to use a certain mode predominantly, because of the characteristics of their commodity or the nature of their business. These participants mentioned that severe rate changes would need to be in effect for them to change their mode choice. Furthermore, the higher volume shippers typically enter into annual contracts with the railroads to move their product, which means that a change in mode cannot be a *"spur of the moment"* decision. Participants in the El Paso Shipper Workshop also mentioned that when transportation costs increase, shipments are made less frequently with better utilized—i.e., more fully loaded—trucks. Incentives (i.e., discounts) are offered to customers that ship truck loads.

5.2.7 Fast Transit Time

Fast transit time was considered important or extremely important by 74% of the respondents and participants. On the other hand, 18% of the participants rated fast transit time neutral.

Participants argued that fast transit time is not necessarily a major factor in all mode choice decisions. The importance of this factor is largely a function of the shipment size, the characteristics of the commodity, and the value of the cargo. For example, a shipment of several tons of material may not be delivered fast anywhere. Also, for materials that do not have an expiration date, faster delivery is not necessary. In these cases, predictability is more valuable. On the other hand, some participants deliver 24 hours per day and some of these deliveries need to be made within a specified 2-hour window. For these shippers, fast transit time is very important. Also, some customers are willing to pay a premium for delivery if it can be delivered sooner. In the latter cases, these shippers use trucking almost exclusively.

Participants also mentioned that fast transit time may be important, but that it is perhaps not always realistic and that longer transit times do not necessarily equate to a reduction in the level of service. Fast transit times also do not necessarily exclude the rail option. Faster transit arrangements can be made by rail, if necessary, but the process is more complicated than for truck.

5.2.8 Relationship with the Carrier

Relationship with the carrier was considered important or extremely important by 78% of the participants and respondents. Of the 76 responses, 43% rated the relationship with the carrier as extremely important and 35% rated it important. Many participants felt that the relationship with the carrier is as important as the relationship with the customer and will often, within a mode, determine which carrier is selected.

5.2.9 Tracking Service Provided

Tracking service provided was rated neutral to important as 52% of the respondents and participants rated this factor important or extremely important and 28% rated this factor neutral. This rating can be partly explained by the fact that most participants expected that the transportation carriers will be in a position to tell them where their shipments are. Most participants contact the transportation service provider to determine where the shipments to and from their facility are.

> Global Position System (GPS) is one of the most used systems for tracking freight goods. GPS in trucks is considered valuable, but shippers must contact the trucking company to obtain the tracking information. Similarly, UP has tracking devices that track rail cars.

5.2.10 Shipment Value

Shipment value was rated neutral to important as 59% of the respondents and participants rated this factor important or extremely important and 21% rated this factor neutral. Participants mentioned that shipment value is more of an insurance issue than a decision factor in mode choice. A more important consideration—that is to some extent correlated with shipment value—is the characteristics of the commodity shipped. For example, a lower value commodity, such as cardboard, is moved through intermodal movements. On the other hand, the preferred mode of transportation for beer is rail, because revenue margins are small. Other commodities, such as appliances, are shipped by both truck and truck and rail. Finally, computers are moved by truck because of concerns about loss and theft.

5.2.11 Shipment Size

Shipment size was rated neutral to important as 54% of the respondents and participants rated this factor important or extremely important and 19% rated this factor neutral. For some participants, shipment size was an important factor in their mode choice decision. For example, these participants mentioned that if the shipment is larger than 13 feet it cannot be shipped by rail. On the other hand, shippers with an in-house trucking fleet mentioned that the only reason for using/considering another mode would be if the size of the shipment does not allow the company to move it with its own trucking fleet.

5.2.12 Distance

Distance was rated overall as neutral to important as 19% of the respondents and participants rated this factor extremely important, 35% rated this factor important, and 22% rated this factor neutral. Participants mentioned that the Class I railroads seem to prefer to move unit train loads over long distances. They argued that the size or volume of the shipment is thus the dictating factor for moving the shipment by road or rail—not distance. Participants also mentioned that a team driver arrangement allows for the delivery of a shipment anywhere in the U.S. by truck in 48 hours. Distance is therefore also not a major factor for domestic shipments.

5.2.13 Flexible Services to Many Markets

Flexible services to many markets was rated overall as neutral to important as 20% of the respondents and participants rated this factor as extremely important, 27% rated the factor as important, and 29% rated the factor neutral. Participants that rated this factor as important considered the availability of a water mode necessary to provide viable and flexible access to more markets for their product.

5.2.14 Specialized Equipment

Specialized equipment was rated overall neutral as 20% of the respondents and participants rated this factor as extremely important, 21% rated the factor as important, 25% rated the factor neutral, and 21% rated the factor unimportant. Participants that rated this factor as important mentioned that the characteristics of their product determined the mode chosen. For example, some commodities require the use of special containers that can be moved only by truck or rail or in some instances barges, when the containers are very heavy. On the other hand, participants with an in-house trucking fleet mentioned that there is a risk when using a for-hire carrier that the truck may not have the equipment necessary to offload the product. The company's in-house fleet is equipped with forklifts to offload their product.

5.3 Concluding Remarks

Although one of the objectives of engaging freight stakeholders in this study was to improve the understanding of the characteristics or attributes that businesses consider when procuring freight transportation services, some stakeholders cautioned against focusing on individual modes. Rather, they argued that the focus should be on the characteristics or attributes of a combination of modes that will meet customer expectations. For example, companies such as UPS use multiple modes without the customer being aware of the different modal combinations. These participants argued that the individual modes are less relevant. Instead, the key issue is how a combination of modes meets customers' expectations. The emphasis should thus be on ensuring an efficient multimodal freight transportation system in Texas. The next chapter describes Texas's transportation infrastructure that facilitates the movement of freight, including major commodities, tonnage, and values moved.

Chapter 6. Truck, Rail, Water, and Air Freight Infrastructure: *What Moves Freight?*

Texas's transportation system comprises over 1,000 port facilities and 10 deepwater ports, 10,743 miles of railways, almost 80,000 miles of centerline state-maintained highways, 200,000 miles of pipeline infrastructure, 8 international airports that facilitate the movement of freight in passenger carriers, as well as 1 dedicated freight airport at the inland port of Alliance, and 11 land border ports of entry between Texas and Mexico. This chapter of the report describes Texas's transportation infrastructure that facilitates the movement of freight, including major commodities, tonnage, and values moved.

6.1 Texas's Freight Transportation Infrastructure—An Overview

Texas's economy depends on its transportation infrastructure to facilitate trade and the economic prosperity of the state. Table 6.1 describes the current freight mix by transport mode, both in tons and value, and projects volume and value to 2040.

Table 6.1 indicates that in 2007 Texas shipped an estimated $2,318 billion of freight within, to, and from the state ($281 billion in freight via multiple modes, $1,379 billion via truck, and $166 billion via rail). This figure translated into freight movements of 131 million tons by multiple modes, 1,257 million tons by truck, and 336 million tons by rail. Together truck and rail accounted for more than 64% of the total freight tonnage moved in 2007 within, to, and from Texas (FHWA, 2010).

Furthermore, by 2040 Texas will ship an estimated $5,515 billion in freight within, to, and from the state ($1,224 billion in freight via multiple modes, $3,143 billion via truck, and $296 billion via rail). This figure translates into freight movements of 223 million tons by multiple modes, 2,064 million tons by truck, and 546 million tons by rail. Truck, rail, and multimodal freight together will account for 73% of the total freight tonnage moved in 2040 within, to, and from Texas compared to 69% in 2007 (FHWA, 2010).

Table 6.1: Texas Freight Summary by Mode

Mode	2007	% of Total	2040	% of Total	% Change
Tons (millions)					
Truck	1,257.1	51%	2,063.9	53%	64%
Rail	335.7	14%	546.2	14%	63%
Water	91.7	4%	144.8	4%	58%
Air (includes Truck & Air)	0.7	0.03%	2.4	0%	236%
Multiple modes & mail	131.1	5%	222.9	6%	70%
Pipeline	485.2	20%	624.7	16%	29%
Other and unknown	48.7	2%	77.6	2%	59%
No domestic mode	134.9	5%	185.9	5%	38%
Total	2,485.3	100%	3,868.4	100%	56%
Dollars (billions)					
Truck	$1,379.0	60%	$3,143.0	57%	128%
Rail	$165.5	7%	$296.3	5%	79%
Water	$42.0	2%	$63.4	1%	51%
Air (include truck-air)	$87.9	3.79%	$338.9	6%	285%
Multiple modes & mail	$280.9	12%	$1,122.4	20%	300%
Pipeline	$236.8	10%	$311.0	6%	31%
Other and unknown	$64.5	3%	$156.2	3%	142%
No domestic mode	$61.0	3%	$84.0	2%	38%
Total	$2,317.6	100%	$5,515.2	100%	138%

Source: FHWA Freight Analysis Framework (FAF^3) 2007–2040

Note: Data shows combined total flows of commodities originating from Texas and destined for Texas, including both domestic and foreign shipments. Dollars are 2007 values, based on the earliest report FAF^3 year.

6.2 Texas's Highway System

In 2007, TxDOT maintained 79,696 centerline miles of road that comprise:

- 3,233 centerline miles of interstate highways,
- 12,101 centerline miles of U.S. highways,
- 16,273 centerline miles of state highways,
- 40,988 centerline miles of farm-to-market and ranch-to-market roads,
- 6,761 centerline miles of frontage roads, and
- 339 centerline miles of park roads (TxDOT, 2007).

Texas's highway system facilitates the movement of truck shipments within, from, to, and through the state. Figure 6.1 graphs the truck shipments in terms of millions of tons that were shipped within, from, and to the state in 2007 and the anticipated truck tonnage moved by

2040. Figure 6.1 evidences that truck tonnage within Texas is estimated to increase by almost 60% between 2007 and 2040, and more than double for out-of-state movements. Truck movements into Texas are also expected to increase by 75% within the same time period (FHWA, 2010).

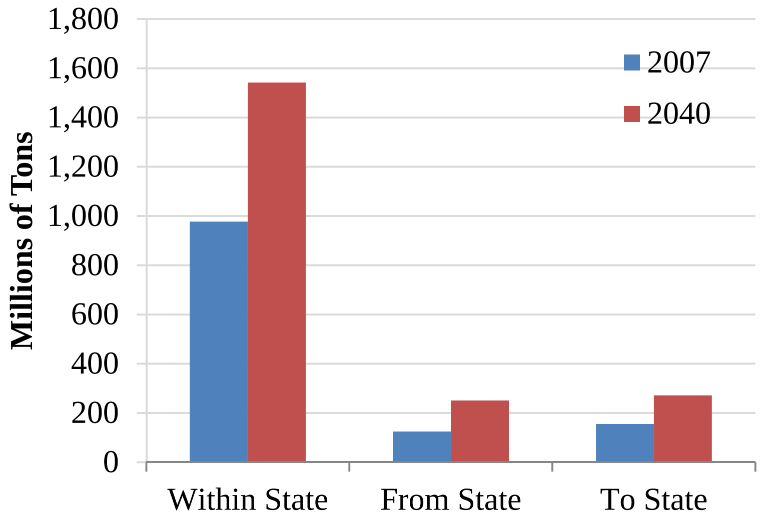


Figure 6.1: Truck Tonnage Moved in Texas (Millions of Tons)

Table 6.2 illustrates goods movement by tonnage within, to, and from Texas in 2007, and projections made for 2040. Non-metallic mineral products (12%) topped the list of commodities moved by trucks in 2007, followed by gravel (9%), waste/scrap materials (7%), gasoline (6%), cereal grains (6%), and coal, natural sands, and fuel oils also at 5%. The biggest increase in goods movement from 2007 to 2040 is the transport of mixed freight (164%). According to the Standard Classification of Transported Goods (SCTG), mixed freight is composed of items (including food) for grocery and convenience stores; supplies and food for restaurants and fast food chains; hardware or plumbing supplies; office supplies; and miscellaneous goods. Thus mixed freight joins the list of top five commodities projected to be transported in Texas by 2040. The other major commodities include non-metallic mineral products (11%), gravel (7%), waste/scrap material (6%), cereal grains (6%), and gasoline, natural sands, and mixed freight at 5%.

Table 6.3 also illustrates the value of commodities moved by trucks in Texas in 2007, and projections made for 2040. Machinery (13%), electronics (12%), motorized vehicles including parts (8%), mixed freight (6%), and articles of base metals (5%) make up the top five commodities by value transported in Texas in 2007. By 2040, the fastest growing commodities (by value) to be transported by trucks include chemical products (275%), miscellaneous manufactured products (260%), mixed freight (157%), machinery (149%), and textiles and leather products (118%). The top five commodities (by value) projected to be transported by trucks by 2040 include machinery (14%), electronics (11%), mixed freight (7%), motorized vehicles including parts (6%), and miscellaneous manufactured products and chemical products (5%).

Table 6.2: Major Commodities (in millions of tons) Moved by Trucks in Texas (2007–2040)

Commodity	2007	% of Total	2040	% of Total	% Change
Nonmetal min. prods.	154.1	12%	227.6	11%	48%
Gravel	110.7	9%	149.3	7%	35%
Waste/scrap	84.5	7%	131.0	6%	55%
Gasoline	72.2	6%	100.7	5%	39%
Cereal grains	70.1	6%	118.9	6%	70%
Coal	62.5	5%	92.2	4%	48%
Natural sands	61.5	5%	96.8	5%	57%
Fuel oils	56.8	5%	85.1	4%	50%
Basic chemicals	55.0	4%	86.2	4%	57%
Coal	52.5	4%	55.9	3%	6%
Other foodstuffs	41.3	3%	80.5	4%	95%
Base metals	38.5	3%	52.8	3%	37%
Mixed freight	36.7	3%	96.8	5%	164%
Articles-base metal	32.0	3%	45.0	2%	41%
Wood prods.	28.3	2%	29.6	1%	5%
All Other	300.5	24%	615.5	30%	105%
Total	1257.1	100%	2,063.9	100%	64%

Source: (FHWA, 2010)

Table 6.3: Major Commodities (in Billions of Dollars) Moved by Trucks in Texas (2007–2040)

Commodity	2007	% of Total	2040	% of Total	% Change
Machinery	$175.3	13%	$437.2	14%	149%
Electronics	$162.0	12%	$349.6	11%	116%
Motorized vehicles	$108.8	8%	$204.1	6%	88%
Mixed freight	$82.3	6%	$211.8	7%	157%
Articles-base metal	$74.8	5%	$101.1	3%	35%
Plastics/rubber	$59.7	4%	$128.3	4%	115%
Gasoline	$53.3	4%	$73.5	2%	38%
Base metals	$52.5	4%	$73.7	2%	41%
Coal	$47.4	3%	$76.9	2%	62%
Basic chemicals	$46.2	3%	$76.6	2%	66%
Misc. mfg. prods.	$45.3	3%	$163.3	5%	260%
Other foodstuffs	$45.1	3%	$87.3	3%	94%
Chemical prods.	$43.1	3%	$162.0	5%	275%
Textiles/leather	$40.0	3%	$87.1	3%	118%
Meat/seafood	$36.3	3%	$67.2	2%	85%
All Other	$306.8	22%	$843.3	27%	175%
Total	$1,379.0	100%	$3,143.0	100%	128%

Source: (FHWA, 2010)

6.3 Texas's Rail System

Rail is a critical component of Texas's transportation infrastructure. Texas has 10,743 miles of railway, most of which is operated by UP, Burlington Northern Santa Fe (BNSF), and Kansas City Southern (KCS) Railway[17]. Rail serves major border ports of entry, including Laredo, El Paso, and Brownsville, and key nodes in San Antonio, Houston, Dallas, Fort Worth, and Amarillo (AAR, 2008). Table 6.4 illustrates the national ranking of Texas on key rail statistics in 2006 and 2008.

Table 6.4: Texas's Ranking on Key Statistical Indicators (2006 and 2008)

Key Indicator	Statistic-2006	Rank-2006	Statistic-2008	Rank-2008
Number of Freight Railroads	44	2nd	44	2nd
Total Rail Miles				
Excluding Trackage Rights	10,600	1st	10,743	1st
Including Trackage Rights	14,965	-	14,982	-
Total Rail Tons	395,222,630	5th	384,405,761	5th
Originating	115,132,816	2nd	96,626,971	4th
Terminating	218,294,813	1st	210,282,792	1st
Total Rail Carloads	10,141,437	2nd	9,425,554	2nd
Originating	2,218,220	4th	1,944,989	4th
Terminating	3,245,459	3rd	3,096,548	3rd
Total Railroad Employment	17,394	1st	17,251	1st
Total Wages by Rail Employees	$1,211,040,000	1st	1,283,800,000	1st

Source: Association of American Railroads, 2006 and 2008

Figure 6.2 illustrates the rail shipments in terms of millions of tons that were shipped within, from, and to the state in 2007 and the anticipated rail tonnage moved by 2040. Between 2007 and 2040, rail tonnage moved within the state will increase by an estimated 75%, rail tonnage moved from the state will increase by 80%, and rail tonnage moved to the state will increase by 48% (FHWA, 2010). Increased rail freight movements raise concerns about the need for modernizing and enhancing rail system capacity, inadequate capacity to accommodate passenger trains on freight rail track, landside access concerns to rail intermodal yards, safety and security at at-grade road-rail crossings, and inadequate coordination among states to ensure an efficient rail system that will facilitate rail freight shipments passing through multiple states.

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[17] These three Class I railroads operated on 12,180 (81%) of the state's total track miles in 2008, including trackage rights.

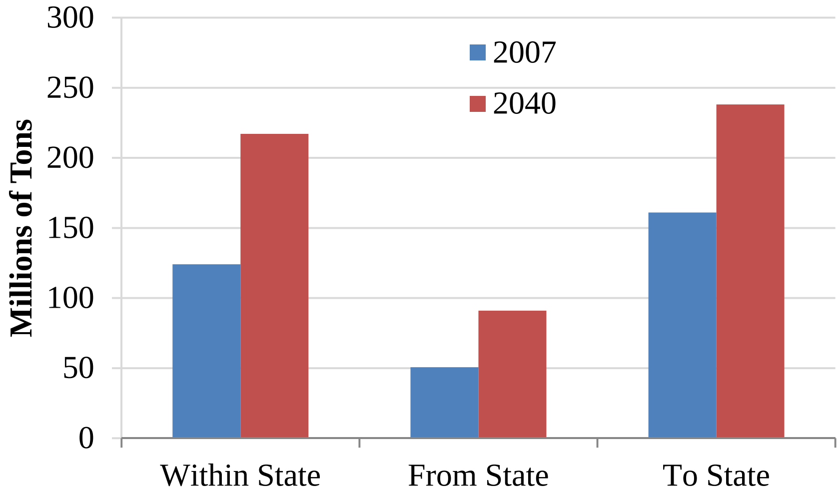
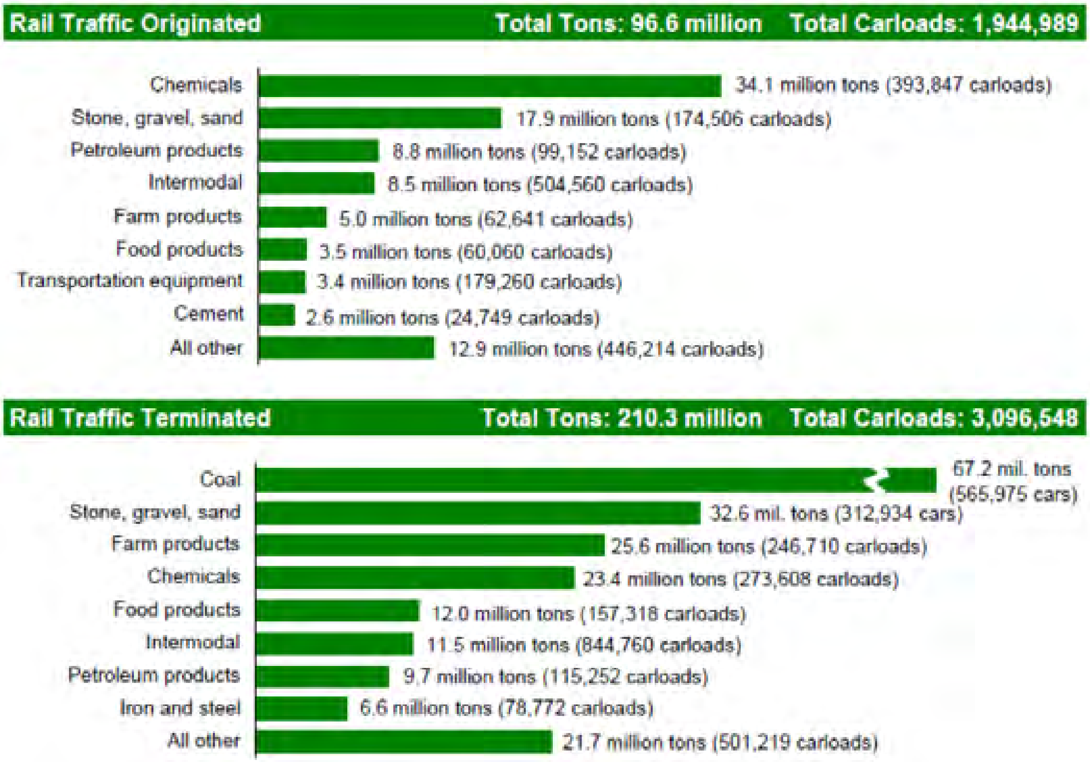


Figure 6.2: Rail Tonnage Moved in Texas (Millions of Tons)

Figure 6.3 illustrates current major commodities that originated and terminated in Texas in 2008. As is evident from Figure 6.3, 35% of the rail tonnage originating in Texas in 2008 was chemicals, 18% was stone, gravel, and sand, 9% was petroleum products, and 9% was intermodal traffic. In terms of rail tonnage terminating in Texas, 32% was coal, 16% was stone, gravel, and sand, 12% was farm products, and 11% was chemicals (AAR, 2010).



Source: AAR, 2010

Figure 6.3: Rail Commodities Originating and Terminating in Texas (2008)

Table 6.5 summarizes available data for the four largest commodity groups—in terms of tonnage—originating in Texas in 1991, 1996, 2006, and 2008. As is evident from Table 6.5, the freight tonnage of most commodity groups experienced a decline between 2006 and 2008—the exception is mixed freight, which experienced an increase. Prior to the decrease, petroleum products posted the largest percentage increase at 60% between 1991 and 2006.

Table 6.5: Major Railroad Commodity Groups Originating in Texas

Commodity Group	**1991**		**1996**		**2006**		**2008**		**% Change, 1991–2008**
	Tons	% Total	Tons	% Total	Tons	% Total	Tons	% Total	
Chemicals	27,558,824	32	33,568,992	33	39,527,390	34	34,060,894	35	24
Non-Metallic Minerals	17,473,657	20	20,954,179	21	26,891,452	23	18,916,900	20	8
Petroleum Products	6,112,348	7	8,317,200	8	9,760,498	9	8,798,656	9	44
Mixed Freight	6,062,817	7	7,042,740	7	8,055,400	7	8,465,760	9	40
All Other Commodities	24,210,205	28	32,013,771	31	30,898,076	27	26,384,761	27	9
Total	81,417,851	100	101,896,882	100	115,132,816	100	96,626,971	100	19

Source: AAR, 2010

Table 6.6 summarizes the largest commodity groups—in terms of tonnage—terminating in Texas in 1991, 1996, 2006, and 2008. Growth in shipments of coal, non-metallic minerals (e.g., stone and aggregates), and farm products coincide with heightened demand for energy, roads, and food from Texas's increasing population. After 2006, tonnage of chemicals terminating in Texas continued to increase while the other major commodity groups decreased because of increased chemical production after a series of large-scale investments. Freight rail shipments of chemicals terminating in Texas are exported from Texas ports to international markets or used as inputs in the production of other chemicals or manufactured goods.

Table 6.6: Major Railroad Commodity Groups Terminating in Texas

Commodity Group	1991		1996		2006		2008		% Change 1991–2008
	Tons	% Total	Tons	% Total	Tons	% Total	Tons	% Total	
Coal	39,997,651	28	49,052,357	29	68,164,252	31	67,186,336	32	68
Non-Metallic Minerals	19,579,387	14	24,934,767	15	39,724,558	18	34,294,664	16	75
Farm Products	19,373,633	14	21,627,685	13	25,900,856	12	25,550,893	12	32
Chemicals	18,218,919	13	18,945,148	11	23,042,975	11	23,355,435	11	28
Food Products	9,782,907	7	10,010,216	6	12,289,637	6	12,005,696	6	23
All Other Commodities	33,774,473	24	43,853,394	26	49,172,535	22	47,889,768	23	42
Total	140,726,970	100	168,423,567	100	218,294,813	100	210,282,792	100	49

Source: AAR, 2010

Table 6.7 illustrates the commodity tonnage that moved through Texas between 2002 and 2007. Mixed-freight is the largest commodity by tonnage traveling through Texas that is neither originating nor terminating in Texas. Consistent with the pattern seen for other types of freight movement, the tonnage of mixed-freight declined in 2007. However, growth continued in the trough movements of the other top five commodities as shown in Table 6.7.

Table 6.7: Major Commodities (in millions of tons) Moving Through Texas (2002–2007)

Commodity	2002	2003	2004	2005	2007
Mixed	32.40	34.70	37.70	40.20	36.20
Food	7.49	7.03	7.45	9.87	10.30
Coal	3.29	2.63	3.69	3.66	9.99
Farm products	6.77	7.63	6.86	6.69	8.38
Hazmat	4.40	3.95	5.75	6.35	6.60
Chemicals	5.25	5.55	5.14	5.27	5.01
Transport equipment	2.77	2.54	2.76	3.13	3.66
Paper, pulp	3.29	3.38	3.48	3.73	3.58
Non-metallic minerals	2.73	2,18	3,08	3.66	3.26
Metal products	2.51	2.96	3.26	2.79	3.20
Clay, concrete, glass, stone	1.23	1.23	1.34	1.65	1.72
Lumber and wood products	1.49	1.59	2.09	2.08	1.64
Petroleum or Coal Products	0.99	1.29	1.34	1.47	1.55
Shipping Containers	1.01	1.13	1.46	1.92	1.40

Source: STB Waybill Data; 2006 data excluded due to inconsistent commodity categories and outliers

6.4 Texas's Marine Ports

Texas is home to 9 of the nation's top 100 marine ports when accounting for cargo volume. Texas has more than 970 wharves, piers, and docks for handling freight located on 271 miles of deep-draft channels and 750 miles of shallow-draft channels. The Port of Houston, Texas's largest port, ranked second in terms of total trade volume and first in terms of international trade volume in the U.S. (American Association of Port Authorities, 2007). Table 6.8 illustrates the tonnage handled by Texas's deep-draft ports in 1990 and 2008.

Table 6.8: Tonnage Handled by Texas Deep-Draft Ports, 1990–2008

Port	1990	2008	% Change 1990–2008
Beaumont	26,729,000	69,483,539	160
Brownsville	1,372,000	5,669,445	313
Corpus Christi	60,165,000	76,786,173	28
Freeport	14,526,000	29,842,295	105
Galveston	9,620,000	9,781,368	2
Houston	126,178,000	212,207,921	68
Port Arthur	30,681,000	31,752,742	3
Port Lavaca Point Comfort	5,097,000	10,317,614	102
Port of Orange	709,000	676,735	-5
Texas City	48,052,000	52,606,030	9

Source: U.S. Corps of Engineers Waterborne Commerce Statistics Center

Texas's ports are primarily bulk cargo ports, transporting commodities such as dry and liquid bulk, chemicals, petroleum, grains, and forest products. Only the Ports of Houston, Freeport, and Galveston regularly handle containerized cargo[18]. Several Texas ports, including the Ports of Beaumont and Corpus Christi, move a considerable amount of military cargo (Kruse et al., 2007). Texas's seaports contribute substantially to the state's economic vitality and the flow of goods.

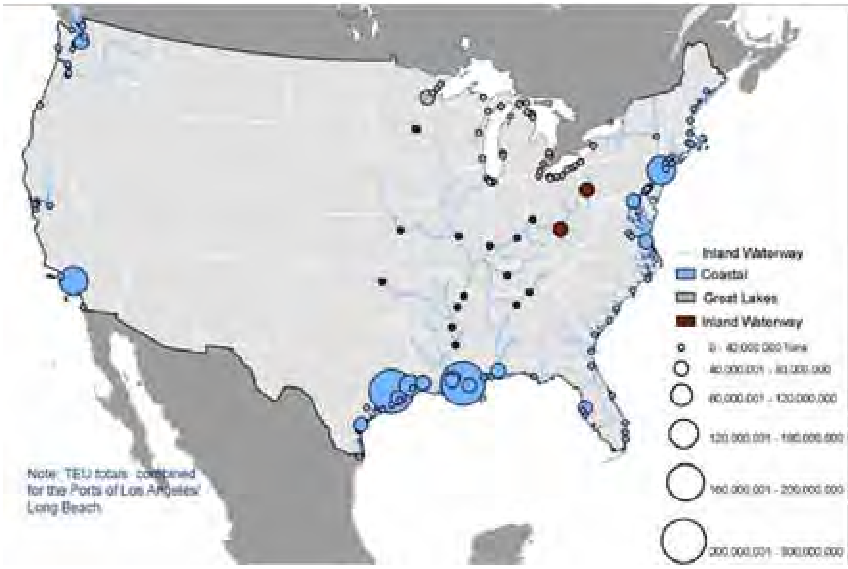
- Port of Beaumont—The Port of Beaumont Navigation District was established in 1949 and currently encompasses approximately 150 square miles of land, including the City of Beaumont, and is accessible via the federally maintained Sabine-Neches Ship Channel. The facilities at the port include heavy lift cranes, forklifts, and other heavy equipment for handling cargo.
- Brownsville—The Port of Brownsville is governed by the Brownsville Navigation District, a political subdivision of the State of Texas. It provides the services to facilitate the international movement of goods between Mexico and the United States via the Gulf Intracoastal Waterway. The port opened in 1936 and currently serves over 230 companies. Activities include construction of offshore drilling rigs,

[18] In addition, Beaumont, Corpus Christi, Port Arthur, and Port Lavaca have handled some containers in the last three years. The container movements at Beaumont, Port Arthur, and Corpus Christi are usually tied either to military shipments or project cargoes for offshore developments.

ship repairing and dismantling steel fabrication, boat construction, rail car rehabilitation, liquefied petroleum gas storage/distribution, waste oil recovery, and bulk terminals for miscellaneous liquids, grain handling, and storage.

- Port Corpus Christi—Corpus Christi has one of the deepest seaports along the Gulf of Mexico, with a depth of 45 feet along its navigational channel and is second in the amount of tonnage moved at Texas seaports. Port services include an extensive line of heavy equipment such as heavy lift docks, cranes, and forklifts.
- Freeport—The Port Freeport came into being after construction of the first jetty system in Freeport, Texas. It is located just three miles from deep water, and is one of the most accessible ports on the Gulf Coast. Its 400-foot-wide, 45-foot-deep channel handles approximately 3,000 vessel calls (including barge/tug calls), and over 75,000 TEUs annually.
- Galveston—The Port of Galveston's inbound trade consists mainly of cement, fruits, and vehicles, while the outbound trade is mostly grain.
- Port of Houston—Texas's busiest and largest seaport in terms of tonnage and commercial value is the Port of Houston. The Port of Houston is a 25-mile-long complex of public and private shipping agencies and facilities located just a few hours from the Gulf of Mexico. The main commodities include grain, iron, and steel, and container shipments. As of 2008, the Port of Houston ranks first in the U.S. in foreign waterborne tonnage, second in the U.S. in total tons, seventh in terms of container movements in the U.S., and tenth in the world in total tonnage. U.S. Corps of Engineers statistics showed a constant increase in total tonnage handled by the Port of Houston until 2007 when tonnage started to decrease. By 2008, tonnage declined to 212.2 million tons from a high of 222 million tons in 2006.
- Port of Port Arthur—Port Arthur is equipped to handle any type break bulk general cargo, including forest products; iron and steel products; dry bulk cargoes; project and military cargo; and bagged and bailed goods. The Port is connected to the KCS Railroad providing direct intermodal service to and from major markets of the United States and Canada.
- Port of Port Lavaca-Point Comfort—This port is located near the midpoint of the Texas Gulf Coast, at the western terminus of the Matagorda ship channel. The port is owned by the Calhoun County Navigation District and primarily serves local industries and manufacturers.
- Port of Orange—The Port of Orange is a deep-water port currently being equipped to handle intermodal freight transport under the Transmodal Marine Yard project.
- The Port of Texas City—This port is the fourth largest in Texas by tonnage handled. The port has been in operation since 1893 and is located on Galveston Bay, 11 miles inland from the Gulf of Mexico. A number of oil refineries and chemical processing plants are located on port property and nearby, with an extensive network of pipelines connecting the docks to these refineries.

Marine ports are located along and at the ends of waterways, and serve as entry and departure points for international trade (see Figure 6.4). Increased waterborne trade raises concerns about ports being capable of handling increasingly larger ships, landside docks not providing sufficient access to an increased volume of ships, and dray operations[19] not being able to keep up with the extra demand (AASHTO, 2007a). Environmental and community constraints sometimes limit port infrastructure development, adding to the challenge.



Source: Horsley, 2007

Figure 6.4: U.S. Ports by Tonnage, 2004

Table 6.9 shows the projected increase in tonnage for Texas ports. Table 6.10 shows the anticipated increase in intermodal containers moved through Texas's deep water ports given three growth scenarios. As is evident from Tables 6.9 and 6.10, both tonnage and the number of containers handled by Texas ports are anticipated to increase significantly between 2008 and 2035, i.e., on average 63 and 359%, respectively.

[19] Freight is primarily transported to and from these ports by truck, although a few direct rail connections are in place to the Turning Basin and Barbours Cut Terminals at the Port of Houston and the Port of Corpus Christi.

Table 6.9: General Cargo Forecasts for Largest Texas Ports by Tonnage, 2008–2035

	2008 (tons)	2035 (tons)			Percent Change		
Port		**Low-Growth**	**High-Growth**	**Average**	**Low-Growth**	**High-Growth**	**Average**
Beaumont	81,383,531	128,292,792	131,742,692	130,017,742	57.6%	61.9%	59.8%
Brownsville	5,306,311	10,066,802	10,894,183	10,480,493	89.7%	105.3%	97.5%
Corpus Christi	85,859,440	128,342,706	185,781,802	157,062,254	49.5%	116.4%	82.9%
Freeport	36,000,000	53,812,806	58,276,372	56,044,589	49.5%	61.9%	55.7%
Galveston	5,911,882	8,837,082	11,215,654	10,026,368	49.5%	89.7%	69.6%
Houston	225,000,000	354,689,431	364,227,325	359,458,378	57.6%	61.9%	59.8%
Orange	681,982	1,019,427	1,260,129	1,139,778	49.5%	84.8%	67.1%
Port Arthur	29,261,601	43,740,246	47,368,332	45,554,289	49.5%	61.9%	55.7%
Port Lavaca-Point Comfort	4,600,000	6,876,081	7,446,425	7,161,253	49.5%	61.9%	55.7%
Texas City	53,953,540	80,649,761	87,339,349	83,994,555	49.5%	61.9%	55.7%
Victoria	3,035,978	4,538,180	4,902,769	4,720,475	49.5%	61.5%	55.5%
Total	**530,994,265**	**820,865,315**	**910,455,032**	**865,660,174**	**54.6%**	**71.5%**	**63.0%**

* The 2008 data shown in Table 6.9 differs from the 2008 data shown in Table 6.10, because the Cambridge Systematics (CS) report used different baseline 2008 data for their forecasts. For the Ports of Beaumont, Orange, and Port Arthur, CS used 2007 American Association of Port Authorities (AAPA) tonnage data only. For the rest of the ports, CS used data reported by the ports for CY 2008, which is different from the 2008 data reported by the AAPA and the Corps.

Source: Cambridge Systematics, Inc, 2009

Table 6.10: Forecast Container Increases at Texas Ports (in TEUs)

	2008	2035			Percent		
Port		**Low-Growth**	**High-Growth**	**Average**	**Low-Growth**	**High-Growth**	**Average**
Beaumont	3,280	4,407	4,407	4,407	34.36%	34.36%	34.36%
Brownsville	0	2,658	2,658	2,658	N/A	N/A	N/A
Corpus Christi	0	856,538	1,064,096	960,317	N/A	N/A	N/A
Freeport	71,900	800,000	800,000	800,000	1012.66%	1012.66%	1012.66%
Galveston	8,666	20,822	45,104	32,963	140.28%	420.47%	280.37%
Houston	1,794,309	4,311,277	9,338,893	6,825,085	140.28%	420.47%	280.37%
Orange	0	4,681	4,681	4,681	N/A	N/A	N/A
Port Arthur	170	408	885	647	140.28%	420.47%	280.37%
Total	**1,878,325**	**6,000,792**	**11,260,724**	**8,630,758**	**219.48%**	**499.51%**	**359.49%**

Source: Cambridge Systematics, Inc, 2009

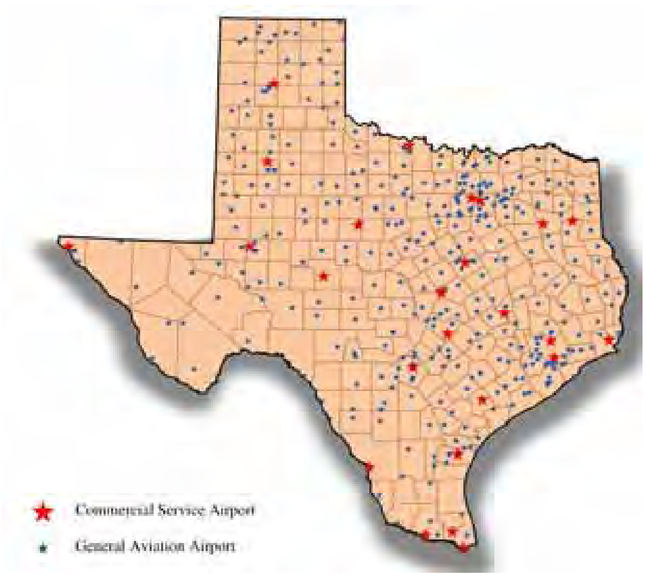
Texas ports, rail lines, and highway corridors are anticipated to be significantly impacted by the Panama Canal expansion expected to be completed and operational in 2014. Furthermore, the Port of Houston will likely be the most impacted because of its partnership with the Panama Canal Authority that aims to increase trade and because it is the primary container port along the Texas coast. Currently, only Port Freeport is able to handle the larger, post-Panamax ships expected to travel through the expanded Panama Canal. A post-Panamax containership can be up to 366 m (1,200 ft) long and 49 m (160 ft) wide and have a maximum 15-m (50-ft) draft with capacity of up to 12,000 TEUs (Panama Canal Authority, 2006).[20]

Finally, the Gulf Intracoastal Waterway extends 423 miles along the Texas coast, facilitating the movement of commodities, such as coal, petroleum, chemicals, and grain to other Gulf Coast ports (Kruse et al., 2007). In 2004, 116,243 barges carried 72.3 million short tons of cargo on the Gulf Intracoastal Waterway (TxDOT, 2007).

6.5 Texas's Airports

Texas is home to more than 400 international, municipal, regional, county, and other smaller local airports (see Figure 6.5). Of these 400 airports, 25 are classified as commercial service airports and 266 are considered general aviation airports (Wilbur Smith Associates, 2006). Texas's economy depends on its airport infrastructure to facilitate trade and the economic prosperity of the state. Nine of Texas's airports qualify as "cargo" airports because they land more than 100 million pounds of freight per year. These airports include the eight international commercial service airports in Dallas/Fort Worth, Houston, San Antonio, Austin, El Paso, Laredo, Harlingen, and Lubbock (Federal Aviation Administration, 2007). Texas's only dedicated cargo airport, Alliance Airport, opened in 1989 and is located in the Alliance Texas Logistics Park in Fort Worth. Port San Antonio's Kelly Field (SKF) has an 11,500 foot (3,505 meter) runway that can handle all heavy lift aircraft, and can be served by both truck and rail. The airfield is operated under a joint use agreement with Lackland Air Force Base (Port of San Antonio, 2010).

[20] Panama Canal Authority, Proposal for the Expansion of the Panama Canal: Third Set of Locks Project, April 24, 2006.



Source: Wilbur Smith Associates, 2006

Figure 6.5: Texas's Airports

Although the remaining 16 commercial service airports[21] also handle freight destined for the region or local area, the volume of freight handled at these airports is not adequate to allow their classification as cargo airports. Data is not readily available on the volume or value of freight handled at the general aviation airports, but it is generally believed that freight movements to these airports are limited to package deliveries (Personal Communication with TxDOT Aviation Division).

Air freight tends to be very high value. In Texas, the 0.03% market share (approximately 0.7 million tons) by weight of air and air and truck shipments represented 4% of the market share by value in 2007. Figure 6.6 illustrates the value of air and air and truck shipments in terms of millions of dollars that were shipped within, from, and to the state in 2007 and the anticipated air and air and truck values that will be shipped by 2040. By 2040, the air tonnage moved within, to, and from the state will approach an estimated 2.4 million tons, translating into an increase in the value of these shipments from approximately $88 billion in 2007 to $339 billion in 2040 (FHWA, 2010).

[21] The remaining commercial service airports are Abilene Regional, Rick Husband Amarillo International, Southeast Texas Regional, Brownsville/South Padre Island International, Easterwood Field, Corpus Christi International, Dallas Love Field, Killeen-Fort Hood Regional, William P. Hobby, East Texas Regional, McAllen Miller International, San Angelo Regional/Mathis Field, Tyler Pounds Field, Victoria Regional, Waco Regional, and Sheppard Air Force Base/Wichita Falls Municipal.

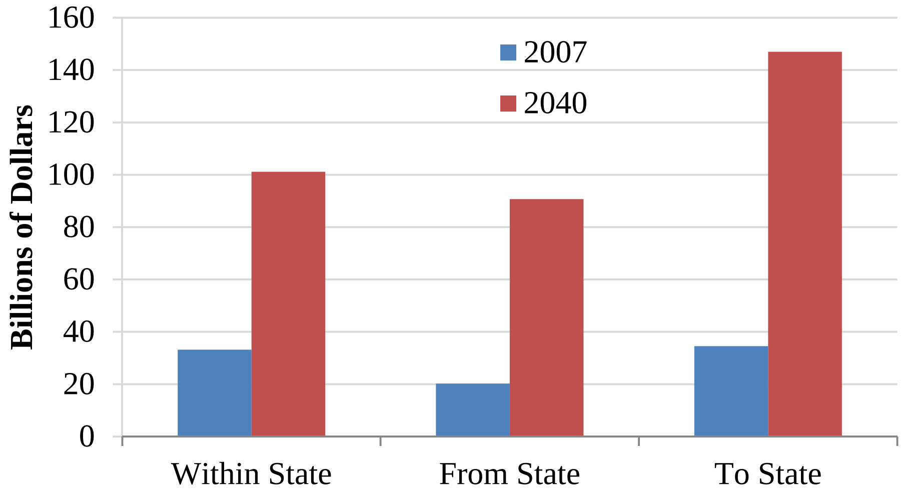


Figure 6.6: Value of Air Shipments at Texas Airports ($ Billions)

Because of the types of cargo moved by air (e.g., high value electronics) and the design of air cargo containers, trucking tends to be the preferred mode due to time considerations and flexibility in accommodating different load sizes. Uncongested landside access to airports will thus become even more important in the future. Table 6.11 illustrates the importance of good highway access and the truck mode to airports. As shown, most of Texas's air cargo airports are located within 5 miles of a U.S. Interstate highway and most airports—for which information were available—have truck terminals onsite or nearby. Freight forwarder warehouses and distribution facilities are also usually clustered in close proximity to airports.

Table 6.11: Distance between Texas Airports and Rail, Interstate, and Truck Terminal Facilities

	Distance to Nearest		
Airport	**Rail Terminal**	**Interstate Highway**	**Truck Terminal**
Austin-Bergstrom International	50	5	2
Brownsville/South Padre Island	2	4	Onsite
Dallas/Ft Worth International	30	1	Onsite
El Paso International	6	2	NA
Fort Worth Alliance	3	2	NA
Houston	4	6	20
Laredo International	3	onsite	NA
San Antonio International	5	1	2
Valley International	3	2	3

Source: Air Cargo World, 2007

Truck freight movement[22] to and from airports is also one of the few types of freight traveling during peak traffic hours (Hall, 2002), thus interacting with commuter and automobile traffic. This type of freight movement aggravates congestion and often creates bottlenecks when automobile and freight trucks share highways and access roads serving airports.

6.6 Inland Ports

Texas's most significant inland port is the Alliance Texas Logistics Park, a 17,000-acre master-planned intermodal facility. The large industrial park has air, rail (i.e., BNSF Intermodal Facility), and truck service (with access to both IH 35 and FM 156) and is located 15 miles from Fort Worth and Dallas. The inland port houses numerous developments, including a business park, a technology complex, and a 1,500-acre distribution center. The business park is home to over 140 companies. The 735-acre intermodal yard, operated by BNSF, was relocated from Dallas to Alliance. Alliance Airport is a 7,500-acre dedicated industrial airport, the first of its kind in the Western Hemisphere. The airport handles air cargo, corporate aviation, and military operations. The airport is also home to FedEx's Southwest Regional Sorting Hub, American Airlines aircraft maintenance center, and the Federal Aviation Administration's (FAA) Flight Standards District Office. Alliance Texas Logistics Park is a very successful planned intermodal port. From 1990 to 2006, it has generated $31.3 billion in economic activity and created almost 28,000 jobs (Alliance Texas, 2007).

6.7 Texas's Pipelines

Texas's pipeline infrastructure is vital to the transportation of fuel and chemicals in the state. Texas's total pipeline infrastructure totals nearly 200,000 miles, representing nearly 17% of all hydrocarbon pipeline mileage in the U.S. (Roop et al., 2000). Products moved by pipeline in Texas typically include crude oil, natural gas, liquefied petroleum, refined products, and petrochemicals. These products are transferred from pipeline system tanks to other storage tanks or refinery tanks; products are then transferred to surface and water transportation modes, including tanker trucks, rail tank cars, or barges or tankers, at terminal or refinery facilities. Figure 6.7 illustrates pipeline shipments in terms of millions of tons that were shipped within, from, and to the state in 2007 and the anticipated tonnage by 2040. Between 2007 and 2040, it is estimated that pipeline tonnage within the state will increase by 43%, tonnage moved from the state will increase by 17%, and tonnage moved to the state will decrease by 5% (FHWA, 2010).

[22] This report separates the air freight industry into five categories of carriers: integrated freight, non-integrated freight, passenger/freight, postal, and freight forwarders (Hall, 2002).

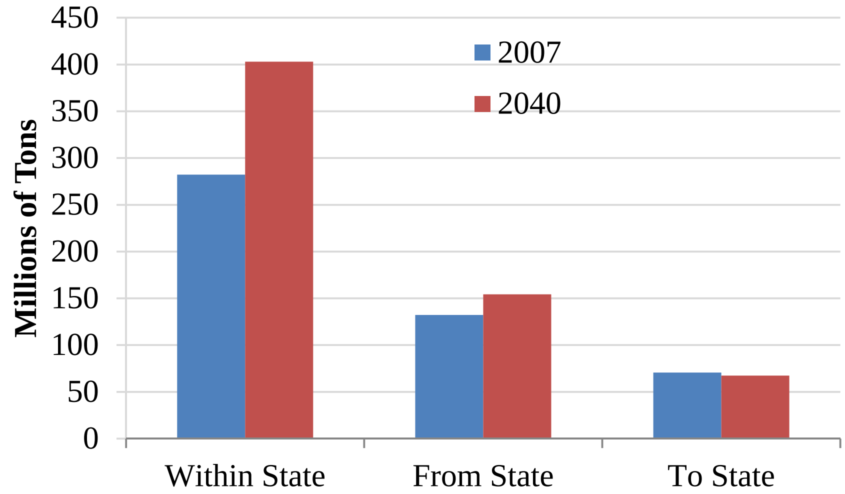
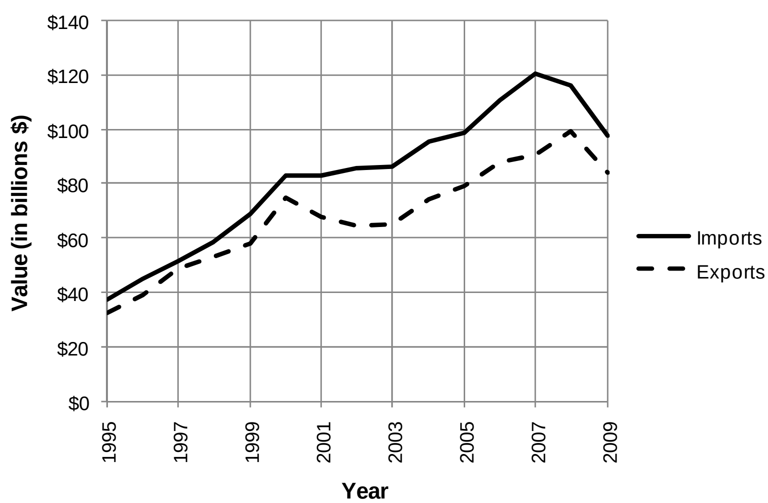


Figure 6.7: 2007 and 2040 Texas Shipments using Pipelines

6.8 Border Ports of Entry

When NAFTA went into effect on January 1, 1994, it enhanced already increasing trade levels between the U.S. and Mexico. Between 1995 and 2000, total U.S. surface trade with Mexico increased from $96.7 billion to $210.6 billion—a 118% increase. Between 2000 and 2009, U.S. surface trade with Mexico continued to increase to $251 billion in 2009. The increase in overall surface trade was led by imports from Mexico (see Figure 6.8).

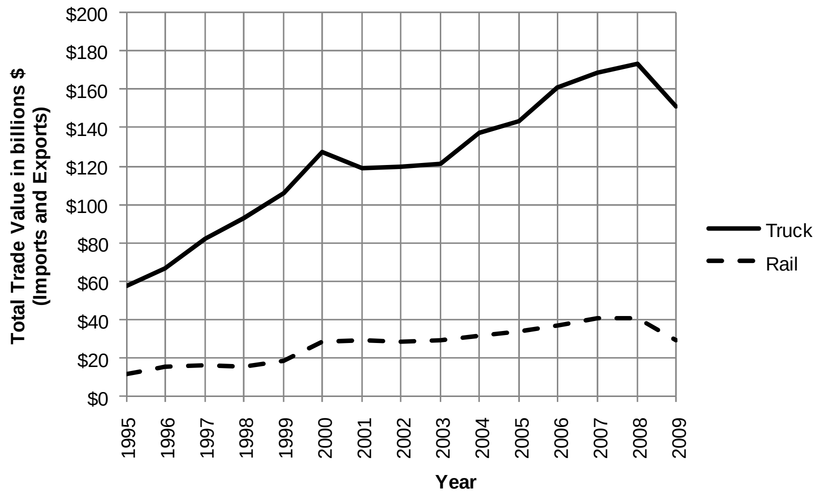


Source: Bureau of Transportation Statistics, Transborder Freight Data

Figure 6.8: Annual Import and Export Trade Values by All Land Transportation Modes

With its extensive transportation network and connections with Mexico, Texas has become the hub of international trade between the U.S. and Mexico. Eleven land ports of entry are sited along the border between Texas and Mexico: El Paso, Fabens, Presidio, Del Rio, Eagle

Pass, Laredo, Roma, Rio Grande City, Hidalgo, Progreso, and Brownsville. Trucks are the dominant mode of transportation for U.S. trade with Mexico. More than 80% of the total value of imports and exports were transported across the border by truck and less than 20% by rail since 1995 (see Figure 6.9).



Source: Bureau of Transportation Statistics, Transborder Freight Data

Figure 6.9: Total U.S.–Mexico Trade Value by Rail and Truck at Texas Border Crossings

Laredo and El Paso were ranked first and second both in terms of trade value that crossed the U.S.–Mexico border through Texas from 2000 to 2009 (North American Transborder Freight Data, 2010). In 2009, approximately 2.85 million trucks crossed the Texas–Mexico border into the United States. Figure 6.10 illustrates the total number of trucks that crossed the Texas–Mexico border between 2000 and 2009 (North American Transborder Freight Data, 2010). The majority of the trade shipments that cross at El Paso and Laredo by truck move on the three primary highway corridors—i.e., IH 10, IH 35, and IH 20—that link these major border crossings with major inland consumption areas (e.g., Dallas/Fort Worth in Texas).

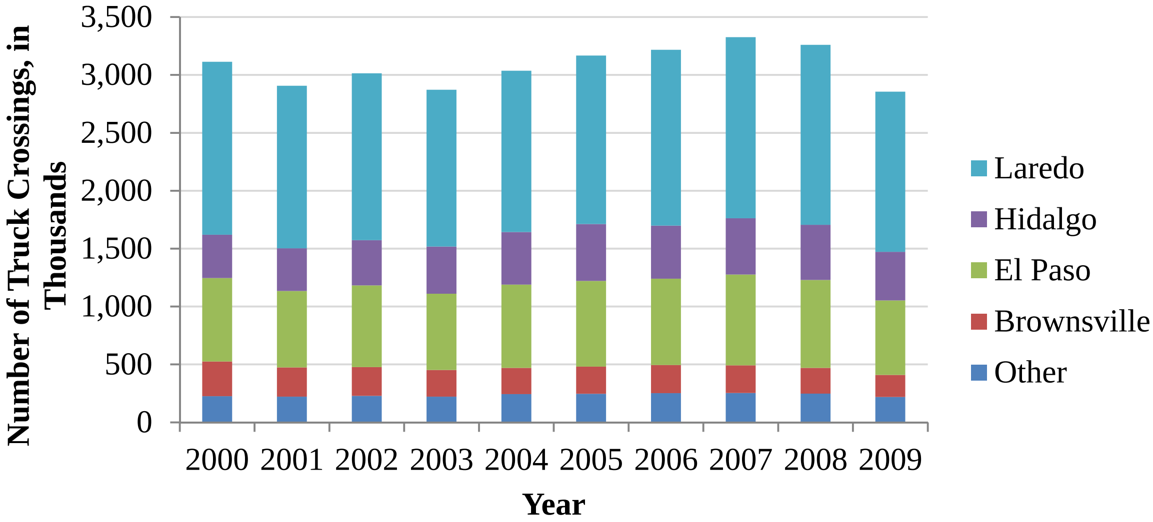


Figure 6.10: Number of Trucks Crossing Texas–Mexico Border in U.S.

A considerable amount of cargo also enters Texas from Mexico via rail. In 2009, 6,406 trains crossed the Texas–Mexico border. Figure 6.11 illustrates the number of trains that crossed the Texas–Mexico border between 2000 and 2009 (North American Transborder Freight Data, 2010). Rail is of critical importance for the movement of vehicles and vehicle parts at the Laredo, El Paso, and Eagle Pass ports of entry.

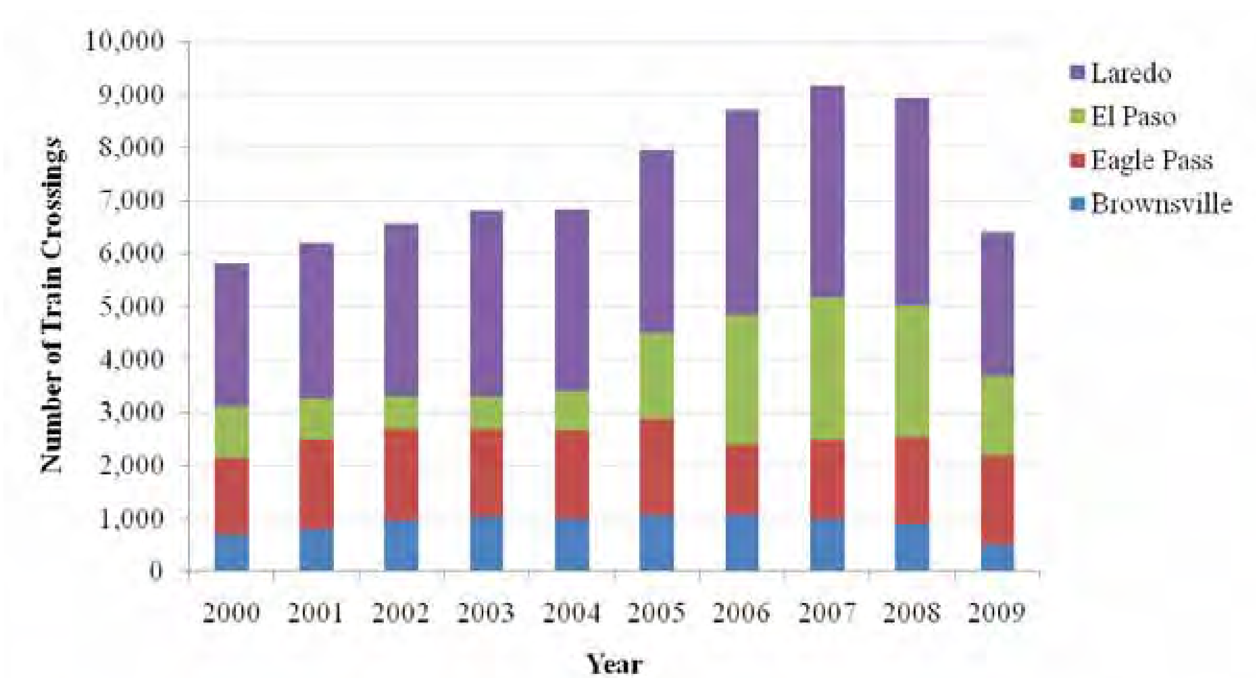


Figure 6.11: Number of Trains Crossing Texas–Mexico Border

6.8.1 Rail Crossings

Five of the seven locations where rail crosses the U.S.–Mexico border are in Texas. The international rail gateways in Texas are in Brownsville, Laredo, Eagle Pass, Presidio, and El Paso (see Table 6.12). Each of these five gateways has one single-track bridge to transport rail freight over the Rio Grande with the exception of El Paso, which has two rail bridges. The two Mexican railroads connecting to the Texas gateways are Ferrocarril Mexicano (Ferromex) and Kansas City Southern de Mexico (KCSM). Table 6.12 provides a list of the connecting U.S. railroads at each border crossing and also includes the TxDOT district in which crossings are located.

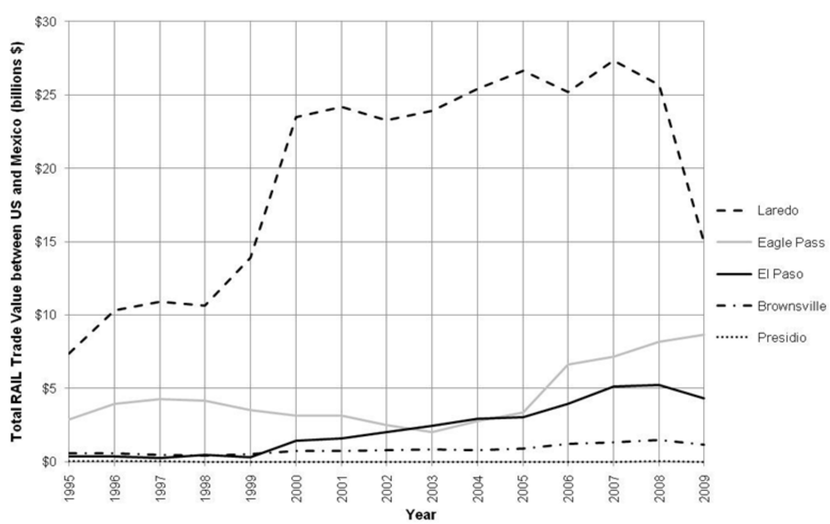
Table 6.12: Texas–Mexico Border Gateways and Railroad Connections

District	Border Crossing		Connecting Railroads	
	Texas	Mexico	Texas	Mexico
Pharr	Brownsville	Matamoros	UP*	KCSM
Laredo	Laredo	Nuevo Laredo	UP, KCS	KCSM
	Eagle Pass	Piedras Negras	UP, **BNSF	Ferromex
El Paso	Presidio	Ojinaga	TXPF	Ferromex
	El Paso	Ciudad Juarez	UP, BNSF	Ferromex

*BNSF does not have trackage rights to connect with KCSM, but does have trackage rights with UP to access the Port of Brownsville.
**Through trackage rights with UP.

Source: Texas Transportation Institute, 2001 (updated to reflect the KCS acquisition of TFM & TexMex)

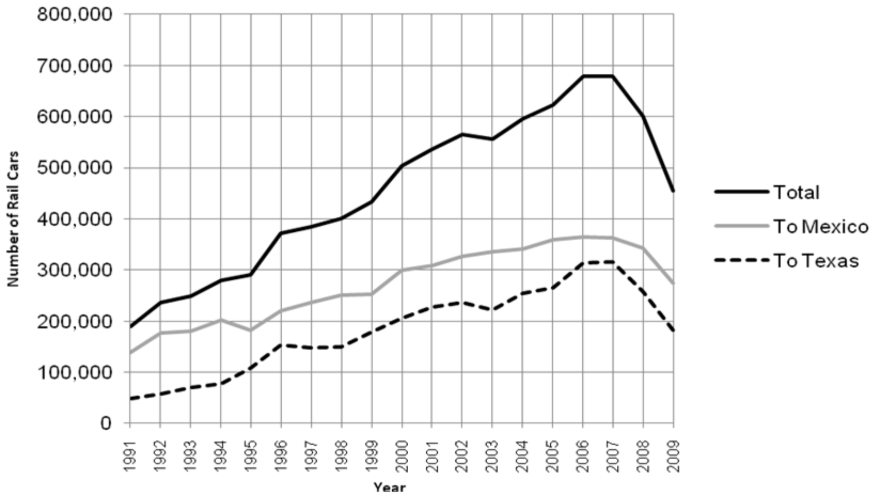
Of the five Texas border rail crossings, Laredo has consistently been ranked first in terms of total trade value crossing the U.S.–Mexico border (see Figure 6.12). In 2009, Laredo accounted for 51.4% of the total value of U.S.–Mexico imports and exports crossing the Texas border by rail. In the same year, Eagle Pass ranked second, with 29.8% of the total value, followed by El Paso (14.8%), and Brownsville (3.9%).



Source: Bureau of Transportation Statistics, Transborder Freight Data

Figure 6.12: Total U.S.–Mexico Trade Value by Texas Rail Border Crossing

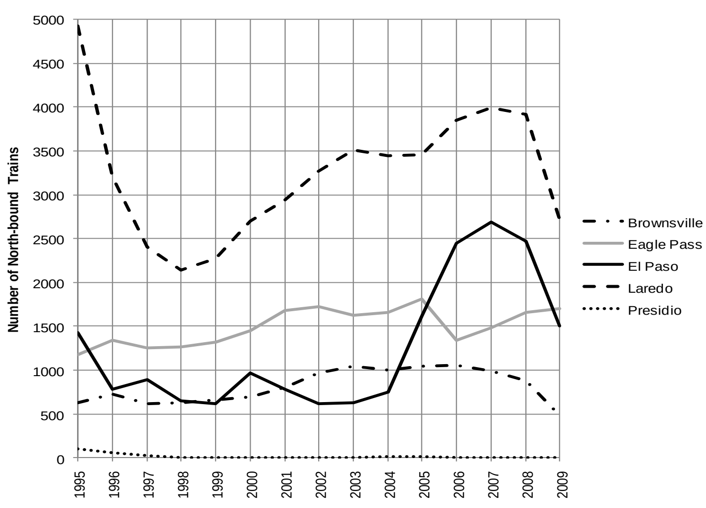
Figure 6.13 illustrates the total loaded and empty rail cars crossing the Texas–Mexico border between 1991 and 2009. Figure 6.13 shows that the total number of rail cars crossing the Texas–Mexico border generally increased after the inception of NAFTA and the privatization of the Mexican rail system, which began in 1997 and was fully implemented in 1998. The impact of the economic recession is also evident in the decline in rail car crossings after 2007.



Source: Texas A&M International University, Laredo, Texas

Figure 6.13: Total Loaded and Empty Rail Cars through Texas Border Crossings, 1991–2009

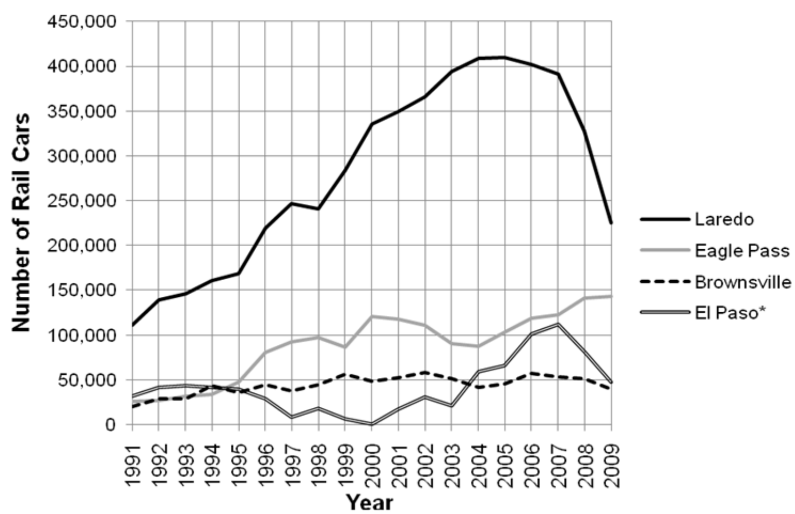
Figures 6.14 and 6.15 illustrate the number of trains entering Texas from Mexico and the total number of loaded and empty rail cars crossing the Texas–Mexico border by border crossing, respectively. Figure 6.14 evidences that the number of trains entering Texas from Mexico at Laredo and El Paso generally increased between 1998 and 2007, after which a steep decline is evident that can partly be attributed to the economic recession. The exception is Eagle Pass, which experienced an increase in train crossings between 2007 and 2009.



Source: Bureau of Transportation Statistics Border Crossing/Entry Data

Figure 6.14: Total Number of Trains Entering Texas from Mexico

Figure 6.15 indicates that the total loaded and empty rail cars crossing at El Paso, Eagle Pass, Laredo, and Brownsville more than doubled between 1994 and 2000 and continued to trend upward until 2006. Rail traffic at Laredo accounted for the majority of northbound and southbound rail car crossings. For example, between 1993 and 2000 the volume of loaded rail cars handled in Laredo increased by 130% and continued to increase until 2005. Figure 6.15 also illustrates the general decline in rail car crossings after 2006—the exception being Eagle Pass. At Eagle Pass, which is seen as a substitute for Laredo due to its geographic proximity, rail car volumes actually increased subsequent to 2007. Furthermore, in early 2009, a similar number of northbound rail cars crossed in Eagle Pass as in Laredo. In January of 2009, Eagle Pass handled 4,086 northbound railcars while Laredo handled 4,764 (Texas Center for Border Economic and Enterprise Development: Rail Border Crossings, ND). While the difference in southbound rail car volumes crossing in Eagle Pass and Laredo has also narrowed, the latter can almost exclusively be attributed to the decline in southbound car loads crossing at Laredo. For example, in January 2009 11,339 rail cars crossed southbound at Laredo as opposed to 20,227 in January 2008 (Texas Center for Border Economic and Enterprise Development: Rail Border Crossings, ND).



Notes: The asterisk (*) indicates that the data for El Paso is incomplete after 1999 and completely missing in 2000. The El Paso loaded rail car count after 2000 includes only the northbound counts available from the U.S. Customs Service and does not include any southbound counts.

Source: Texas A&M International University, Laredo, Texas

Figure 6.15: Total Loaded and Empty Rail Cars at Specific Texas Border Crossings, 1991–2009

To conclude, the growth in U.S.–Mexico trade and the emerging concentration of North American manufacturing in Mexico created a more intensive use of Texas rail prior to the economic downturn, both at the border crossings as well as throughout the state. In addition, the amount of freight moving through Mexico’s five largest ports of Tampico, Veracruz (Gulf Coast), Guaymas, Manzanillo, and Mazatlan (Pacific Coast) increased with much of the freight also destined for the U.S. KCSM has also been promoting the Gulf Coast port of Lazaro

Cardenas as an alternative to other, more congested ports and offers 7-day rail service from there.

6.8.2 Highway Crossings

Truck crossings are available at only 10 of the 16[23] U.S.–Mexico crossing locations in Texas: Brownsville, Del Rio, Eagle Pass, El Paso, Fabens, Hidalgo, Laredo, Presidio, Progreso, Rio Grande City, and Roma. Table 6.13 shows the total number of bridges and truck crossing bridges at each gateway.

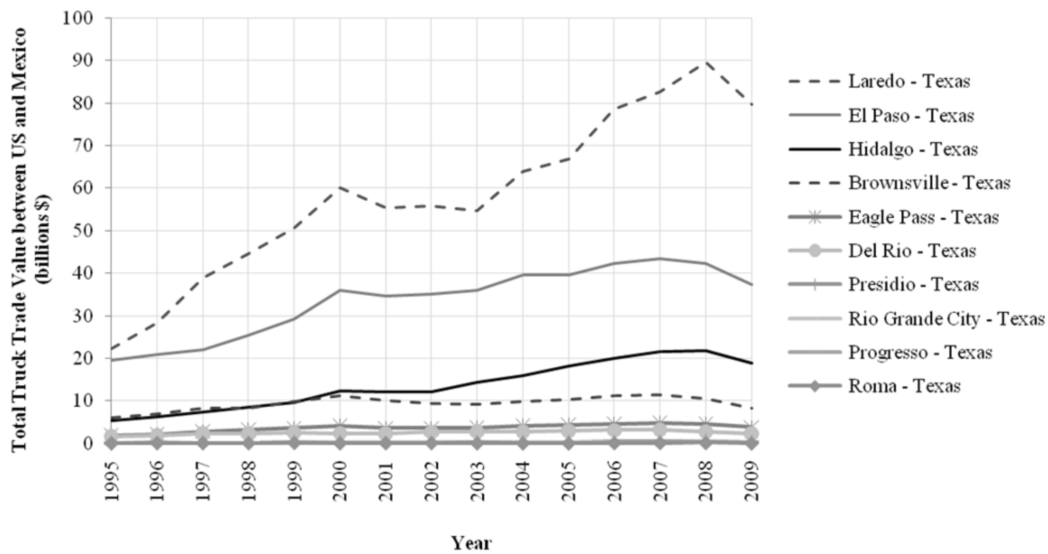
Table 6.13: Texas–Mexico Border Gateways and Commercial Truck Connections

Area	Number of Bridges	Truck Crossing Bridges
Brownsville	4	1
Del Rio	1	1
Eagle Pass	2	1
El Paso	4	2
Pharr[24]	1	1
Laredo	4	2
Presidio	1	1
Progreso	1	1
Rio Grande City	1	1
Roma	1	1

Of the identified Texas border truck crossings, Laredo has consistently been ranked first in terms of total trade value crossing the U.S.–Mexico border (see Figure 6.16) since 1995. In 2009, Laredo accounted for 53% of the total value of U.S.–Mexico imports and exports crossing the Texas border by truck. In the same year, El Paso ranked second, with 25% of the total value, followed by Hidalgo (12%), and Brownsville (5%).

[23] Other identified bridge locations include Fabens, Falcon Lake, Fort Hancock, Lake Amistad, Los Ebanos, and McAllen-Hidalgo.

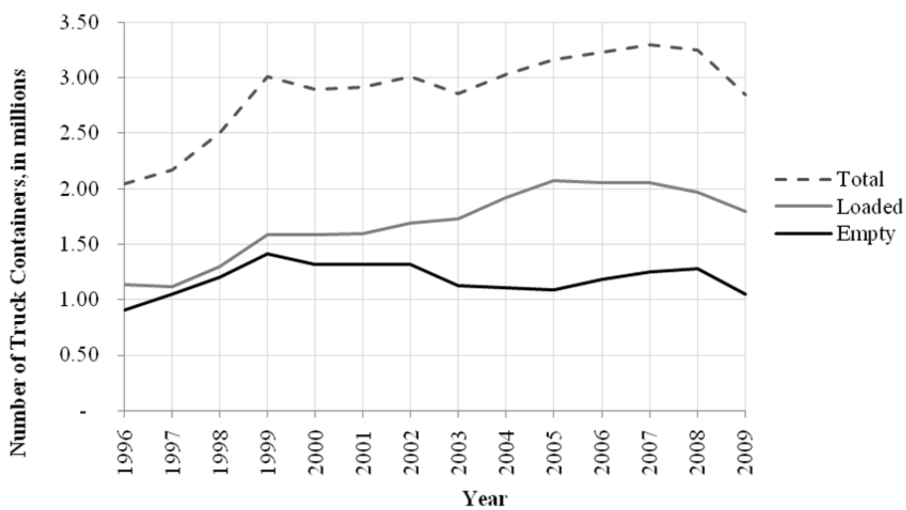
[24] Beginning September 1, 1996, all northbound commercial vehicles were directed to this bridge from the McAllen-Hidalgo-Reynosa Bridge. Southbound commercial vehicles are permitted to use either bridge to enter Mexico.



Source: Bureau of Transportation Statistics Border Crossing/Entry Data, 2010

Figure 6.16: Total U.S.–Mexico Trade Value by Texas Truck Border Crossing

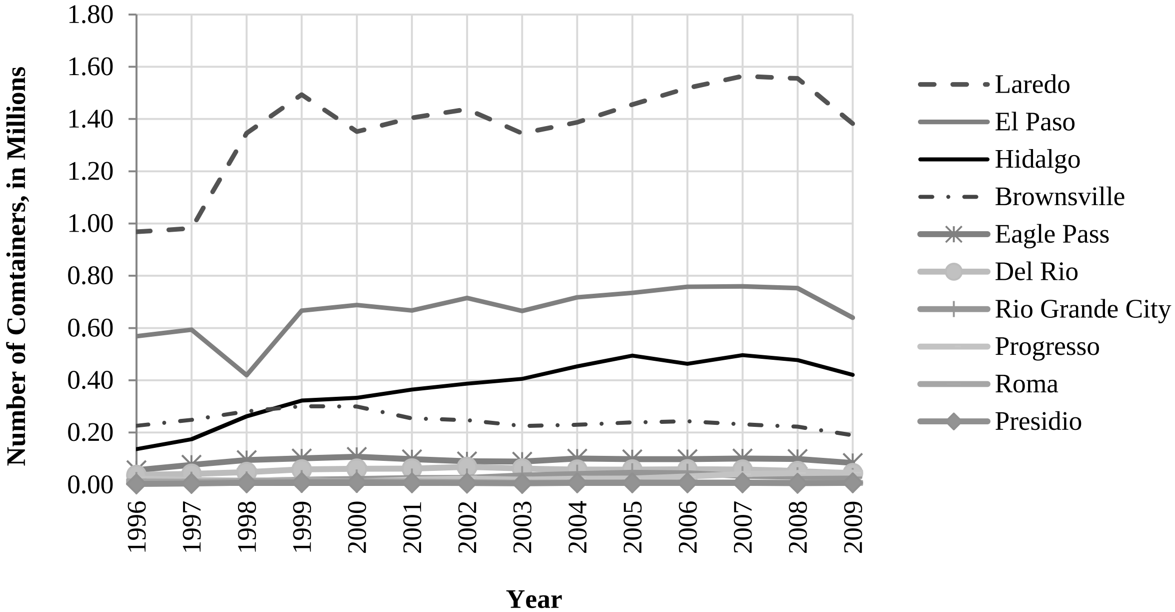
Figure 6.17 illustrates the total loaded and empty truck containers crossing the Texas–Mexico border between 1996 and 2009. Figure 6.17 shows that the total number of truck containers crossing the Texas–Mexico border generally increased after the inception of NAFTA. The impact of the economic recession is also evident in the decline in the number of trucks (see Figure 6.16), and truck container crossings after 2007. Overall, container traffic decreased by 12% between 2008 and 2009 compared to the average growth of 4% from 1996 to 2008.



Source: Bureau of Transportation Statistics Border Crossing/Entry Data, 2010

Figure 6.17: Total Loaded and Empty Truck Containers through Texas Border Crossings, 1996–2009

Figure 6.18 illustrates the number of loaded and empty containers entering Texas from Mexico by border crossing. Similar to earlier discussions, the number of containers for the top three border crossings (Laredo, El Paso, and Hidalgo) increased gradually from 1996 to 2007, before beginning to decline at the start of the economic recession in 2008. On the other hand, the border crossing at Brownsville had plummeted since 2000 and continued to do so throughout the decade.



Source: Bureau of Transportation Statistics Border Crossing/Entry Data

Figure 6.18: Total Number of Truck Containers Entering Texas from Mexico by Border Crossing

In conclusion, U.S.–Mexico truck traffic grew significantly after the implementation of NAFTA. As with rail movements, the concentration of North American manufacturing in Mexico spurred this rise in container traffic. However, the current economic downturn seemed to have stalled this growth. Also, Laredo, El Paso, and Pharr (Hidalgo) remained as the strongest truck crossing regions in the state during the past decade, with Brownsville slowly losing its market share.

6.9 Concluding Remarks

Texas's economy depends on its freight transportation infrastructure to facilitate trade and the economic prosperity of the state. This chapter provided an overview of Texas's transportation infrastructure that facilitates the movement of freight, including major commodities, tonnage, and values moved by mode. The next chapter provides available information on freight transportation demand that have been disaggregated into flows and assigned onto Texas's transportation network.

Chapter 7. Truck, Rail, Water, and Air Freight Movements: *Where Does Freight Move?*

Although the economic development impacts of freight transportation are seldom disputed, the challenge often lies in disaggregating freight transportation demand to flows that can be assigned onto a state's transportation network. Disaggregated freight flows are necessary to:

- provide a clear picture of freight movements on a state's transportation system;
- determine the impact of freight on a state's road infrastructure—bridges and pavements—and the implications in terms of funding;
- evaluate strategies for improving freight mobility;
- forecast system performance;
- mitigate the impacts of truck traffic on general mobility, and
- improve the safety performance of the transportation system.

This chapter of the report provides available freight flow information on Texas's rail and highway system.

7.1 Truck Flows on Texas's Highway System

The FHWA recently released a new and improved version of the Freight Analysis Framework (i.e., $FAF^{3.1}$) that estimates commodity flows (i.e., tonnage and value) within, to, and from a state by mode for 2007 and 2040, as well as freight movements among major metropolitan areas, states, regions, and international gateways. Figures 7.1 and 7.2 illustrate average daily long-haul freight traffic on the national highway systems. Long-haul freight trucks typically serve locations at least 50 miles apart, excluding trucks that are used in movements by multiple modes and mail (FHWA, 2010). The figures illustrate the truck flows in 2007 and anticipated highway flows in 2040. As is evident from the figures, Texas's key trade corridors—i.e., IH 35, IH 10, IH 20, IH 37, IH 30, and IH 45—are expected to experience significant increases in truck flows. The situation is even worse when considering that trucks are often a key link in intermodal supply chains involving air and rail. Increased truck movements raise concerns about traffic congestion, safety, transportation system deficiencies, infrastructure deterioration, multimodal connections, environmental impacts, quality of life, and security (Parsons Brinckerhoff, 2003).

Source: U.S. Department of Transportation, Federal Highway Administration, Office of Freight Management and Operations, Freight Analysis Framework, version 3.1, 2010.

Figure 7.1: Average Daily Long-Haul Freight Traffic on the National Highway System,2007

Source: U.S. Department of Transportation, Federal Highway Administration, Office of Freight Management and Operations, Freight Analysis Framework, version 3.1, 2010.

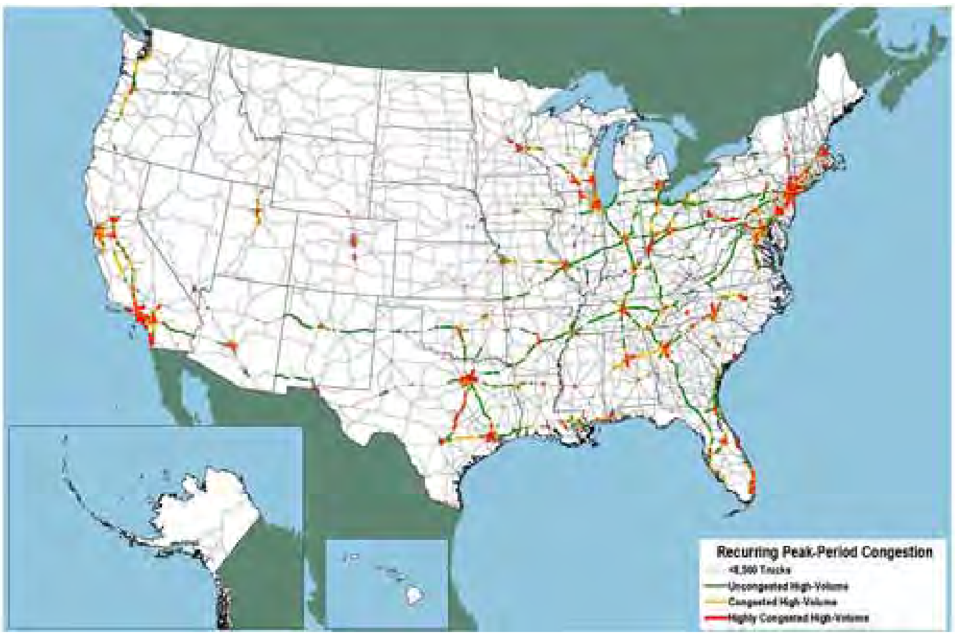
Figure 7.2: Average Daily Long-Haul Freight Traffic on the National Highway System, 2040

Figures 7.3 and 7.4 also illustrate increasing congestion on high-volume truck portions of the National Highway System. The FHWA defines high-volume truck portions of the National Highway System as roadways carrying

> “more than 8,500 trucks per day, including freight-hauling long-distance trucks, freight-hauling local trucks, and other trucks with six or more tires. Highly congested

> segments are stop-and-go conditions with volume/service flow ratios greater than 0.95. Congested segments have reduced traffic speeds with volume/service flow ratios between 0.75 and 0.95" (FHWA, 2010).

In Texas, the entire IH 35 corridor from Dallas to San Antonio is expected to be highly congested by 2040 in contrast to the localized congestion that has been experienced in 2007, which was mainly between Austin and Dallas. Congestion on IH 10 will also shift from congested high-volume (yellow line) to highly congested high-volume levels (red line) by 2040, with the biggest changes occurring around the Houston suburbs. IH 10 from Houston to New Orleans is also expected to be highly congested by 2040. In 2007, most sections of IH 45, IH 30, and IH 20 from Dallas to Little Rock, Arkansas, were classified as uncongested high-volume roadways, but this is expected to change by 2040 when all will be classified as highly congested high-volume roadways.



Source: U.S. Department of Transportation, Federal Highway Administration, Office of Freight Management and Operations, Freight Analysis Framework, version 3.1, 2010.

Figure 7.3: Peak Period Congestion on High-Volume Truck Portions of the National Highway System, 2007

Source: U.S. Department of Transportation, Federal Highway Administration, Office of Freight Management and Operations, Freight Analysis Framework, version 3.1, 2010.

Figure 7.4: Peak Period Congestion on High-Volume Truck Portions of the National Highway System, 2040

As is evident from Figures 7.1 to 7.4, FAF data are very valuable for aggregate types of analysis and corridor level analysis. However, more detailed data—freight flows assigned to more of Texas's transportation system—are required for statewide freight planning.

7.2 Rail Flows on Texas's Rail System

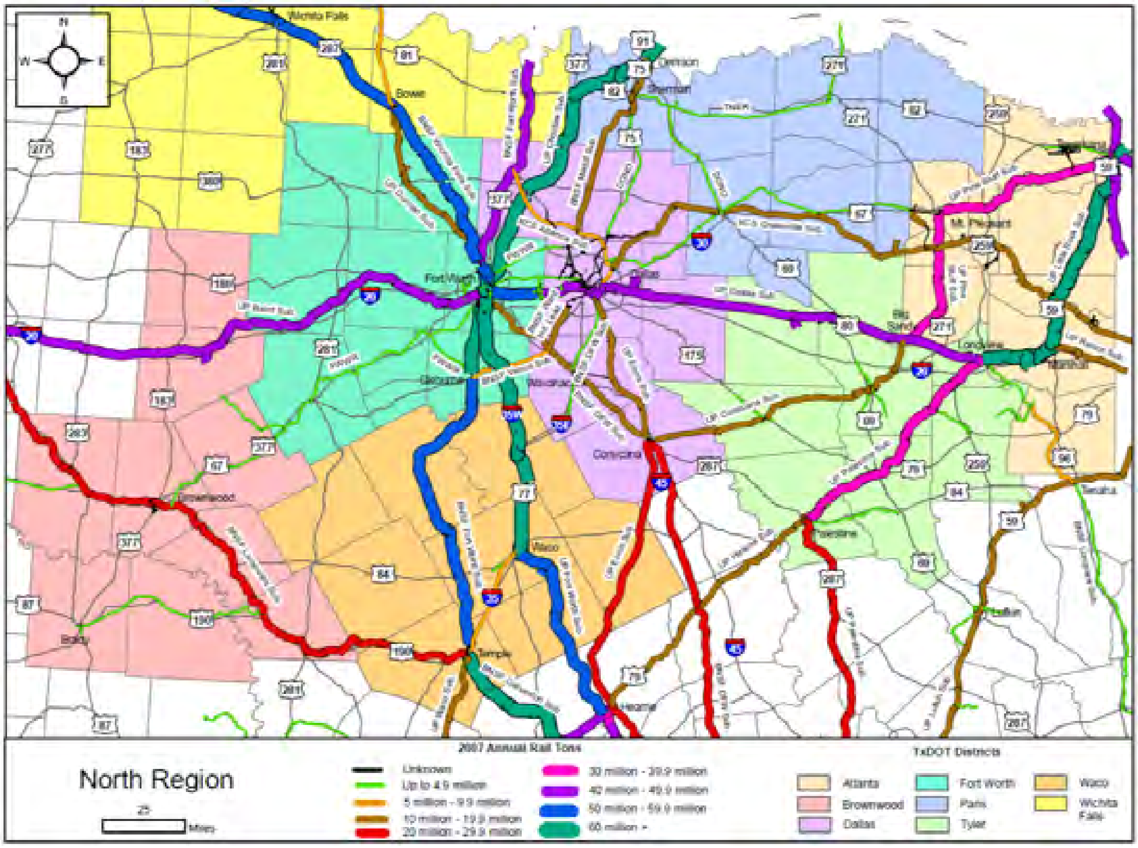
Figure 7.5 depicts the annual rail tons moved on Texas's rail system in 2007. As is evident, the freight rail routes linking Dallas/Fort Worth and Houston, with New Mexico, Colorado, and Kansas through Amarillo, Texas, and Tulsa, Oklahoma have experienced the highest freight rail densities in the state in 2007. Most of these routes are BNSF-owned routes. In addition, BNSF owns the rail lines from El Paso to Sierra Blanca. UP owns the rail line from Longview, Texas, to Arkansas. More than 60 million tons of rail freight was moved on these two BNSF-owned routes in 2007. The El Paso-to-Sierra Blanca rail line splits into two UP-owned routes, one to Houston through San Antonio, and the other to Dallas/Fort Worth through Sweetwater.

Other major rail routes are UP's Amarillo to Dallas/Fort Worth and San Antonio to Houston (i.e., 50–59.9 million tons) segments; UP's Spofford (near Eagle Pass) to San Antonio, Odessa to Dallas/Fort Worth, and Dallas/Fort Worth to Longview; and BNSF's Dallas/Fort Worth to Oklahoma City (i.e., 40–49.9 million tons) segments. Relatively lower density routes include UP's El Paso to Sweetwater segment, Laredo to San Antonio, Tyler to Texarkana, and BNSF's Palestine to Longview (30–39.9 million tons) segments. The remaining Texas rail lines moved less than 29.9 million tons of rail freight in 2007, with the short lines carrying between 10 and 20 million tons of freight.

Source: TxDOT, 2010

Figure 7.5: Annual Rail Tons on Texas Rail Routes, 2007

Figures 7.6, 7.7, 7.8, and 7.9 display the annual rail tons on routes in north, southeast, southwest, and west Texas respectively. As illustrated in Figure 7.6, Dallas/Fort Worth is the major rail hub of the region with most rail lines traversing the city. BNSF, UP, and KCS all have rail yards located in the region. As is evident from Figure 7.6, one of the busiest rail lines is UP's north-south line between Waco and Denison, which moved more than 60 million tons of freight in 2007. BNSF's Galveston subdivision, heading south from Temple, and UP's Little Rock subdivision also moved more than 60 million tons in 2007.



Source: HNTB Corporation

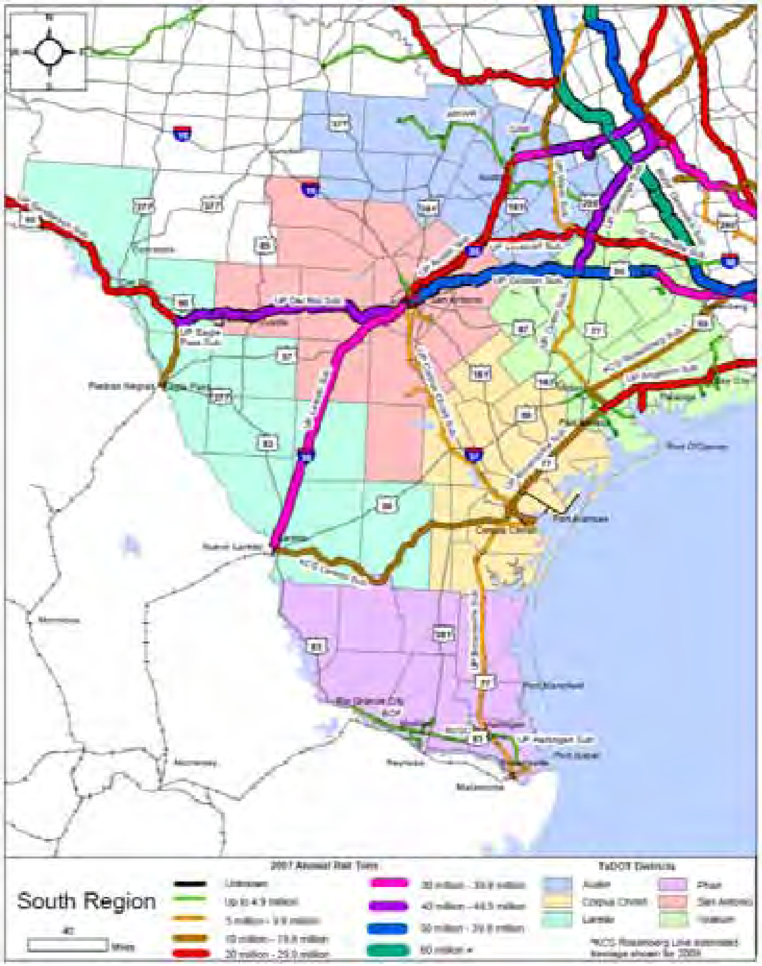
Figure 7.6: Annual Rail Tons on North Texas Rail Routes, 2007

In southeast Texas, the city of Houston is the most important rail hub. As illustrated in Figure 7.7, a significant volume of rail freight either originates or terminates in the city. In addition, the Port of Houston is also an important gateway for international freight. The BNSF route from Houston to Temple recorded the highest freight rail flows in the region in 2007, i.e., more than 60 million tons. Other important rail subdivisions in the region include UP's Navasota, Beaumont, Fort Worth, Lafayette, and Glidden subdivisions and BNSF's Galveston subdivision.

Source: HNTB Corporation

Figure 7.7: Annual Rail Tons on Southeast Texas Rail Routes, 2007

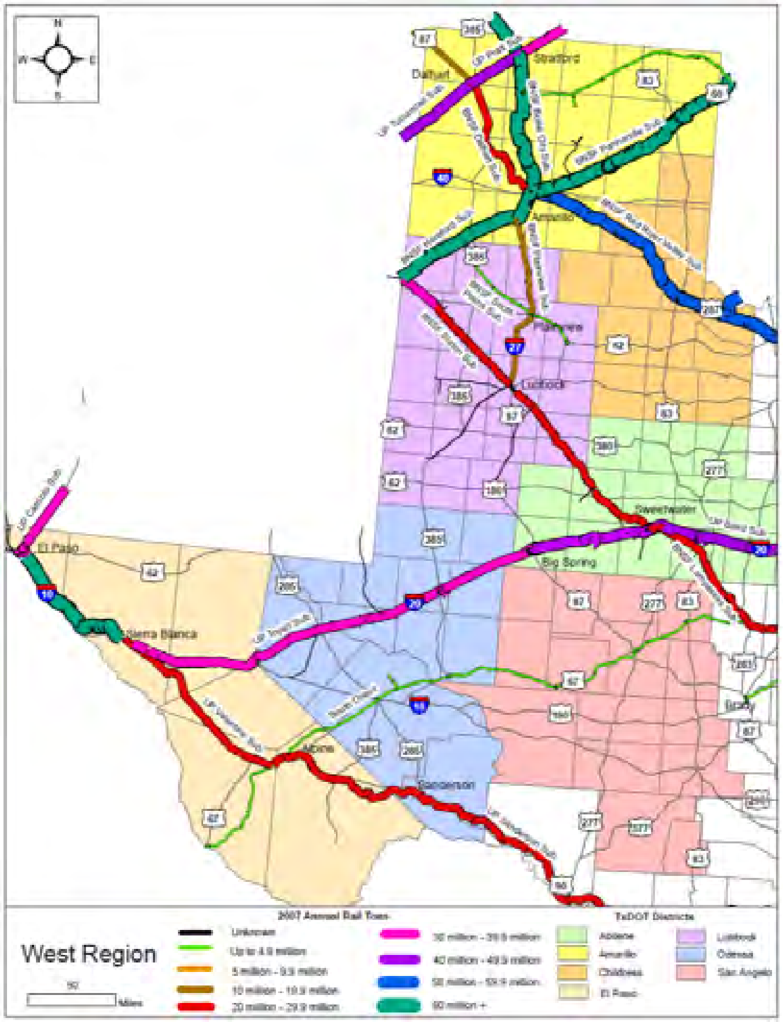
In southwest Texas, the city of San Antonio serves as a major point of intersection for trade from the West Coast and Mexico destined for Houston, Dallas/Fort Worth, and destinations in the Midwest and northeast U.S. (see Figure 7.8). In 2009, UP opened a 300-acre San Antonio Intermodal Terminal facility to serve West Coast and Mexico traffic. Major rail subdivisions in the area include UP's Glidden, Giddings, Laredo, and Del Rio subdivisions, which moved more than 40 million tons of freight in 2007. KCS also owns a rail line in the area, which connects Laredo to Corpus Christi. The KCS line moved between 10 and 20 million tons of freight in 2007.



Source: HNTB Corporation

Figure 7.8: Annual Rail Tons on Southwest Texas Rail Routes, 2007

The west Texas freight rail infrastructure serves West Coast and Mexico traffic, as well as the communities of West Texas and the Panhandle. El Paso, Amarillo, and Sweetwater have major rail centers in the region. El Paso is the major port-of-entry for rail traffic to and from Mexico in the region. The majority of the rail traffic through Amarillo involves commodities either destined for or originating from Los Angeles, Denver, Kansas City, Chicago, or Dallas/Fort Worth (see Figure 7.9). The BNSF line from Lubbock to Galveston and the UP line from El Paso to Dallas/Fort Worth intersect at the city of Sweetwater. The major rail subdivisions in the region include BNSF's Hereford, Panhandle, Boise City, and Red River Valley subdivisions, and UP's Tucumcari, Pratt, Toyah, and Baird subdivisions. These subdivisions moved more than 30 million tons of freight in 2007.



Source: HNTB Corporation

Figure 7.9: Annual Rail Tons on West Texas Rail Routes, 2007

Appendix C highlights the freight rail needs in the eight economic regions of Texas. Experts, however, generally believe that rail demand will exceed capacity in the future in a number of key rail corridors in Texas. This development could necessitate substantial capacity investments to reduce congestion on major rail corridors.

7.3 Concluding Remarks

This chapter alluded to the importance of Texas's freight corridors to the economy of the U.S. A number of critical highway and rail corridors that connect the West Coast, Mexico, and the Port of Houston with the Midwest and Northeast U.S. traverse Texas. The figures and data, however, also illustrated that the anticipated freight flows will result in increased congestion on some of Texas's major highway freight corridors. Specifically, major interstate highways, such as IH 35, IH 10, and IH 45, are predicted to experience truck flows that cannot be supported by the current infrastructure at uncongested levels of service. Similarly, rail freight demand is also anticipated to exceed capacity on certain key rail corridors in the future as the highway corridors become more congested, and if a modal shift from road to rail is encouraged for environmental and energy efficiency reasons. By identifying the major concerns and bottlenecks impacting Texas's freight transportation system, planners and policy makers can adequately evaluate, improve, and proactively plan for investments in a sustainable freight system that will support economic growth in Texas and the U.S.

Chapter 8. Texas's Freight Concerns and Needs

A comprehensive literature review revealed national concerns about the maintenance of existing freight transportation infrastructure, the development of intermodal facilities, the integration of modes to develop a multimodal freight transportation system, the standardization of regulations among states (e.g., weight restrictions), and the challenge to develop a statewide freight program that balances private sector concerns with economic development, multimodal efficiency, and the safety goals of the public sector. This chapter summarizes the salient concerns and needs pertaining to Texas's freight transportation system[25].

8.1 Texas's Freight Concerns and Needs

Table 8.1 illustrates the major statewide freight concerns and needs that were identified in the eight defined economic regions in Texas. In general, the table indicates that in most of the economic regions concern was expressed about (a) continued maintenance of the existing road infrastructure (b) delays and congestion experience on major interstates and rail yards, and (c) inadequate rail capacity, specifically seasonal capacity. In addition, concern was also expressed about (a) delays and congestion experienced in metropolitan areas, (b) limited options to move oversize and overweight freight, (c) inadequate truck access to rail yards and ports, (d) the need for at-grade crossing safety improvements, and (e) the need for more intermodal options.

The subsequent sections of this chapter briefly discuss the identified freight concerns and needs categorized as follows: (1) Texas's road system, (2) Texas's rail system, (3) Texas's multi-modal system, and (4) other. Specific regional examples are included as appropriate to illustrate the identified concerns and needs. These examples were obtained from recently completed freight-related studies, including the MPO plans, and the input and insight obtained during the Freight Shipper Workshops and the Freight Focus Groups. For a more detailed discussion of the various freight concerns and needs identified by economic region, see Appendix C.

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[25] The information presented in this chapter was obtained from recently completed Texas freight related studies (i.e., specifically for the N IH 35 Corridor and S IH 35 Corridor), the results from the mail-out mail-back shipper survey (see Appendix A), the telephone interviews with Chambers of Commerce, Economic Development Agencies, and MPOs, and the insight and input obtained from the Freight Shipper Workshops (see Appendix B), and the Freight Focus Groups (see Appendix C) that were conducted in six economic regions in the state (see Chapter 1).

Table 8.1: Freight Concerns and Needs by Texas Economic Region

Report Section		West	Piney Woods	South Coastal	Panhandle	North Coastal	Central	N IH 35 Corridor	S IH 35 Corridor
8.2	**Texas's Road System**								
	Maintenance of Existing Infrastructure	X	X		X	X	X		X
	Delays and Congestion in Metropolitan Areas			X		X		X	X
	Limited Options for Oversize/Overweight Freight Movements		X		X	X		X	
	Investments in Major Freight Highway Corridors	X		X		X		X	X
	Wind Energy Impacts on Texas's Roads	X			X		X		
	Improved Access to Downtown Areas	X				X			X
	Investments in Local Roads			X					
8.3	**Texas's Rail System**								
	Inadequate Rail Capacity		X	X	X	X	X	X	
	At-grade Crossing/Safety Improvements			X		X	X	X	
	Single Tracks/Rail Sidings	X		X			X		
	Improve Rail Track Condition		X	X	X		X		
	Railroad Customer Service		X		X		X		
	Lack of Rail Competition		X		X				
	Accommodating Passenger Rail on Freight Infrastructure								
	Improved Connections to Railroads				X		X		
8.4	**Texas's Multi-Modal System**								
	Delays and Congestion on Interstates/Major Rail Corridors					X	X	X	
	Inadequate Access to Rail Yards and Ports	X		X		X			
	Enhance Intermodal Options				X			X	
	Rail Border Crossing Bottlenecks and Congestion	X		X					X
	Improved Barge Infrastructure/Barge Reliability			X		X			
8.5	**Funding**								
	Limited Road Funding	X					X		
	Insufficient Funding for Rail Relocation	X							
8.6	**Other**								
	Concerns about Hazmat Movements			X	X	X	X	X	X

8.2 Texas's Road System

8.2.1 Maintenance of Existing Infrastructure

In most of Texas's eight economic regions, freight stakeholders expressed concern about the maintenance of Texas's existing road infrastructure. Stakeholders believe that failure to maintain the existing infrastructure will result in the deterioration of the road network, leading to reduced capacity and increased congestion. Texas's freight stakeholders are concerned that budget shortfalls and inadequate transportation funding will impact the critical freight corridors. Also, in the Central Region freight stakeholders highlighted the importance of maintaining the Farm-to-Market roads that are used to transport hazardous materials.

8.2.2 Delays and Congestion in Metropolitan Areas

A number of freight stakeholders have pointed to congestion in major metropolitan areas in Texas (e.g., Dallas/Fort Worth, Austin, Houston, and San Antonio) that are impacting freight movements to, from, and through the areas. The North Central Texas Council of Governments (NCTCOG) (2009) reported that truck traffic in the North IH 35 Corridor Region—specifically in the Dallas/Fort Worth metropolitan area—is increasing twice as fast as automobile traffic. Trucking dominates freight movements in the region, accounting for 87% (237.4 million tons) of all goods movements (Ang-Olson and Ostria, 2005). High trucking demand coupled with high passenger vehicle demand has resulted in significant congestion on key freight corridors, such as:

- Loop 820 WB, at Rufe Snow Drive;
- IH 35E SB, at Downtown Dallas, and
- IH 35W SB, at TX 121 (INRIX, 2009).

In Austin, IH 35 through downtown Austin (i.e., from Oltorf Street to 38½ Street) is the most congested (INRIX, 2009). Similarly, critical highways in the North Coastal Region (specifically, the Houston metropolitan area) are routinely gridlocked. IH 10—a major east-west connector between California and Florida—traverses the city and accounts for a substantial percentage of the nation's freight movements. Also, US 59 from Laredo moves a substantial amount of freight traffic, particularly NAFTA traffic that crosses the Mexico–Texas border. During peak hours, these and most other major routes experiences substantial congestion, significantly limiting the ability of freight to move through the metropolitan area. This congestion is resulting in increased financial, environmental, and social costs.

8.2.3 Limited Options for Oversize/Overweight Freight Movements

To move oversize/overweight freight on Texas highway infrastructure requires a special permit from the TxDOT Motor Carrier Division. A number of stakeholders mentioned that obtaining these permits can be a lengthy process. Furthermore, these stakeholders promoted the allowance of Long Combination Vehicles (LCVs) on state highways. They argued that the use of these higher productive vehicles would improve efficiency and reduce overall transportation costs. Currently, LCVs are not allowed to operate on Texas's highway system. In the Piney Woods Region, stakeholders recommended that oversize/overweight freight should be moved by rail rather than trucks because of the damage caused by oversize/overweight freight to the road pavement. They stated that this transition will, however, require the development of the region's rail services, especially the short line railroads.

8.2.4 Investments in Major Freight Highway Corridors

Currently, trucking is the dominant mode of intercity freight transportation in Texas and concern has been expressed that truck traffic is increasing faster than capacity in most metropolitan areas of the state (see Section 8.2.2). If trucking trends continue, by 2035 key highway links on major freight highway corridors in areas such as Houston, Dallas, Austin, and San Antonio could likely become critical bottlenecks on the corridors. To accommodate increased truck traffic, freight stakeholders generally saw a need for additional freight capacity, technology investments (e.g., Intelligent Transportation Systems), and operational improvements to facilitate freight movements.

In addition to the freight bottlenecks and congestion experienced around major metropolitan areas discussed in Section 8.2.2 freight stakeholders also identified the following bottlenecks on major freight highway corridors:

- South IH 35 Corridor Region: IH 35 NB from Petroleum to Rittiman Road in San Antonio and I 410 (Loop 410) NB at Macro in San Antonio;
- West Region: IH 10 EB and WB from Raynor Street to McRae Boulevard in El Paso; and
- South Coastal Region: IH 37 and US 77 in Corpus Christi.

Finally, a number of stakeholders pointed to the need for investments in additional capacity. For example, in the South Coastal Region, freight stakeholders supported the development of the IH 69 corridor because currently no interstate highway connects Laredo, Brownsville, and McAllen to major hubs, such as Houston or San Antonio. Also, in the Central Region, the San Angelo MPO is promoting a relief route to support the mobility objectives of the Texas Trunk System and the Ports-to-Plains Trade Corridor Coalition. The proposed relief route will connect US 277 to US 83 (San Angelo MPO, 2010).

8.2.5 Wind Energy Impacts on Texas's Roads

In the Panhandle and parts of the Central and West Texas Regions, stakeholders expressed their concern about the impact of the movement of wind energy equipments such as wind turbines on the FM and county roads. FM and county roads typically serve as the final link and are a critical part of wind energy equipments distribution network. A study is currently being performed by the Center for Transportation Research in collaboration with TxDOT to better understand the impact of wind energy on the Texas transportation system.

8.2.6 Improved Access to Downtown Areas

In a number of economic regions, stakeholders pointed to the need for improved access to downtown areas in Texas. For example, some freight stakeholders argued that the geometric design and curve radii in downtown areas are often inappropriate for 18-wheelers. The question is, however, whether 18-wheelers are the most appropriate vehicle to serve downtown areas. Also, freight stakeholders in the West Texas Region pointed to the need for better transportation access to downtown Midland—i.e., the provision of ingress/egress points into the city from the proposed La Entrada corridor. They believe this access would stimulate economic development in the area.

8.3 Texas's Rail System

8.3.1 Inadequate Rail Capacity

Inadequate rail capacity is a growing concern in Texas. The National Rail Freight Infrastructure Capacity and Investment Study anticipated that Texas's rail level of service rating—i.e., capacity versus usage—will reduce from a concerning average "D" rating to a critical average "F" rating (Cambridge Systematics, 2007). This finding was largely supported by the concerns expressed by freight stakeholders in all but the West Texas Region. Also, in the North IH 35 Corridor Region, particularly in Austin, CAMPO's 2030 mobility report listed sharp turns, poor grades, and single-track segments (specifically, on the Colorado River bridge) as the main contributors to slow rail speed through the city. Ultimately, the capacity and frequency of trains on a network is a function of the track speed.

Also, in the South Coastal Region shippers have reported diverting freight from rail to truck in recent years because of worsening delivery times and inadequate rail capacity (Cambridge Systematics, 2007). One of the worst rail bottlenecks is also reported to exist at the border crossing between Brownsville and Matamoros.

In the Central Region, freight stakeholders expressed dire concern about the condition and capacity of the South Orient Railroad (SORR) serving the area. The eastern section of the SORR line begins at San Angelo Junction, where the SORR interchanges with the BNSF Railway, and the Fort Worth and Western Railroad (FWWR). This section of the line is constructed of predominantly 90-pound jointed rail and has been operated as Excepted Track (10 mph) from San Angelo Junction (5 miles southwest of Coleman) through the west end of San Angelo (approximately 85 miles) due to the deteriorated state of the infrastructure. In September 2008, the Martifer-Hirschfeld Energy Corporation announced plans to develop a wind tower manufacturing facility in the city of San Angelo. Rail service is essential for transportation of Martifer's raw materials and finished products. Other shippers have also expressed an interest in locating on the line, and the existing shippers are experiencing an increased need for rail service. This has resulted in a commitment from TxDOT and TXPF to rehabilitate the line as funding is secured to improve service. Currently, TxDOT is using $14.09 million in American Recovery and Reinvestment Act (ARRA) funds, $1.1 million remaining from a prior project, $250,000 from the city of San Angelo, and $4.6 million from TXPF to rehabilitate the line between San Angelo Junction and San Angelo. Rehabilitation will be accomplished through several construction projects, which will include installation of more than 70,000 cross ties, replacement of worn rail, reconstruction of 103 roadway-rail crossings, miscellaneous bridge repairs, and replacement of a truss bridge at Ballinger, Texas, where clearance restrictions would prevent the movement of Martifer-Hirschfeld's wind towers. When completed in the summer of 2011, this section of the line will be operable at a minimum of Class II (25 mph) speeds.

In addition, freight stakeholders in the Central, Panhandle, and Piney Woods Regions have expressed concern about inadequate rail capacity during the harvest season. For example, in the Central Region, freight stakeholders reported that rail congestion in Houston, Fort Worth, and El Paso impacts rail shipments out of the region, particularly during peak seasons. Capacity issues on the SORR are also exacerbated by insufficient labor employed by the short line, which limits the number of trips that can be made during the peak harvest season. Currently, only two full time rail engineers are employed by the SORR and stakeholders mentioned the need for additional employers during peak seasons. The latter is of specific concern to the grain industry as the products need to be shipped as soon as it is harvested. Furthermore, rail capacity concerns have been reported to be aggravated by a lack of rail cars during the peak harvest periods. Stakeholders cited that this limits their ability to ship commodities and raw materials on time, impacting the expansion of existing businesses in the area.

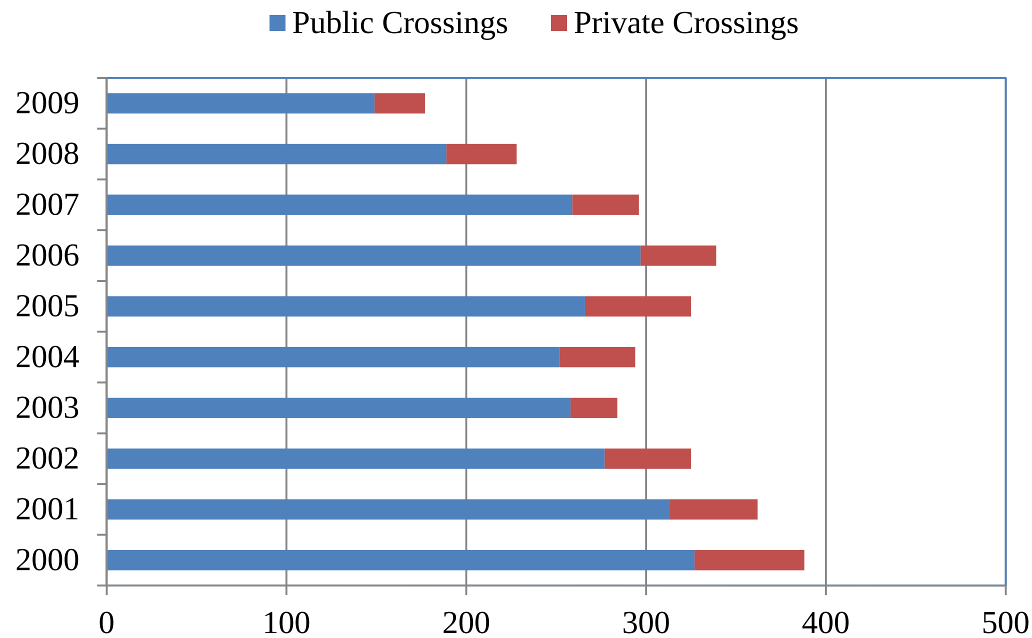
Freight stakeholders in the Piney Woods reported that rail congestion in Dallas Fort Worth negatively impacts shippers in the Piney Woods Region. The called for the development of the region's short line railroad system to facilitate goods movement in the region.

Inadequate rail capacity concerns were also expressed in the Panhandle Region. It was reported that the existing rail capacity is only able to move a third to half of the cotton containers generated in the region in a year (Lubbock Metropolitan Planning Organization, 2006). Rail capacity concerns in the region are anticipated to increase in the future as the rail demand increases for the region's growing industries—e.g., agriculture, livestock, and energy production (i.e., wind and ethanol). For example, agricultural production alone is expected to increase by 151% by 2025 (HNTB Corporation, 2008).

Finally, increasing rail freight tonnage is straining capacity at rail yards in many parts of the state. For example, yard capacity is a concern at the UP railroad interchange yard at the Port of Beaumont.

8.3.2 At-grade Crossing/Safety Improvements

Safety at rail grade crossings is a major issue in Texas. According to the Texas Rail Plan (2010), Texas ranks first among the states with the highest number of grade crossing incidents, fatalities, and injuries. It also has the highest number of grade crossings compared to other states. Fortunately, grade crossing safety substantially improved in Texas between 1981 and 2009 with the number of auto-train grade crossing accidents decreasing by 85% from 1,202 (1981) to 177 (2009). This reduction occurred despite a growth in population, vehicular traffic, and rail traffic throughout the state (Texas Rail Plan, 2010). Figure 8.1 shows the steady decline in the last 10 years.



Source: Federal Railroad Authority Office of Safety Data

Figure 8.1: Texas Grade Crossing Accidents/Incidents, Public and Private Crossings, 2000–2009

As examples, several rail grade crossings have been identified as "hot spots" for auto-train collisions in the greater Houston area. Conflicts between trains and trucks at grade crossings also impede trucks serving the Port of Brownsville and significant grade crossing issues have also been identified on rail lines serving the Ports of Texas City and Lavaca. Furthermore, of the 61 railroad crossings in San Angelo, 55% were reported to be in poor condition. Conditions ranged from exposed spikes, broken timbers, sunken holes, and missing timbers, to unpleasant travel conditions (San Angelo MPO, 2010).

At-grade crossings, however, not only pose a potential safety issue but also impact the community. In addition, at-grade crossings and the high land use density of commercial and residential activity near the rail lines adversely impact rail operations. For example, UP reported in 2006 that 26 at-grade street crossings were blocked for tests and inspections in Laredo, which contributed to increased rail delays through the area (Union Pacific, 2006).

8.3.3 Single Tracks/Rail Sidings

Shippers have seen an increase in the use of longer and heavier trains by the Class I railroads to maximize existing capacity and improve rail efficiency. For example, BNSF prefers all its international intermodal shipments be moved in 40-foot well cars and all its intermodal trains to be 8,000 feet long. This approach will allow BNSF to increase the amount of freight moved over its mainlines without increasing the number of trains. However, concern has been expressed in a number of regions that the longer trains cannot be handled without investments to lengthen sidings to permit trains to meet and pass—and without providing additional yard capacity to assemble and accommodate the longer trains. For example, in the West Texas Region, the BNSF rail yard line is single-tracked with limited siding lengths, which makes passing maneuvers difficult. Also, the UP rail line between the Port of Corpus Christi and the Brownsville area subdivision is currently not equipped with rail siding to marshal, store, load, and unload vehicles. Insufficient siding length at San Angelo Junction also limits the number of railcars that can be collected by the Class I railroads to only 45 rail cars in the Central Region. Freight stakeholders thus expressed the need for investments in rail sidings to facilitate the Class I business model.

8.3.4 Improve Rail Track Condition

Freight stakeholders in a number of regions of the state expressed concern about the condition of rail track in their areas. They felt that throughout Texas the existing rail infrastructure required maintenance and repair to improve overall rail system efficiency. For example, stakeholders in the Panhandle Region observed that rail tracks in poor condition result in slower operating speeds in the region. Also, in the Central Texas Region, freight stakeholders described the condition of the SORR track as being in poor condition[26]. In the South Coastal Region, particularly in Laredo, other factors contributing to slow operating speeds and safety concerns included at-grade crossings, poor geometry, and high land use density of residential and commercial activity surrounding the rail lines. The complication in remedying these factors is that a binational solution needs to be achieved. Otherwise investments in one side of the border can complicate the situation on the other side of the border if additional rail traffic results from the investment.

Although it was not always clear whether freight stakeholders were concerned about the condition of the Class I rail infrastructure or the short line infrastructure, it is well-known that substantial investments are needed to improve the condition of the short line rail infrastructure in Texas. A Texas Transportation Institute paper (2005) pertinently highlighted the importance of the Texas short line railroad system to the transportation of bulk agriculture commodities and the improvements needed to address needs in the overextended system. Furthermore, Texas's freight stakeholders in the Panhandle, Piney Woods, and Central Regions were very supportive of short line rail investments and argued that a more efficient short line rail system will make rail more competitive with trucking in the state.

8.3.5 Railroad Customer Service

Stakeholders in the Central Texas Region cited the need for better communication with Class I railroads regarding investment needs in the region as that region currently lacks a UP/BNSF interchange, despite the rail lines crossing each other at Sweetwater, which is approximately 70 miles from San Angelo and 40 miles from Abilene. In the Piney Woods Region, stakeholders reported on the difficulty of dealing with the Class I rail lines, especially concerning movement of small volumes of goods. They expressed the need for the development of short line railroads in the area to accommodate the movement of goods from the region. Stakeholders in the Panhandle also expressed the need for a more efficient rail system to transport materials from the region. The current system is such that commodities destined for the West Coast are sent east to Dallas and Fort Worth for assembling and loading before being transported to the West Coast, resulting in additional shipping cost and travel time.

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[26] As indicated before, TxDOT is currently rehabilitating the line to allow an operational speed of 25 mph by the summer of 2011.

8.3.6 Lack of Rail Competition

Stakeholders in the Panhandle and Piney Woods Regions cited the need for alternative modes of transport to trucking. A more efficient short haul rail system that will make rail movement competitive with trucking is highly desired in the region. Poor condition of rail tracks result in slower operating speeds, inability to invest in large rail cars, and inadequate capacity to move containers during the cotton harvest. Existing rail lines are able to carry only a third to a half of the containers of the cotton generated in the region in a year, leaving the remaining containers to idle in a warehouse or a storage yard away from the rail transfer facilities (Lubbock MPO, 2006).

8.3.7 Accommodating Passenger Rail on Freight Infrastructure

During the freight stakeholder meetings, the issue of passenger rail on freight infrastructure was not discussed extensively. According to the Texas Rail Plan (2010), the Class I railroads have expressed the desire for additional capacity on their lines to accommodate passenger rail but this cooperation has not been without opposition. Major concerns among railroads include restricted right-of-way acquisitions, schedule restrictions, existing freight bottlenecks, restricted access associated with high-speed rail service because of the barriers required, and liability of passenger trains sharing track with freight trains. Railroads also cite mixed results of cooperation in the past resulting in substantial passenger rail delays (Texas Rail Plan, 2010).

8.3.8 Improved Connections to Railroads

Stakeholders in the Panhandle and Central Regions expressed the need for better rail connections with the Class I railroads. A lack of an intermodal facility in the Panhandle Region for assembling and loading containers onto rail negatively impact shippers in the region. For example, the majority of cotton shipped to the west coast from the Panhandle is primarily sent east to Dallas and Fort Worth for assembling and loading, resulting in additional shipping costs and travel time that impacts the profitability of the industry (TxDOT, 2008). In 2009, the San Angelo City Council established the Railroad Coalition to promote the development of the SORR line from San Angelo Junction to Presidio and strengthen the rail component of the Ports-to-Plains Trade Corridor Coalition (San Angelo MPO, 2010). The San Angelo MPO is also exploring the feasibility of an intermodal facility in San Angelo due to the SORR line and the Ports-to-Plains Trade Corridor meeting in the city.

8.4 Texas's Multi-Modal System

8.4.1 Delays and Congestion on Interstates/Major Rail Corridors

A major concern during the stakeholder workshop in the North Coastal Region was delays and congestion on major interstates and on major rail corridors. This concern is also reflected in studies in the North IH 35 Corridor Region. For example, the Dallas/Fort Worth metropolitan area experiences major bottlenecks on its major interstates and rail corridors. Furthermore, one of the most congested rail intersections in the Dallas/Fort Worth area is Tower 55, located underneath the IH 35W and IH 30 interchange. Through and turning movements necessitated by the 100 to 120 freight trains traversing Tower 55 result in delays of up to 90 minutes per train (NCTCOG, 2009). Stakeholders in the Central Region also stated that that rail congestion in Houston, Fort Worth, and El Paso impacts the Central Texas Region as shippers experience delays when these cities are backlogged.

8.4.2 Inadequate Access to Rail Yards and Ports

Texas freight stakeholders expressed concern about inadequate access to rail yards and ports in a number of economic regions. In the West Texas Region, for example, stakeholders mentioned that major rail delays are experienced as trains approach downtown El Paso. This delay occurs because both the UP and BNSF rail yards are located within the highly populated and geographically constrained metropolitan area of El Paso. The historical location of yards in some areas hinders good truck access and there is not much space for infrastructure expansion—i.e., increasing the capacity of the rail yards or increasing the capacity of the access roads.

> **Tower 55 Success**
>
> On October 20, 2010, Secretary LaHood announced the grant recipients for the TIGER II Program. Among the projects funded, Tower 55, a major rail and traffic bottleneck in downtown Ft. Worth, was awarded $34 million (USDOT, 2010). The total project cost amounts to $91.2 million of which BNSF and UP committed $51.2 million.
>
> Among other benefits, the project will:
>
> - Enhance safety by eliminating several pedestrian and bicyclists at grade crossings through the provision of underpasses;
> - Provide 20 years of additional capacity; and
> - Allow 40% more trains through the intersection.

Land connections to ports have also been raised as a concern by Texas's freight stakeholders. The TxDOT Waterborne Freight Corridor study identified the most critical rail and highway connections affecting Texas's waterborne freight system. Figures 8.2 to 8.5 illustrate the critical land connections that are in need of improvement to enhance access to Texas ports.

Source: Cambridge Systematics, 2010

Figure 8.2: Landside Chokepoints—Sabine-Neches Area

Source: Cambridge Systematics, 2010

Figure 8.3: Landside Chokepoints—Houston-Galveston Area

Source: Cambridge Systematics, 2010

Figure 8.4: Landside Chokepoints—Central Coast Area

Source: Cambridge Systematics, 2010

Figure 8.5: Landside Chokepoints—South Texas Area

8.4.3 Enhance Intermodal Options

In general, Texas's freight stakeholders were very supportive of investments to enhance intermodal options in Texas. In the Panhandle Region specifically, the cotton industry argued for an intermodal facility to assemble and load containers onto rail. Currently, cotton destined for West Coast ports is trucked to Dallas and Fort Worth for assembling (i.e., loading into containers) and loading on to rail. These containers then move back through the Panhandle Region to ports in Southern California. This process results in additional shipping costs and travel time, which negatively impact the profitability of the industry. Also, freight stakeholders pointed to the need for additional intermodal facilities in the North IH 35 Corridor Region to alleviate the burden on current intermodal facilities and to enhance multimodal transportation in the region. Specifically, the Austin Area Freight Transportation Study (2008) pointed to the need for a rail yard in the area as local short line railroads must perform transfers to Class I railroads at interchange yards.

8.4.4 Rail Border Crossing Bottlenecks[27] and Congestion

Texas's border regions (i.e., the West, South Coastal, and South IH 35 Corridor Regions) expressed concern about the following issues that adversely impact the operation of rail at and near border crossings: (a) inadequate rail infrastructure; (b) limited hours of operation; and (c) lengthy border inspections.

In terms of rail infrastructure, freight stakeholders were concerned that poor geometry and strained capacity accessing and crossing the Texas–Mexico border contributes to train delays. For example, the rail bridge at Laredo is a single-track structure used by UP, KCS, and KCSM to cross to and from Mexico. According to the Laredo MPO (2009), the bridge is

[27] Texas ports and waterways will similarly be impacted by a combination of national and local rail bottlenecks. These capacity constraints will make it difficult for Texas ports to access the national rail system and move efficiently into and out of Texas port facilities, contributing to delays on the system and hindering the ability of Texas ports to handle increased volumes (Cambridge Systematics, 2010).

expected to exceed its capacity of 40 trains per day by 2020 or before, if more stringent screenings and inspections were implemented.

Rail border crossing operating hours also impact train crossings to and from Mexico. Operating hours are limited by Customs and Border Patrol (CBP) and by the border crossing communities. Border operating hours were a major concern in the West Texas Region. Trains can cross into and from Mexico in El Paso only between 10:00 p.m. to 6:00 a.m., mainly due to at-grade crossing issues[28] in Ciudad Juarez, Mexico. Also, the rail companies would like CBP to staff the Laredo and Eagle Pass gateways 24 hours a day, 7 days a week.

Finally, border inspections also contribute to train delay. According to UP (2006), inspections in Mexico are repeated in Texas at the Port of Laredo, adding 5 to 7 hours of delay to each train. This delay is significant given that more than 300 trains are inspected annually. If FRA-required train inspections can be conducted on the Mexican side of the border, Texas-bound trains would be able to cross the border and move beyond the immediate congested border region before any inspections were conducted. Such a program could alleviate rail congestion substantially and increase operating efficiencies on portions of the rail network. Various interest groups, however, oppose this proposal due to a perceived threat to public safety and homeland security.

8.4.5 Improved Barge Infrastructure/Barge Reliability

The Gulf Intracoastal Waterway (GIWW) was completed in June 1949, mainly to facilitate barge traffic with its standard depth of 12 feet. Freight stakeholders expressed concern about erosion along the GIWW and a lack of investment to update facilities on the GIWW. Some argued that the latter has slowed commercial barge traffic significantly on the GIWW over the past few decades. For example, two specific infrastructure concerns in the North Coastal Texas Region are (1) the relatively narrow (75 ft) dimensions of the Brazos River Floodgates, and (2) the bridge supports of the Galveston Island Railroad Bridge. The former requires barge operators to separate their barges, move them through the floodgates separately, and reassemble them on the other side (TxDOT, 2004). The bridge supports of the Galveston Island Railroad Bridge, which crosses over West Galveston Bay and the Waterway, allows for barges with a width of only 105 ft to pass. This width causes damage to both the barges and the bridge supports when barges pass through the narrow opening. This location has been identified as the greatest hazard to navigating along the entire 1,300 miles of the Waterway (TxDOT, 2004)[29].

8.5 Funding

8.5.1 Limited Road Funding

A major concern among Texas freight stakeholders in the West and Central Texas Regions was fear of inadequate funding to maintain existing road infrastructure in Texas. In West Texas, specifically, freight stakeholders were concerned that, without addressing the funding shortfall, any proposed policies and strategies to add capacity, address bottlenecks, or maintain existing infrastructure are moot. Without adequate funding, alternative means of

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[28] Ciudad Juarez, the State of Chihuahua, and the Mexican rail company Ferromex have been planning and seeking funding to grade separate five roads in Juarez to allow the removal of the restriction on operating hours.

[29] The Galveston Causeway had the highway lanes completely replaced and the railroad bridge will have its lift bridge replaced. The new lift bridge will widen the horizontal clearance from 104 ft to 300 ft (House.gov, 2008).

financing the Texas transportation system, specifically the sections that facilitate freight movements, will become critical in the future. In the Central Region, stakeholders expressed their fear of roadway funding being shifted to other areas in the state because of the current good state of the region's road network. They are concerned that without adequate funding coming into the region, the region's road network might deteriorate in the future.

8.5.2 Insufficient Funding for Rail Relocation

Freight stakeholders were also concerned about insufficient funding for much needed rail relocation projects in the West Texas Region. In El Paso, insufficient funding has resulted in the postponement of plans to move UP and BNSF rail yards out of downtown. The proposed Santa Teresa intermodal facility was on the verge of construction until November 2009 when UP delayed the project, citing funding concerns (Davenport, 2009).

8.6 Hazardous Materials

8.6.1 Concerns about Hazmat Movements

In almost all of the Texas's economic regions, there was concern about the movement of hazardous materials on Texas's transportation system. In the Panhandle Region, where the major rail lines typically run through the urban, heavily populated regions of the metropolitan areas, the safe and timely transport of the hazardous materials and containers on the rail system is a source of concern. In the South IH 35 Corridor, concern is growing about the movement of hazardous material on the Laredo Rail Bridge located in the city center and there are calls for a new international bridge to accommodate increasing border traffic and hazardous materials movement. In the Central Region, hazardous materials are transported via Farm to Market roads surrounding the city of San Angelo. This usage creates a need for adequate maintenance of these roadways. The rehabilitation of the SORR line will also facilitate efficient movement of hazardous materials, particularly petroleum and natural gas products, in the region. Currently, the transport of hazardous materials is restricted to five cars per train (TxDOT, 2010). In the North Coastal Region, freight stakeholders expressed concern over hazardous material movement in the area as Harris County ranks first in the top five counties where hazmat originate or terminate in Texas. Also, in the South Coastal Region, a major commodity moved by rail and truck is a range of hazardous materials including ammonia, chlorine, hydrogen chloride, hydrogen fluoride, hydrogen sulfide, sulfur dioxide, and liquefied petroleum (LP) gas. Most hazardous material movement is made up of about 20,000 truckloads per year of LP gas and 10,000 truckloads per year of molten sulfur. Additional hazardous material movement is 100 truckloads per year of ammonia, hydrogen chloride, hydrogen fluoride, and sulfur dioxide. Each truck contains about 40,000 pounds of material. These materials travel along US 281 and US 77 in the South Coastal Region (Corpus Christi Metropolitan Planning Organization, 2006).

According to Table 8.2, Dallas County has the highest hazardous materials incidence rate in Texas, even though only a small percentage of hazardous material originates or terminates in the county (Warner et al., 2009). The NCTCOG began a mapping project to identify patterns in hazmat incidents. Strategies to reduce the number of hazardous material incidents include public education to raise awareness of the need for passenger vehicles to give enough clearance and space between their vehicles and trucks. In addition, NCTCOG is reevaluating hazardous materials routes to minimize the exposure of the population to intercity hazardous materials movement.

Table 8.2: Top Ten Texas Counties with Hazmat Incidents in 2007

Hazmat Incidents Texas 2007		
County	**No. Incidents**	**%**
1 Dallas	516	33
2 Harris	301	19
3 Tarrant	118	8
4 El Paso	117	8
5 Bexar	57	4
6 Lubbock	35	2
7 Webb	33	2
8 Jefferson	32	2
9 Guadalupe	24	2
10 Taylor	24	2
Total	1257	81

Source: Warner and Terra, 2005

Warner et al. (2009) examined the movement of hazardous materials by rail in Texas in terms of internal, through, originating, and terminating movements, and the percentage of hazardous materials and the top ten commodities transported by category of rail movement (see Table 8.3 for the top five commodities by category of rail movement). As shown, Texas ranks first in originating and terminating shipments of petroleum products in terms of rail tons.

For Texas's rail system, hazmat movements not only pose safety concerns[30], but can also impact the capacity of the rail line. For example, a rail line that has been designated as "excepted" tracks can move a maximum of only five hazmat cars per train at a lower maximum allowed train speed. This limitation negatively impacts the overall capacity of the rail line (San Angelo MPO, 2010).

[30] Regarding safety issues concerning the movement of hazardous material by freight rail, the 80th Texas Legislature passed HB 160 directing TxDOT to conduct a study to determine the economic feasibility of relocating freight trains that carry hazardous materials away from residential areas of the state in municipalities with a population of more than 1.2 million. This study presented an evaluation of cost options for reducing the risk of hazardous material exposure, which included the relocation of freight trains from urban residential areas in Houston, San Antonio, and Dallas/Fort Worth.

Table 8.3: Hazardous Material Rail Movement in Texas

Category of Rail Movement	Origin	Destination	% of Total Hazardous Waste Rail Shipments by tonnage in Texas	Top Five Hazardous Materials Commodities Shipped by Rail
Internal	Texas	Texas	14%	Vinyl Chloride Petroleum Gas Liquid Caustic Sodium Petroleum Oil Sulfuric Acid
Through	Non-Texas	Non-Texas	18%	Freight Forward Traffic Ethyl Alcohol All Freight Rate Shipment Alcohols, NEC Petroleum Gas Liquid
Originating	Texas	Non-Texas	43%	Petroleum Fuel Chemicals, NEC Vinyl Chloride Vinyl Acetate Asphalt, Petroleum Liquid
Terminating	Non-Texas	Texas	25%	Petroleum Gas Liquid Sulfur Liquid Propylene Chlorine Gas Sulfuric Acid

"All Freight Rate Shipment" refer to break-bulk shipments with more than one commodity on the same carload/waybill.

Source: Warner et al., 2009

8.7 Concluding Remarks

This chapter illustrated some of the concerns as documented and expressed by freight stakeholders engaged in a dialogue to discuss statewide freight concerns and needs and is by no means an exhaustive list of the freight needs and issues in the state. Appendix C contains a more detailed discussion of freight needs and issues by economic region. The next chapter discusses a list of recommended policies and strategies proposed by Texas's freight stakeholders to address and alleviate some of the freight concerns and needs in the state.

Chapter 9. Policies, Strategies, and Improvements for Enhancing Freight in Texas

State transportation plans and "standalone" freight plans are increasingly listing freight policies, plans, and programs to address freight transportation needs given an increased awareness of the importance of the freight transportation system to a state's and region's economic competitiveness. The literature revealed that a number of states are considering initiatives such as truck toll lanes, congestion pricing, time shifting strategies to promote off-peak highway use, investments in advanced truck information systems, and strategies to divert freight traffic from road to rail. Some of these strategies are necessitated by inadequate funding for highway infrastructure capacity projects and the preservation of existing highway infrastructure. This chapter summarizes policies and strategies that have been proposed by Texas freight stakeholders[31] to enhance the movement of freight in the state.

9.1 Proposed Policies, Strategies, and Improvements

Table 9.1 illustrates major policies, strategies, and improvements that were proposed in the eight defined economic regions of Texas. In general, freight stakeholders supported investments in (1) highway capacity projects, (2) intelligent transportation systems (ITS), (3) improved incident management systems, and (4) additional intermodal facilities. Support was also expressed for funding to rehabilitate abandoned rail tracks and for investments in shortline railroad infrastructure. These proposals to improve Texas's freight transportation system are, however, predicated on securing adequate transportation funding. A number of stakeholders argued that a discussion of proposed policies, strategies, and improvements are mute until adequate funding[32] becomes available to implement the proposed policies, strategies, and improvements.

Similar to the discussion on freight concerns and needs, the proposed policies, strategies, and improvements are subsequently discussed in more detail under the following headings: (1) Texas's road system, (2) Texas's rail system, and (3) Texas's multi-modal system. Specific regional examples are highlighted as appropriate to illustrate the proposed policy, strategy, or improvement. These examples were obtained from the literature, including MPO plans, and the input and insight obtained during the Freight Shipper Workshops and the Freight Focus Groups. For a more detailed discussion of the proposed freight policies, strategies, and improvements by economic region, see Appendix C.

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[31] The information presented in this chapter was obtained from recently completed Texas freight-related studies (i.e., specifically for the N IH 35 Corridor and S IH 35 Corridor), the results from the mail-out mail-back shipper survey (see Appendix A), the telephone interviews with Chambers of Commerce, Economic Development Agencies, and MPOs, and the insight and input obtained from the Freight Shipper Workshops (see Appendix B) and the Freight Focus Groups (see Appendix C) that were conducted in six economic regions in the state (see Chapter 1).

[32] Several studies have been conducted to evaluate alternative funding initiatives, such as gas tax increases, weight-distance fees, tolling, container fees, and state sales taxes. It appears, however, that currently the political will does not exist to implement these funding initiatives (Mineta, Skinner, and Shane, 2009).

Table 9.1: Proposed Policies, Strategies, and Improvements

Report Section		West	Piney Woods	South Coastal	Panhandle	North Coastal	Central	N IH 35 Corridor	S IH 35 Corridor
9.2	***Texas Road System***								
9.2.1	Critical road capacity projects	X	X	X	X	X	X	X	X
9.2.2	Invest in Intelligent Transportation System	X	X	X		X		X	X
9.2.3	Improve incident management systems	X						X	
9.2.4	Allow higher productivity vehicles					X			
9.2.5	Implement dedicated truck lanes					X		X	
9.2.6	Incentives to divert truck travel to off-peak hours					X			
9.3	***Texas Rail System***								
9.3.1	Invest in short line railroads				X		X	X	
9.3.2	Rehabilitate abandoned rail tracks		X	X			X	X	
9.3.3	Accommodate seasonal shippers	X					X		
9.3.4	Improve access to rail yards	X						X	
9.3.5	Invest in at-grade crossings	X					X		
9.4	***Texas Multi-Modal System***								
9.4.1	Invest in intermodal facilities	X		X	X		X	X	X
9.4.2	Invest in port facilities			X		X			
9.4.3	Promote short-sea routes			X					

9.2 Texas's Road System

Most of the proposed road-related policies, strategies, and improvements focused on using existing road infrastructure more efficiently, such as by implementing ITS technologies, allowing higher productivity vehicles, providing incentives to trucking companies to travel during off-peak hours, and enhancing incident management systems. This can partly be attributed to inadequate funding for significant capacity projects to "build the state out of congestion." These efficiency improvements could alleviate some of the congestion concerns that were identified in many of Texas's large metropolitan areas (see Chapter 8).

9.2.1 Critical Road Capacity Projects

Although most of the proposed road related policies, strategies, and improvements focused on using existing road infrastructure more efficiently, critical road capacity projects were identified in all Texas's economic regions. These critical capacity projects ranged from capacity enhancement projects to alleviate congestion on major freight corridors to new capacity projects to improve system connectivity. Specific illustrative examples are provided below for some of Texas's economic regions.

Freight stakeholders in the Panhandle Region supported the development of the Texas Trunk System that will connect parts of the state and integrate rural communities through the provision of a high quality highway network. TxDOT envisions the Texas Trunk System to be a rural four-lane divided highway network that will improve mobility, connect major activity centers within Texas, and provide access to major points of entry (see Figure 9.1 for Phase 1 of the Texas Truck System). In addition, an extension of IH 27 to the Mexico border and a bypass around Amarillo are also being promoted in the region.

Figure 9.1: Texas Trunk System Phase 1 Corridors [6]

In the Piney Woods Region, the construction of IH 69 from US 59 is well supported as a means to increase highway capacity in the region. IH 69 will also serve as a major north-south corridor as there is currently no north-south interstate traversing the region. Both IH 20 and IH 30 traverse the area in an east-west direction.

In the West Texas Region, the number of highway corridors serving and traversing El Paso is constrained by the geographic location of the city on the border with Mexico, the location of the Fort Bliss army base, and the Franklin Mountains. As a result, most of the truck freight traffic in and through the region moves on a few parallel corridors, specifically IH 10. Both TxDOT and the El Paso MPO have identified a number of capacity projects to alleviate congestion on IH 10 in El Paso. For example, TxDOT has planned to construct four flyover connections—two of which were estimated to be bid in December 2009—between IH 10 and several arterial roads in an effort to address congestion along IH 10 (El Paso MPO, 2010). The El Paso MPO has also developed an ambitious plan to alleviate congestion through downtown El Paso and along IH 10 as part of their *"Mission 2035: Metropolitan Transportation Plan"* (El Paso, MPO, 2010).

In the Central Region, the completion of Loop 322—an urban expressway connecting US 83 and IH 20—has been strongly supported for several years. Three phases to add capacity have been completed: (1) from the US 83 interchange to FM 1750, (2) from FM 1750 to SH 36, and (3) from SH 36 to IH 20. Additional planned improvements include providing frontage bridges across Lytle Creek, enhancing frontage road operations, improving ramps to improve safety and operational efficiency, and extending Loop 322 to SH 351. The reconstruction of the Loop 322 interchange with IH 20 is also well supported, but currently no funding is available for this project (Abilene MPO, 2010).

In the South Coastal Region, a number of capacity projects for IH 69 are well supported to improve the landside access to the region's ports and border ports of entry. The Texas section of IH 69 is a trident-shaped network that connects Houston with Laredo, McAllen, and Harlingen. It is believed that major capacity investments in IH 69 are required to ensure the future economic competitiveness of the region.

9.2.2 Invest in Intelligent Transportation Systems

Stakeholders in six of Texas's economic regions supported additional investments in ITS in Texas. These ITS investments range from the implementation of dynamic message signs and speed detectors in the Dallas/Fort Worth area to traffic signal coordination in the El Paso area. In general, ITS investments in systems that monitor congestion (e.g., trip time), incidents (e.g., indicating location of incident and available route alternatives), and weather information are well received by the general public. ITS investments to improve information exchange solely for the benefit of the freight sector has, however, not been fully explored. For example, information on truck parking availability would be very beneficial to the trucking industry.

9.2.3 Improve Incident Management Systems

Freight stakeholders in the El Paso region supported investments to improve incident management systems. It was argued that improved incident management systems will help avoid delays at El Paso's border crossing facilities and surrounding roadways.

As part of efforts by the North IH 35 Corridor Region to address freight issues and improve the efficiency of the transportation system, NCTCOG initiated the Freeway Incident Management Training program. According to NCTCOG, "the goal of the Freeway Incident Management (FIM) training course is to initiate a common, coordinated response to traffic incidents that will build partnerships, enhance safety for emergency personnel, reduce upstream traffic accidents, improve the efficiency of the transportation system, and improve air quality in the Dallas/Fort Worth region." The training program has designed specific courses for both first responders and managers and executive level policy–makers (NCTCOG, 2010).

9.2.4 Allow Higher Productivity Vehicles

Freight stakeholders in the Piney Woods and North Coastal Regions argued for permitting to allow for the operation of higher productivity vehicles—i.e., long combination vehicles (LCVs)—in Texas. The benefits of allowing higher productivity vehicles are fewer trucks, fuel savings, and lower emissions to move the same amount of freight. On the other hand, concern has been expressed about the impact on bridges and pavements, as well as competition with the rail mode. The proposal to allow LCVs on Texas highways is well supported by truck industry advocates, who have requested federal and local legislatures to allow LCVs on the interstate system and Texas roads, specifically on significant freight corridors. TxDOT Research Study 0-6095 entitled "Potential Use of Longer Combination Vehicles in Texas" is currently exploring the feasibility of allowing LCVs on Texas roads.

9.2.5 Implement Dedicated Truck Lanes

Freight stakeholders in the North Coastal and the North IH 35 Corridor Regions, which contain the large metroplexes of Houston and Dallas/Fort Worth, respectively, have supported the idea of implementing dedicated truck lanes—although not necessarily truck toll lanes. Dedicated truck lanes are believed to alleviate the impacts of congestion on goods movement, reduce pavement consumption, alleviate passenger truck safety concerns[33], and potentially allow for efficiency gains if larger trucks can be accommodated.

9.2.6 Incentives to Divert Truck Travel to Off-Peak Hours

Freight stakeholders in the North Coastal Region recommended that incentives be provided to trucking companies to divert truck travel from peak to off-peak hours. It was pointed out that if the incentives were substantial enough, truck travel could be diverted to off-peak hours, alleviating congestion during peak hours in large metropolitan areas, such as Houston[34]. Some shipments are, however, time sensitive or require delivery during peak hours. In the latter case, such incentives will be ineffective in diverting truck travel to off-peak hours. It is unclear how effective this strategy would be without a clear understanding of how many trucking companies would subscribe.

9.3 Texas's Rail System

As opposed to most of the proposed road-related policies, strategies, and improvements that focused on using existing road infrastructure more efficiently, most of the proposed rail-related strategies and improvements require significant investments—for example, improving access to rail yards, upgrading rail track (i.e., investing in shortline railroad tracks), and rehabilitating abandoned rail track.

9.3.1 Invest in Short line Railroads

Freight stakeholders in four of Texas's economic regions supported investments in short line rail track. In general, it was felt that the Class I rail lines are well-maintained in Texas, but track upgrades and maintenance are required in the short line railroad industry. The situation is aggravated by the fact that the Class I railroads have invested in their track to allow the movement of 286,000 lbs railcars. The short line railroad industry in general does not have the funding to upgrade their track to the higher standards required for the movement of 286,000 lbs railcars. Warner and Terra (2006) found that approximately $250 million is needed to upgrade the short line rail infrastructure to support 286,000 lbs railcars. This inability of the shortline industry to handle these

> Short line railroads are a critical component of the U.S. railroad system. In 2005, one-third of all U.S. rail shipments originated or terminated on short line railroads. The infrastructure and operations of short line railroads and the Class I railroad companies therefore need to be compatible to ensure an efficient and reliable freight rail system. As the Class I railroads move towards the use of 286,000 lbs rail cars, the short line railroads would be increasingly required to handle these rail cars (Warner and Terra, 2006).

[33] Dedicated truck lanes have been implemented on several Texas highways to enhance road safety. A Texas Transportation Institute study (1997) found this strategy to be effective in reducing truck-related crashes by 68%.

[34] On the other hand, the Houston-Galveston Regional Transportation Plan (2007) discussed providing a disincentive (e.g., pricing) to divert truck travel to off-peak hours.

higher capacity rail cars introduces some inefficiency into the movement of freight by rail in Texas. In the Panhandle Region, specifically, freight stakeholders argued that short line infrastructure upgrades and repairs are needed to support the cotton and corn industries. Upgrades included investments to support 286,000 lbs railcars and to increase train speeds. In this region the West Texas & Lubbock Railroad (WTLC) is also promoting an extension of the WTLC line to the Port of Del Rio, eventually connecting to one of the Pacific seaports in Mexico. It was argued that this line would serve as an alternative north-south route through West Texas, diverting traffic from the Californian ports of Long Beach and Los Angeles and diverting traffic from some of the major east-west rail corridors that serve the Californian ports (Lubbock MPO, 2006).

9.3.2 Rehabilitate Abandoned Rail Tracks

Freight stakeholders in four of Texas's economic regions also supported the rehabilitation of abandoned rail tracks. For example, in the South Coastal Region, freight stakeholders pointed to an abandoned rail track that directly connects McAllen and San Antonio. It was argued that if this track were repaired, trains bound for San Antonio could bypass the switching yards in Harlingen and Corpus Christi, thereby alleviating shipment delays. Also, in the Piney Woods Region, concern was expressed about the future capacity of the current rail infrastructure. In this region, freight stakeholders also recommended the possible rehabilitation of rail lines that have been abandoned or fallen into disrepair. This was argued to be a potentially cost effective strategy as the railroad companies would only have to invest in the infrastructure. The right-of-way has already been acquired.

9.3.3 Accommodate Seasonal Shippers

Historically, rail has moved bulk commodities, such as grain, coal, and metallic ores. Some bulk commodities are produced seasonally, which typically translates into a significant increase in the number of shipments during certain peak months. Freight stakeholders have raised concern about the railroad's ability to provide quality service to some shippers during peak seasons. For example, agricultural shippers in San Angelo and the Texas panhandle have raised concern about the railroad's ability to provide adequate rail cars and locomotives during the harvesting season. Also, in San Angelo it was argued that Texas Pacifico (TxPF) needs to hire additional rail engineers during peak periods to ensure that the grains harvested can be shipped in a timely manner. The freight stakeholders in these regions argued that this inability of the railroads to serve seasonal shippers limits their ability to expand in the area. On the other hand, from the railroads' perspective it is not financially feasible to invest in equipment (i.e., rail cars and locomotives) that will not be utilized for a substantial part of the year. One strategy discussed at the San Angelo freight stakeholder meeting to accommodate seasonal shippers is increasing the capacity of the rail car siding at San Angelo Junction from 45 rail cars to 110 rail cars. In addition, stakeholders discussed the option of hiring full-time seasonal workers for the SORR during the harvest season.

9.3.4 Improve Access to Rail Yards

Most rail shipments are delivered to or collected from rail yards by trucks. Adequate access to rail yards is thus important in ensuring "seamless" intermodal transportation services. Inadequate access to rail yards was raised as a concern in the West Texas Region and was documented to be a concern in the North IH 35 Corridor Region. Specifically, freight stakeholders in West Texas expressed concern about access to the downtown rail yards in El Paso. Inadequate funding to relocate these rail yards to the outskirts of the city has increased the need to improve access to the existing yards. Freight stakeholders in this region thus supported investments to improve access to existing rail yards.

9.3.5 Invest in At-Grade Crossings

At-grade crossing safety was a major concern in most economic regions in Texas (see Chapter 8). In San Angelo, the MPO has been working with TxPF and TxDOT to address rail crossing concerns in San Angelo after receiving $1 million in July 2009 from the Subcommittee on Transportation, Housing and Urban Development Appropriations Committee.

9.4 Texas's Multi-Modal System

9.4.1 Invest in Intermodal Facilities

Freight stakeholders in six of Texas's economic regions supported additional investments in Texas's intermodal facilities. Intermodal facilities are viewed as an important element in achieving an efficient and "seamless" intermodal freight transportation service that ultimately enhances the economic competitiveness of a region. Following are examples of investments in intermodal facilities desired by Texas freight stakeholders.

> The planned transload facility at the Reese Technology Center is being designed to handle as many as 45,000 rail containers per year for the cotton industry alone. The existing regional container yard in the region has a capacity of 10,000–11,000 cotton containers per year. The planned transload facility will thus increase the region's capacity to move cotton containers by rail substantially. It will also allow cotton shippers to ship directly from Lubbock to the West Coast by rail, eliminating the need to move cotton to Dallas by truck, where it is loaded in rail containers and shipped through Lubbock to the West Coast (TxDOT, 2008).

- ***The Reese Technology Center, Lubbock:*** In Lubbock, there is a desire to develop a transload facility at the Reese Technology Center. The Reese Technology Center is located at the deactivated Reese Air Force Base, west of Lubbock. It is a 2,500-acre site on which the Lubbock Economic Development Alliance wants to establish a transload terminal to help alleviate some of the freight concerns in the region. Specifically, it is envisioned that the facility would serve agricultural shippers of cotton and peanuts. The facility is currently served by the WTLC, which connects to the BNSF line at Lubbock. The rail network from Reese is being considered for extension south to Seminole, Texas then west to Hobbs, New Mexico, connecting to the Texas–New Mexico Railroad (TNMR). This extension is expected to provide the Lubbock and West Texas area with rail access to the UP mainline through El Paso (TxDOT, 2008). As of 2008, the WTLC serves both the UP and the BNSF 3 days per week at the BNSF rail yards in Lubbock (TxDOT, 2008). The Reese facility would have the ability to receive and ship unit trains between the short line and the national rail lines without considerations for multiple stops and set-out moves (TxDOT, 2008).

- ***San Angelo Intermodal Facility, San Angelo:*** The San Angelo MPO and the City of San Angelo is exploring the feasibility of an intermodal facility in San Angelo at the intersection of the Ports-to-Plains Corridor and the SORR line. Proponents of the intermodal facility argued that the combination of the Ports-to-Plains Corridor and the SORR line provides an alternative U.S. trade corridor that can potentially serve industries in Mexico, the U.S., and Canada (San Angelo MPO, 2010). The facility could also support the growing wind energy industry in West Central Texas (City of San Angelo, 2010).
- ***Santa Teresa Intermodal Facility, El Paso:*** The Santa Teresa Intermodal Facility aims to relocate the intermodal facilities and several freight rail lines from downtown El Paso to the proposed Santa Teresa site. This relocation will allow for the redevelopment of the existing rail right-of-way and is anticipated to hold significant benefits for El Paso's citizens (El Paso MPO, 2010). It is being promoted as a regional solution that involves stakeholders, such as UP, BNSF, and Ferromex railroads; the El Paso MPO; the City of El Paso; TxDOT; and the New Mexico Department of Transportation; among others. The construction of the proposed Santa Teresa Intermodal Facility has, however, been delayed by UP due to inadequate funding.

9.4.2 Invest in Port Facilities

Freight stakeholders in both the South and North Coastal regions supported additional investments in port facilities as ports are viewed as a critical component of Texas's freight transportation system. The Ports of Houston and Galveston have signed a memorandum of understanding to explore the feasibility of a future container handling facility on Pelican Island, located just north of the Port of Galveston. This facility may be required to serve future container demand when the Panama Canal expansion is completed and global shipping routes evolve (TxDOT, 2009).

Freight stakeholders in the South Coastal Region have been very supportive of the development of an intermodal container facility on the La Quinta Channel of the Port of Corpus Christi. The development site—located 17 miles from the Gulf of Mexico—is considered ideal given deep water conditions, available space for future expansion, no substantial environmental obstacles, and access to uncongested highways, such as US 181, IH 37, SH 35, as well as three Class I railroads. Already, permits have been obtained from the U.S. Army Corps of Engineers to extend the channel to the development site, dredge a turning basin, and construct a wharf. In addition to a container facility with a capacity of handling 1.5 million TEUs, it is also anticipated that the development site could accommodate break bulk cargo, cross-docking, warehousing and distribution facilities, as well as a truck chassis pool (Port Professionals Group, 2009). It is believed that such a facility could significantly enhance freight movement in the region by (a) providing an alternative to the current container facilities in the Houston area, (b) providing an improved service to traffic originating from Mexico, and (c) serving as an import center for Panama Canal traffic, which is expected to increase substantially after the Panama Canal expansion (Corpus Christ MPO, 2009; Port Professionals Group, 2009).

9.4.3 Promote Short-Sea Routes

Freight stakeholders in the South Coastal Region were also very supportive of promoting short-sea shipping. It was argued that as the demand for surface modes (i.e., truck and rail) increasingly exceeds capacity over the next 20 years, there will be an increasing need to utilize water-based modes, particularly for the movement of intra-continent freight[35]. Stakeholders felt that the ports at Corpus Christi and Brownsville, as well as the smaller ports along the Laguna Madre, have the opportunity to accommodate short sea services across the Gulf of Mexico. To some extent the success of short sea shipping has already been demonstrated in the South Coastal Region by the Port of Brownsville's partnership with Port Manatee in Florida (International Trade Group, 2009). It was thus recommended that the ports in the South Coastal Region should seek out short sea opportunities and invest in improved landside access to facilitate short sea shipping.

9.5 Concluding Remarks

This chapter summarized the policies and strategies that have been proposed by Texas freight stakeholders to enhance the movement of freight in the state. To some extent the discussion was tempered by the economic climate and inadequate transportation funding at the time when the freight stakeholders were consulted. Some freight stakeholders argued that any discussion of policies and strategies are premature given the lack of funding to implement the proposals. Most of the proposed road related policies, strategies, and improvements thus focused on using existing road infrastructure more efficiently, such as by implementing ITS technologies, allowing higher productivity vehicles, providing incentives to trucking companies to travel during off-peak hours, and enhancing incident management systems. On the other hand, most of the proposed rail and multi-modal strategies and improvements entailed significant investments. For example, some of the rail-related investments included improving access to rail yards, upgrading rail track (i.e., investing in shortline railroad tracks), and rehabilitating abandoned rail track. The proposed multi-modal strategies included investing in intermodal and port facilities. The next chapter discusses a number of freight performance measures that can assist transportation agencies in the development, implementation, and management of their transportation plans and programs.

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[35] The U.S. Department of Transportation (2006) conducted a case study analysis to evaluate the potential performance of four short sea routes that served major U.S. ports. One of the case studies considered the potential cost, transit time, and operating margin of a short sea route between Beaumont, TX and Camden, NJ. It was concluded that the short sea trip would be lengthier, but significantly cheaper than truck and similar in cost to rail. Given a very congested surface freight network, the potential thus exists for short sea shipping to gain greater market share, resulting in more competitive prices.

Chapter 10. Freight Performance Measures for Texas

Performance measures can assist transportation agencies in the development, implementation, and management of their transportation plans and programs. They can (a) provide greater insight into the performance of the current transportation system, (b) provide a means to establish suitable goals and targets, (c) allow agencies to rank capital investments and evaluate alternative programs, and (e) provide a rationale for allocating resources. Furthermore, performance measures can assist an agency in monitoring progress towards achieving specific transportation goals and targets. The use of performance measures can be driven by internal factors to facilitate agency planning decisions (e.g., prioritization of projects) or by external factors that require sharing reliable performance information with the public or the need to make decisions more transparent (Cambridge Systematics, 2000). This chapter presents a list of recommended freight performance measures for Texas. The freight performance measures were identified from an extensive literature review and discussed with Texas freight stakeholders during the Freight Stakeholder Focus Groups that were conducted as part of this research study.

10.1 Freight Performance Measures Defined

Performance measurement is defined by the U.S. Government Accountability Office (1998) as *"the process of developing measurable indicators that can be systematically tracked to assess progress made in achieving predetermined goals and using such indicators to assess progress in achieving these goals."* The literature revealed several documents on the topic of performance measurement. Several states, such as Minnesota and Oregon, have also allocated funding towards the development of suitable Freight Performance Measures (FPMs) for their states. The quantification and tracking of suitable FPMs, however, seem to be hampered by inadequate data.

For the purpose of this study, the study team aimed to identify suitable FPMs that can be used to (a) assess the current performance of Texas's freight transportation system (i.e., identify bottlenecks or areas where freight performance is constrained) and (b) select or prioritize freight improvement projects. Furthermore, the identified FPMs had to be easy to understand and communicate to a wide range of stakeholders, and the necessary data to quantify the FPMs needed to be readily available or at least the potential needed to exist to obtain the information (e.g., from the private sector through surveys).

FPMs that met these requirements were identified from the literature and grouped into four categories:

- maintenance and preservation;
- mobility, reliability, and congestion;
- safety/environmental impact; and
- accessibility and connectivity.

The FPMs under each of these four categories are summarized in Table 10.1. These FPMs were presented to freight stakeholders that participated in the Freight Stakeholder Focus Groups conducted as part of this research study.

Table 10.1: Potential Freight Performance Measures

Maintenance and Preservation
Major Highway Corridors
Percentage of pavement in good condition (or unacceptable condition)
Number of weight-restricted bridges divided by total number of bridges
Bridges scheduled for repair or replacement
Major Rail Corridors
Miles of excepted track (or FRA Class I) divided by total miles of Class I track
Railroad track capacity or service levels
Mobility, Reliability, and Congestion
Major Highway Corridors
Hours of congested conditions per day
- Average speed by time-of-day
- Average hours of delay per day
Level of Service—ratio of peak travel time to free-flow travel time
Travel times/average travel time
- Average travel time
Major Rail Corridors
Average terminal dwell time (train-hours of delay)
Average train travel time by route
Landside access to facility
- Queuing of vehicles
- Turning radius into facility
Delay of trucks at facilities (total transfer time)
Safety/Environmental Impact
Major Highway Corridors
Number of accidents/fatalities involving trucks
Number of accidents/fatalities involving trucks (truck at fault)
Freight loss and damage costs from accidents/VMT
Major Rail Corridors
Loss and damage from accidents per mile
Loss and damage from accidents per ton moved
Train derailments per tons moved
Number of at-grade crossing accidents
Emissions (greenhouse gas [GHG] emissions per mile or GHG emissions per ton-mile)
Energy efficiency (gallons per mile or gallons per ton-mile)
Accessibility/Connectivity
Percentage of shippers within x miles of an intermodal facility
Number or capacity of intermodal facilities
Intermodal train services by city pair

The next sections summarize the input and insight that were obtained from freight stakeholders regarding the identified FPMs, as well as any challenges that may be encountered in terms of obtaining the required data. Additional FPMs that were recommended are also listed and discussed where appropriate.

10.2 Maintenance and Preservation

FPMs in this category aim to identify areas where a lack of maintenance expenditures or preservation investments is constraining freight movements on existing highway and rail corridors in Texas. Maintaining Texas's major freight corridors is important because they directly impact the costs of the operators and, from TxDOT's perspective, maintaining a road is far less expensive than rehabilitating a road.

10.2.1 Major Highway Corridors

As mentioned in Chapter 8, in most of Texas's eight economic regions, freight stakeholders expressed concern about the maintenance of Texas's existing road infrastructure. Specifically, Texas's freight stakeholders are concerned that budget shortfalls and inadequate transportation funding will impact the maintenance and preservation of Texas's critical freight corridors. In this regard, bridges are also a key part of Texas's freight corridors. Functionally obsolete or weight-restricted bridges on major truck corridors can necessitate the re-routing of oversize and overweight loads onto more circuitous routes, increasing the costs of trucking shipments.

The following three FPMs were thus presented to Texas freight stakeholders as a means to identify any areas where freight movement is constrained or to prioritize maintenance or preservation investments in major highway corridors:

- percentage of major freight corridor pavement in "good" condition (or unacceptable condition),
- number of weight-restricted bridges divided by total number of bridges by major freight corridor, and
- number of bridges scheduled for repair or replacement by major freight corridor.

The data needed to quantify these FPMs are collected and regularly updated by TxDOT. TxDOT maintains a sophisticated Pavement Management Information System (PMIS) that contains performance information for all roads constructed and maintained by TxDOT. The PMIS database, for example, already captures a pavement condition index, which is a weighted composite index that combines pavement surface defects and ride quality (roadway roughness) into a single value that ranges from 1 (worst condition) to 100 (best condition). A pavement section is regarded in "good" or better condition if its overall score is 70 or above. Once the major highway corridors are thus clearly identified, pavement condition information can be extracted from TxDOT's PMIS database.

Similarly, TxDOT has developed a performance measure that indicates the percentage of bridges in Texas that are in "good" condition. TxDOT calculates the percentage of bridges in "good or better" condition using data collected during regularly scheduled bridge safety inspections. The data is stored in a statewide bridge inventory and inspection database. The data required for the second and third FPM listed earlier are available from the bridge inventory and inspection database[36].

[36] From the database, TxDOT calculates the number of bridges that are load-restricted and reports them in a "sub-standard for load only" category.

In addition to these measures, freight stakeholders in El Paso recommended the consideration of a FPM that will determine the impact of heavy truck traffic on Texas's major highway corridors. Specifically, measures to quantify the impact of NAFTA traffic on major highway corridors were recommended, such as:

- maintenance cost per truck, or
- maintenance cost per truck-mile.

Some stakeholders argued that these measures could also be used by TxDOT for planning purposes and future pavement design.

10.2.2 Major Rail Corridors

The FRA has developed a system of track classes to describe the quality and condition of rail track infrastructure. The track class determines the maximum speed at which a freight train can operate over the specific track. In principle there are ten classes of rail track, of which one is "excepted track."

Two FPMs were presented to Texas freight stakeholders as a means to identify any areas where rail freight movement is constrained by the condition or quality of the rail infrastructure on important rail corridors:

- miles of excepted (or FRA Class 1) track divided by total miles of Class I rail track by rail corridor, and
- railroad track capacity or service levels.

When rail track is classified as "excepted track," it means that the condition of the infrastructure has deteriorated to the point that freight trains are allowed to operate only at speeds up to 10 mph over the track. Also, no more than five cars with hazardous material can be moved by a train that is operating on excepted track. On FRA Class I tracks, a freight train is allowed to operate at 10 mph. The FPM can be used to identify and monitor track condition concerns on important rail corridors. The data to calculate this FPM are available from the FRA Regional Offices.

Rail track capacity is defined as the maximum number of trains that can be moved in each direction over a specified section of track in a 24-hour period[37]. Service levels are a measure to establish whether rail volumes are below, near, at, or above rail capacity in a corridor. The data to calculate these FPMs are not publicly available and would need to be obtained from the railroad companies. Although some stakeholders felt that the calculation of these FPMs would provide TxDOT with valuable information about the capacity of major rail corridors, the representatives of the railroad companies that participated in the freight focus groups were unsure whether the railroads would be willing to share this information with TxDOT. Service levels, in general, are viewed as proprietary information and are regarded as confidential by the railroad companies.

In addition to these FPMs, freight stakeholders in the Panhandle Region recommended creation of a FPM that pertains to the shortline railroad industry, specifying that the *"percentage of rail track-miles that can accommodate 286,000 lbs rail cars"* be added. This information can

[37] Dictionary of Military and Associated Terms. U.S. Department of Defense (2005).

help stakeholders focus investments on tracks that need to be reconstructed to accommodate the higher weight railcars. The information is available from the railroad companies and the FRA.

10.3 Mobility, Reliability, and Congestion

A review of the literature on performance measurement revealed that most of the established performance measures related to the measurement of mobility, reliability, and congestion concerns (Varma, 2008). This focus is understandable as these concerns increase the costs of doing business and ultimately results in higher product prices charged to consumers. Numerous performance measures have thus been recommended and quantified to provide insight into these concerns. This section summarizes the insight obtained from Texas freight stakeholders as to the feasibility of the mobility, reliability, and congestion FPMs presented to them.

10.3.1 Major Highway Corridors

Three FPMs were presented to the freight stakeholders that could be used to determine whether congestion is impacting mobility and the reliability of Texas's major highway freight corridors:

- hours of congested conditions per day by major highway corridor (expressed in terms of the average speed on major freight corridors by time of day and or the average hours of delay per day on important freight segments of the corridor);
- level of service of major highway corridors expressed in terms of the ratio of peak travel time to free-flow travel time[38]; and
- average travel time by major highway corridor.

The quantification of these three recommended FPMs is a function of the availability of accurate travel speed information by time of day. Travel speed information is collected in Texas's major metropolitan areas. This information, however, will need to be reviewed for consistency and may have to be supplemented to ensure all Texas's major highway corridors are covered. In addition, TxDOT can consider adopting the approaches that have been documented by the FHWA (2006) in the document entitled *"Freight Performance Measurement: Travel Time in Freight-Significant Corridors."* In this study, the FHWA selected five interstate highways that accounted for nearly 25% of the truck ton-miles moved. The study collected latitude and longitude data from 250,000 trucks equipped with automatic vehicle location devices (e.g., GPS) nationwide. Anonymous, randomly generated identification numbers was used to maintain the confidentiality of truckers and trucking companies. From the location data and the time stamp at which the data were collected, average speeds could be calculated on the highways (FHWA, 2006).

[38] The ratio of peak travel time to free-flow travel time is a measure to show how much longer it takes to travel on the corridor during peak hours relative to non-peak hours. For example, a ratio of 1.30 indicates a 20-minute trip during off-peak hours will take 26 minutes during the peak period. This FPM can be used as a measure to monitor congestion on major highway corridors or to measure travel time reliability by corridor.

10.3.2 Major Rail Corridors

In a number of Texas's economic regions, freight stakeholders expressed concern about the capacity of Texas's rail system and inadequate access to major rail facilities in the state. Four FPMs were presented to the freight stakeholders that could potentially be used to determine whether congestion or landside access issues are impacting Texas's freight rail system:

- average terminal dwell time (train-hours of delay);
- average train travel time by corridor;
- landside access to facility (expressed in terms of queuing time of trucks entering the facility and or the turning radius into the facility); and
- delay of trucks at facilities (total transfer time).

Average terminal dwell time is defined as the average time a car resides at the specified terminal location expressed in hours. The measurement begins with a customer release, received interchange, or train arrival event and ends with a customer placement (actual or constructive), delivered or offered in interchange, or train departure event[39]. Average train travel time by corridor is defined as travel time in hours between a train's origin and destination points on a specified corridor. Finally, total transfer time is defined as the sum of truck queue time and the time it takes to drop-off or pickup cargo at the rail terminal. The data required to quantify these recommended FPMs have to be collected through surveys (i.e., the landside access to facility and the total transfer time FPMs) and obtained from the private rail companies (i.e., average terminal dwell time and average train travel time by corridor FPMs). In the case of all the recommended FPMs, an agreement will have to be established with the private rail companies to collect and obtain the necessary information. The railroad representatives that participated in the freight stakeholder focus groups, however, pointed out that it is highly unlikely that the railroad companies would be willing to share this information with transportation agencies. These representatives referenced the performance data that the railroad companies report to the AAR as a possible alternative to the recommended FPMs. The data include weekly information about rail cars, train speed, and terminal dwell time. The data are, however, reported in the aggregate and cannot be disaggregated for specific corridors or for particular rail facilities.

In addition, freight stakeholders in El Paso also recommended the inclusion of a FPM that measures delay at border ports of entry, i.e., average travel time and delay time at border crossings by time of day. Some argued that these FPMs could be valuable in informing investment decisions and prioritizing infrastructure and operational projects. The FHWA and TxDOT in collaboration with the Texas Transportation Institute are conducting border wait time studies for commercial vehicles on some Texas border points of entry. The studies are using radio-frequency identification (RFID) technology, which provides a data stream of tag reads and time stamps. The data stream is to be processed and archived in a Central Processing System and disseminated to users as border crossing performance measurements via the Regional Mobility Information System (Hitzfelder and Carlos Villa, 2010)

[39] Cars that move through a terminal on a run-through train are excluded, as are stored, bad ordered, and maintenance of way cars (AAR).

10.4 Safety/Environmental Impact

One of TxDOT's strategic goals is to enhance the safety of all Texas's transportation system users. A number of states have developed safety-related FPMs that can potentially be used to assess the safety of Texas's freight transportation system and to select safety improvement projects (McMullen, 2010). This section provides the feedback obtained from Texas's freight stakeholders on the recommended safety and environmental FPMs.

10.4.1 Major Highway Corridors

Three FPMs were presented to the freight stakeholders that can be used to assess any safety concerns on Texas's major truck corridors and to inform safety investments:

- number of accidents/fatalities involving trucks;
- number of accidents/fatalities involving trucks, where the truck was at fault; and
- freight loss and damage costs from accidents/VMT.

These FPMs would be calculated by major highway corridor. When an incident occurs on a Texas highway, a police accident report is filed with fairly detailed information about the incident. At least for the first two FPMs, incident information can be obtained from filed police reports. The information is, however, not necessarily comprehensive or captured in a format that facilitates the calculation of the FPMs. Information on freight loss and damage costs from crashes can potentially be obtained from the National Association of Insurance Commissioners and the American Insurance Association. However, considerable resources would likely be required to extract the needed information in a format that facilitates the calculation of the recommended FPMs.

In addition to the above FPMs, freight stakeholders also recommended the addition of the *"number of hazmat incidents/truck ton-miles"* by highway corridor FPM. The Hazardous Materials Information System (HMIS) captures information about all unintentional releases of a hazardous material during transportation by mode. This database, as well as the police accident reports, can provide the data required to quantify the FPM. As with the other safety FPMs, extracting the needed information would require both time and staff resources.

10.4.2 Major Rail Corridors

Four FPMs were presented to the freight stakeholders that can be used to assess any safety concerns impacting Texas's freight rail system and to inform safety investments:

- loss and damage from accidents per mile;
- loss and damage from accidents per tons moved;
- train derailments per tons moved; and
- number of at-grade crossing accidents.

These FPMs would also be calculated for each major rail corridor. Upon presenting these FPMs, some stakeholders recommended that the rail and highway measures be comparable. Secondly, some mentioned that these indicators are already quantified by the railroad companies, but that the information may be sensitive. If similar FPMs are, however, calculated for the highway mode, some railroad companies may be willing to provide the information for the rail mode. Regarding train derailments, the recommendation was that caution be exercised in defining train derailments. Often at rail facilities a derailed car wheel would be recorded as a derailment, but no loss or damage of goods occurs. Representatives of the railroad companies emphasized the importance of distinguishing between these types of derailments and train derailments. Stakeholders advised that this FPM consider only derailments with associated loss or damage of goods. Finally, detailed information is already available on the number of annual at-grade crossing accidents that can be used in quantifying the last FPM.

10.4.3 Environmental Criteria

The first proposal for national fuel economy and greenhouse gas emissions (GHG) standards for freight trucks was announced by the National Highway Traffic Safety Administration (NHTSA) and the Environmental Protection Agency (EPA) on October 25, 2010 (Patton, 2010). The proposal recommended measuring fuel efficiency in terms of gallons per ton-mile and GHG emissions in terms of grams of carbon dioxide per ton-mile. The standards were presented by truck category and are expected to take effect in 2014 (Patton, 2010). Given the expectation of an increased emphasis on energy efficiency and reduced emissions associated with Texas's freight transportation system, the following two environmental FPMs were presented to Texas freight stakeholders:

- an emissions measure expressed in terms of GHG emissions/mile or GHG emissions/ton-mile; and
- an energy efficiency measure expressed in gallons/mile or gallons/ton-mile.

To calculate the FPMs by highway or rail corridor, data is needed about the age of the equipment using the corridor, the fuel and emissions characteristics of the equipment, the miles driven, and the tonnage moved over the corridor. Although these measures have been estimated for the highway mode, the data for the rail mode will have to be obtained from the railroad companies and whether the railroad companies would be willing to share this information is unclear.

10.5 Accessibility/Connectivity

As stated earlier, access to intermodal facilities is viewed as an important element in achieving an efficient and "seamless" intermodal freight transportation service that ultimately enhances the economic competitiveness of a region. Freight stakeholders in six of Texas's economic regions thus supported additional investments in Texas's intermodal facilities. Three FPMs were presented to Texas's freight stakeholders to assess the need for an intermodal facility or to prioritize investments in intermodal facilities:

- percentage of shippers within x miles of an intermodal facility;
- number or capacity of intermodal facilities; and
- intermodal train services by city pair.

Similar to most of the FPMs that pertain to the rail mode, two of the recommended FPMs (number or capacity of intermodal facilities and intermodal train services by city pair) require information and data from the rail companies. Apparently, this information may potentially be less sensitive than the data required for the maintenance and preservation, and the mobility, reliability, and congestion FPMs. The data for the first FPM need to be collected, but in general, Texas's freight stakeholders were less supportive of this FPM. They were not clear as to the value in quantifying and tracking this FPM. Rather, some felt that a FPM that tracks the adequacy of existing intermodal facilities is a more valuable measure. A discussion as to how to define "adequate" would be the next step if this FPM is adopted.

10.6 Concluding Remarks

This chapter presented a list of recommended freight performance measures for Texas and the insight obtained on each from stakeholders that participated in the Freight Stakeholder Focus Groups conducted as part of this research study. The information presented in this chapter makes clear that access to data is critical to the development of these freight performance measures—whether they are used to assess concerns and deficiencies or to prioritize investments. Specifically, most of the data needed to quantify the rail performance measures needs to come from the railroad companies. Some of this information is sensitive and some stakeholders pointed out that the rail companies would be unwilling to make the information available. The importance of developing appropriate freight performance measures for Texas needs to be communicated with the private railroad industry and an agreement for information needs to be reached to enable TxDOT to plan and facilitate a multimodal freight transportation system that meets the needs of Texas shippers.

Chapter 11. Texas Freight Stakeholder Working Group

A number of states have entered into a dialogue and working relationship with the private sector as stakeholders when conducting statewide freight planning. It had been argued that the input from the private sector can be invaluable to a transportation agency. By communicating with representatives from the freight railroad companies, the trucking industry, air cargo carriers, ports, airports, border ports of entry, private businesses, third-party logistics suppliers, economic development agencies, chambers of commerce, universities, and industry shippers, a transportation planning agency can obtain input and feedback on issues and needs that have to be addressed, such as programming and financing decisions, and needed infrastructure improvements to alleviate bottlenecks. These stakeholders may also provide the agency with an avenue to verify or obtain additional freight data. As part of this study, the research team thus attempted to establish the interest, feasibility, and requirements for engaging freight stakeholders and forming a Freight Stakeholder Working Group in Texas. This chapter of the report summarizes the research team's findings on the experiences of other states that have implemented a Freight Advisory Committee or Freight Stakeholder Working Group, as well as the interest in developing a Freight Stakeholder Working Group for Texas.

11.1 Freight Stakeholder Groups

A number of states have Freight Advisory Committees/Freight Stakeholder Working Groups, including California, Colorado, Delaware, Florida, Iowa, Indiana, Kansas, Louisiana, Maine, Maryland, Massachusetts, Minnesota, Mississippi, New Jersey, Oregon, Pennsylvania, Virginia, and Washington (Brogan, 2001; Brogan, Brich and Demetsky, 2001; Cambridge Systematics, 2003; Kale, 2005).

These groups/committees vary in their mandate from formal groups established through legislation or statute to more informal groups that assist and work with transportation planning agencies without a formal mandate. The Oregon Freight Advisory Committee serves as an example of the former (see text box), while the freight advisory panel in Minnesota serves as an example of the latter.

> The *Oregon Freight Advisory Committee* was established in August 1998 by the Oregon Department of Transportation (ODOT) Director to fulfill the stakeholders' desire to give freight more visibility in ODOT policy, planning, and programming. In 2001, the Oregon Legislature formalized the Committee through the passage of House Bill 3364 with the functions of advising the ODOT Director and the Oregon Transportation Commission (OTC) on issues, policies, and programs that impact multimodal freight mobility in Oregon and identifying high-priority freight mobility projects for consideration in ODOT's statewide, regional, and local Transportation Improvement Programs (TIP).

The role of these groups or committees can be to provide a forum for the private sector to provide input and exchange ideas concerning the freight sector. In other words, to "give freight a voice" and to ensure that freight transportation needs are considered in the planning process. The potential role of a Freight Advisory Committee/Stakeholder Working Group can thus be to (a) assist an agency in identifying freight transportation needs, (b) provide input on freight transportation policies and the development of freight performance measures, (c) assist in the identification of

> In 2003, the Oregon Legislature through House Bill 2041 authorized the Oregon Freight Advisory Committee to recommend and prioritize $100 million in freight mobility projects (ODOT, ND).

funding opportunities and partnerships between the public and private sectors, (d) assist in the prioritization of freight concerns, (e) communicate the importance of freight investments to the public, elected officials, and other public agencies, and (f) recommend freight research areas and needs. The anticipated role of the committee determines the mission, purpose, and objectives of the group. For example, the *mission* of the Oregon Freight Advisory Committee is

> "To advise the Oregon Department of Transportation, Oregon Transportation Commission and Oregon Legislature on priorities, issues, freight mobility projects and funding needs that impact freight mobility and to advocate the importance of a sound freight transportation system to the economic vitality of the State of Oregon" (FHWA, 2009).

The *purpose* of the Virginia Freight Advisory Committee is to

> "Provide input on the freight study, including recommendations on how to structure the study, identification of major issues and where to target resources, and insight into the freight business.
>
> Provide a mechanism for communication with the larger freight community.
>
> Facilitate partnerships to improve freight mobility and planning.
>
> Assist in developing an Action Plan to ensure implementation of recommendations identified in the study" (FHWA, 2009).

Finally, the *objectives* of the Colorado Freight Advisory Council are to

> "Serve as a forum for discussion regarding freight movement and freight infrastructure within Colorado.
>
> Educate freight interests regarding local, regional, and statewide transportation planning processes.
>
> Educate the public sector regarding the importance of freight infrastructure throughout the state.
>
> Work with the State Transportation Advisory Committee to incorporate freight interests into transportation planning to improve freight infrastructure.
>
> Improve statewide understanding of the importance of freight transportation to Colorado" (FHWA, 2009).

To some extent the role of the committees or groups also determines the structure of the committee or group. In some cases, these committees or groups have a chair, vice chair, and members that are appointed by, for example, the executive director of the state DOT. The Oregon Freight Advisory Committee's legislative mandate stipulates that the Director of ODOT will appoint committee members, and bylaws further stipulate the size of the committee and the provisions for membership. Furthermore, in the case of some freight communities, sub-committees have been formed to address specific freight modal concerns. Typically, these committees or groups require the endorsement and support of senior decision-makers and senior management in public organizations and private companies, respectively. This provides the committee or group with the appropriate stature and ensures that policies or recommendations are provided the necessary consideration.

Although Freight Advisory Committees or Stakeholder Working Groups are not above challenges, the benefits of these committees and working groups can be substantial. For example, it has been shown that involving the private sector can (a) enhance the sector's acceptance of transportation programs, (b) assist in promoting the role of freight to a region's competitiveness, (c) improve the support and cooperation of industry when agencies are collecting data, (d) facilitate the creation of public private partnerships, and (e) assist in securing political support for freight investments (FHWA, 2009). Nonetheless, the feasibility and sustainability of Freight Advisory Committees/Stakeholder Working Groups are often challenged by the effort required to keep the private sector involved and engaged over a long period of time; i.e., maintaining stakeholder interest. Care should thus be exercised not to "over-promise" the potential role and influence of a committee or group and it is of critical importance that agency staff use committee input and acknowledge stakeholders for their input.

11.2 Potential for a Texas Freight Stakeholder Working Group

During this study, the potential interest in implementing a Texas Freight Stakeholder effort was raised with representatives of the freight railroads, the trucking industry, ports, border ports of entry, private businesses, third-party logistics suppliers, economic development agencies, chambers of commerce, and industry shippers, among others. These representatives were asked whether they would be interested in a stakeholder effort that could have the following role:

- liaise with TxDOT in identifying freight issues, concerns, or bottlenecks concerning Texas's freight transportation system,
- work with TxDOT in identifying and securing available freight data, and
- liaise with TxDOT in identifying and prioritizing freight improvements, policies, strategies, and freight performance measures.

Approximately 35 companies and agencies expressed an interest in working with TxDOT in developing and implementing a Freight Stakeholder Working Group for Texas (see Table 11.1).

The existing Freight Advisory Committees/Stakeholder Working Groups tend to have modal sub-committees. It is, however, recommended that for Texas, the emphasis should be on regional representation—i.e., ensuring the participation of freight stakeholders from all economic regions in Texas—as opposed to modal/industry representation. This will potentially temper the focus on individual modes or major industries, but will promote a vision of ensuring an efficient multimodal freight transportation system for the entire shipping community in Texas. The companies and agencies listed in Table 11.1 present a diverse range of freight perspectives and interests in the various economic regions of Texas. These companies and agencies represent a good starting point for the establishment of a Texas Freight Stakeholder Working Group.

Table 11.1: List of Interested Companies

Company	Number of Interested Participants
ACT Pipe & Supply	1
AlonUSA	1
Brazos Valley Council of Governments	1
Buddy's Plant Plus Corp	1
City of El Paso	1
City of Portland Texas	1
Crady, Jewett & McCulley, LLP	1
Dannenbaum Engineering Corporation	1
DuPont	1
East Texas Council of Governments	1
Environmental Infrastructure Planning	1
Freese and Nichols	1
GE Energy	1
Halliburton	1
Houston-Galveston Area Council	1
Kasberg Grain Company	1
Lodestar Logistics	1
Lubbock Chamber of Commerce	1
Merichem Chemicals & Refinery Services LLC	2
San Angelo MPO	1
Pecos Economic Development Corporation	1
Permian Basin Railways	1
Plains Cotton Cooperative Association	1
Port of Corpus Christi	1
Port of Victoria	1
Ports-to-Plains Alliance	1
Reese Technology Center	1
Satellite Logistics Group	1
Shell Pipeline Company LP	1
Texarkana MPO	1
Texas Docks & Rail Company, Ltd	1
Texas Tank Car Works – San Angelo	1
Texas Department of Transportation	2
U.S. Customs and Border Protection	1
UP Railroad	2

11.3 Concluding Remarks

It is recommended that the feasibility and mandate of a Texas Freight Stakeholder Working Group be explored during a meeting of interested freight stakeholders. During such a meeting, a FHWA freight peer exchange can be hosted that would allow other State DOTs with an established Freight Advisory Committee or Stakeholder Group to share their mandates, roles, and objectives, as well as successes, benefits, and challenges that have been experienced. At the conclusion of the peer exchange, attending members can work together with TxDOT to decide on the concept for Texas, as well as the mandate, role, and objectives of a Texas Working Group.

Chapter 12. Conclusions and Recommendations

Freight movements are derived from the need to move intermediate inputs and final products to production and consumption industries and centers in Texas, the U.S., and internationally. Efficient, reliable, and safe freight transportation supports economic development, the expansion of international trade, increases national employment, growth in personal income and the GDP of a region, and improves the quality of life of its citizens. However, dramatic increases in freight volumes have also resulted in concerns about the growing disparity between demand and the capacity of the freight transportation system.

Intermodal and freight concerns have thus received increasing attention in the wake of globalization, increasing congestion, and changes in the logistics structure of shippers. Both the 1991 ISTEA and the subsequent reauthorization of TEA-21 emphasized an understanding of the freight transportation sector as critical to transportation planning. Clearly freight capacity needs to be addressed if the U.S. is to maintain, let alone advance, its economic standing in the world economy. This requires an improved understanding of the factors impacting freight demand, as well as robust models and data to estimate future freight demand.

Against this background, the objective of this research study was to analyze relevant freight data and to start engaging Texas's shippers and freight stakeholders in a dialogue to provide insight into (a) *how, why, who, what, and where* freight moves on Texas's transportation infrastructure, (b) whether Texas's transportation system is adequate in serving business needs, and (c) any improvements deemed necessary to serve Texas businesses better. The emphases of this study were thus on engaging the freight community[40] in Texas and gaining insight into their perceptions of major statewide or aggregate freight issues rather than duplicating the detailed and comprehensive consultancy efforts that were underway.

12.1 Understanding Freight Demand

Freight demand is a function of regional, national, and international economic and demographic factors, operational factors, infrastructure, public policy and regulations, and environmental factors. Changes in any factor within these categories can cause changes not only in some or all of the other factors, but also impact the quantities and method of transporting freight demand (Cambridge Systematics, Inc., et al., 1997). Examples of these categories of factors follow.

- Economic factors: The freight transportation sector of a region or country has an important role in facilitating regional and national trade and economic development. On the other hand, increased development and trade also impacts the freight transportation system. Examples of economic factors include economic activity as measured by state GDP, shipment values, specific market locations, specific market competitiveness, employment by sector, and value and tonnage of production by industry (e.g., agriculture, manufacturing, and mining). Changes to any of these factors could potentially have a direct impact on the amount and movement of freight in a region or at the national level.

[40] The research team engaged Texas's freight community through telephone interviews with Chambers of Commerce and Economic Development Offices, mail-out mail-back surveys, six Freight Shipper Workshops, and six Freight Stakeholder Focus Groups.

- Demographic factors, such as the size and density of the population, education and income characteristics, age distribution, and employment status, typically influence consumption and thus the destination volume of freight moved.
- Operational factors impact the freight volume that can be moved and the cost of freight transportation. The operational factors impact freight demand and flows directly. Examples include mode characteristics, mode capacities, availability/frequency, mode competitiveness, perceptions, operating schedule (all day or just business hours), reliability, technology, cost, and travel time.
- The capacity of Texas's freight transportation infrastructure impacts not only the freight volume that can be moved, but also the cost of freight transportation, and ultimately the economy of a region. Infrastructure factors relate to the capacity or supply of freight transportation and thus impact freight demand indirectly through service levels and costs.
- Public policy factors and the regulatory framework are interrelated and potentially impact all aspects of freight demand and transportation. Examples of public policy factors include funding, dedicated public roles focused on freight planning and promotion, foreign policy, international trade agreements, international transportation agreements, federal/state/local environmental regulations, and publicly provided infrastructure.
- The environmental factors that can impact freight demand potentially include the use of more fuel efficient equipment, such as hybrid locomotives and trucks, sustainable packaging materials, "green" practices, emissions by mode, and alternative fuels.

12.2 Public Policy Framework and Approaches for Conducting Freight Planning: *How Does Freight Move?*

Statewide freight transportation planning is considered critical to ensure an efficient and effective intermodal transportation system to facilitate freight movements within, to, from, and through a state. However, prior to the passage of ISTEA in 1991, few states, if any, conducted statewide freight planning. ISTEA required states for the first time to develop statewide multimodal transportation plans. TEA-21, enacted in 1998, consolidated ISTEA's 20 statewide planning factors into 7 broader areas. Similarly, two of these areas set efficient freight movement as an important planning goal. TEA-21 also added that shippers should be given the opportunity to review and comment on a state's transportation plan (FHWA, 1998). Neither of these Acts, however, provided clear guidance as to how to perform freight planning nor defined the level of detail to be included in a freight plan (Cambridge Systematics, Inc. 2003).

Different states have thus adopted different approaches to comply with the freight planning requirements of ISTEA and TEA-21. Examples include:

- incorporating the freight plan into the overall statewide transportation plan,
- creating a standalone freight plan, and
- funding local freight studies for a major corridor or region in the state (Cambridge Systematics, Inc. 2003).

When the freight plan forms part of the overall *statewide transportation plan*, it means that the transportation plan consists of two broad categories: the movement of people and the movement of goods. The goods movement section typically includes financing and policy initiatives to respond to changes in freight demand, and any needed improvements based on selected performance measures (Cambridge Systematics, Inc. 2003). The Statewide Transportation Plans of all 50 U.S. states were reviewed to determine how state DOTs have planned and considered freight movements in their statewide plans. It was found that 41 states explicitly addressed freight transportation in their statewide plans. Most of these Statewide Transportation Plans, however, included limited information on the freight sector.

The study team also indentified 10 states that have created *standalone freight plans* in addition to their statewide transportation plans to clearly focus on statewide surface freight planning. These states generally argue that transportation plans are too broad to sufficiently detail freight planning issues. Key aspects concerning the freight sector that are typically addressed in the various standalone freight plans are freight trends, issues/needs, freight policies/strategies, performance measures, and data sources. The Minnesota Statewide Freight Plan (2005) is noteworthy in that it was the only plan that looked at enhancing freight movements beyond the statewide borders of Minnesota.

Freight planning has also been conducted through a series of *freight studies*, which may include separate analyses of regional mobility, corridors, or bottlenecks to identify areas of freight need within a state. Freight studies may either be a state's best effort at a freight plan or the result of a freight plan that requires more detailed analysis in a region (Cambridge Systematics, Inc. 2003). In the former case, the state DOT typically does not have the resources available to perform a detailed freight plan or a freight study is a precursor to a more comprehensive plan. In the latter case, the state may want a more detailed report on the issue in question or want to investigate different improvement options.

Finally, a number of U.S. states do not conduct any type of comprehensive freight planning. The literature has revealed numerous reasons for this, including (1) an inadequate understanding of how the private sector approaches decisions involving freight movements and the perceived difficulty working with private companies, (2) an inadequate understanding of the factors that impact the competitiveness of different freight modes operating in a region, and (3) the difficulty of obtaining quality freight data to disaggregate freight flows onto the transportation network, analyze freight system trends, needs, issues, and develop performance measures.

12.3 The Texas Economy

Traditionally, the Texas economy has been dominated by the oil, gas and petrochemical industries. Today, however, Texas has a diverse economy with a GSP of $934 billion in chained 2000 dollars. The emphasis of this research study was on the goods-dependent sectors as these sectors are primarily responsible for the movement of intermediate inputs and final products. On average, the goods-dependent sectors—i.e., agriculture, mining, construction, and manufacturing industries—accounted for 29% of the Texas GSP in 2010. An efficient transportation system, aside from facilitating the competitive operation of many industries in the state, is in itself an important economic generator, contributing 19% of the GSP (together with trade and utilities).

To understand the major economic generators in the state required that Texas be divided in eight economic regions: Piney Woods, North IH 35 Corridor, South IH 35 Corridor[41], North Coastal, South Coastal, Central, Panhandle, and West Texas. Telephone interviews conducted with local Chambers of Commerce and Economic Development Agencies in each of the economic regions revealed the following major economic and revenue generators by region.

Piney Woods: The Piney Woods Region is home to a large number of wood processing industries. Many counties in the region thus reported major economic generators involving wood products, such as lumber mills, and shippers of wood byproducts (biomass), wood fuel (charcoal), and paper products. In addition to the wood processing industries, the region also houses chicken and other food processing plants, as well as feed plants. These industries and the wood processors regularly utilize rail. In addition, the larger cities in the region—i.e., Longview, Tyler, Sherman, and Paris—generally house a large number of major industrial manufacturing plants across many industries, such as food preparation, furniture and home items, metal and machine fabrication, and paper products. Many of these larger cities also featured distribution centers for large U.S. retailers—e.g., Neiman Marcus, Lowe's, etc.—which undoubtedly contribute to truck traffic on the roads.

North Coastal: The economic characteristics of the North Coastal Region appear to be defined by proximity to the coastline, which also coincides with proximity to rail. Some food production occurs in this region, specifically chicken farming and sausage production, as well as a number of smaller agricultural farms. Food production is more prevalent in the more inland section of the region, primarily along the IH 10 corridor. Moving closer to the coast, various refineries and factories for oil, gas, plastics, and chemicals (e.g., OXEA, Celanese, and Nan Ya Plastics Corp) become major economic generators. A significant metal fabrication industry is located here, presumably to assist in the refining and/or oil drilling process. The counties directly on the coastline in this region are well served by rail. A number of respondents indicated that major shippers in the refining and chemical processing sectors utilize rail to serve coastal industrial plants, specifically plants near population centers in Calhoun and Matagorda counties. On the other hand, most of the inland counties indicated limited rail service and use. Finally, the extreme eastern side of this region, primarily Newton, Tyler, and Jasper counties, houses a number of wood and lumber-related industries.

South Coastal: Counties near Corpus Christi feature many economic generators related to oil and gas refining. In the case of Kleberg County, the mechanical manufacturing of engines and turbines is a significant contributor to the local economy. Rolls Royce, Boeing, and Raytheon serve Kingsville Naval Air Station, but also ship extensively internationally. Arguably this region is mostly defined by the industrial manufacturing that occurs in the border cities of Cameron and Hidalgo counties. Outside of the Rio Grande Valley, many of the counties in this region have sparse populations and a limited economic base. While this area was once a famous agricultural region known primarily for citrus fruit, much of that land has been transformed to accommodate industrial manufacturing. This transition was partly initiated by the McAllen-Reynosa FTZ and subsequently NAFTA. The major economic generators in this region thus ultimately reflect the original agricultural basis and the industrial transformation of this region. Many food production services exist, including citrus fruit and fruit juice companies and Mexican food manufacturers of products, such as tortillas and tortilla flour. In addition, the

[41] The IH 35 corridor (i.e., North IH 35 and South IH 35) were excluded from the study area for data collection purposes (i.e., no workshops or focus groups were conducted in the corridor), because of the ongoing work by the IH 35 corridor segment committees at the time of the research study.

region hosts a substantial number of plastic molding companies and metal manipulation industries.

Central Texas: Central Texas may be the most difficult region to characterize in terms of a few dominant industries. In many ways, the region represents an economic “transition zone.” Areas toward the northwest section of the region feature significant wind energy operations supported by industrial manufacturing serving these operations. Some of the counties in this region are currently—and anticipated to be in the future—the highest wind energy producing areas in the U.S. In addition, cotton and grain farming, and oil drilling contributes substantially to the economy of the region. Heavier industry certainly exists, but is limited to the manufacturing of furniture and steel. Many counties have cotton gins, because cotton farming is conducted in large parts of the region. Many livestock operations, feed mills, and goat and sheep processing facilities (such as wool houses) also exist in the region. The few large distribution centers in the region—i.e., Wal-Mart, Lowe’s, Home Depot, and Target—are concentrated in San Angelo and Abilene. A number of food processing operations—specifically peaches and pecans—exist closer to the IH 35 corridor, i.e., the east and southern sections of the region. These food industries also contribute to the local economy by attracting tourist traffic to many of the Texas Hill Country towns, including Fredericksburg, Uvalde, and Kerrville.

Panhandle: The top freight generators in the Panhandle are agriculture, livestock, oil and gas, and wind. The Panhandle Region is one of the leading producers of cotton for the state and nation. It produces approximately 25,000 and 35,000 containers of cotton annually. One of the areas in the Panhandle, Hereford, is also known as the cattle capitol of the world with more than one million head of cattle and 100,000 dairy cows located within a 100-mile radius of the town. Almost half of the state’s corn is also grown in the northwestern part of the Panhandle. Finally, the Panhandle is considered one of the top five wind energy producing zones located within Texas.

West Texas: Industrial activity is concentrated near the larger cities in the region, primarily Odessa, Midland, Fort Stockton, and El Paso. Steel pole and wind energy-related manufacturing facilities are present near Odessa and Midland, serving largely the wind energy region in the northwest part of the state (i.e., the Central Texas Region). Otherwise, oil and gas remain the dominant industry throughout much of this region. The El Paso area, including some towns in nearby New Mexico, has more of a manufacturing base. In El Paso assembly plants thus manufacture various electronic products and mold plastics and steel.

12.4 Modal Choice Considerations: *Who Moves Freight?*

The reliance of shippers on multiple modes of transportation to obtain intermediate inputs and to move finished product to centers of consumption has always been an important component of product supply chains. Increased globalization, however, has increased the need for efficient supply chains (and ultimately freight transportation) to ensure competitiveness within global markets. This shift has resulted in downward pressure and increased scrutiny of all the components of the supply chain, including the freight transportation component. Modal service attributes—i.e., readily available, easy to arrange shipments, fast transit time, reasonable rates, flexible service, high quality equipment, reliability, minimal loss and damage, and prompt pick-up and delivery—are thus increasingly evaluated to determine the impact on the supply chain transaction costs. These alternatives are typically a function of the capacity of the infrastructure and the underlying technologies and characteristics of the individual modes.

As part of this research study, Texas shippers were surveyed and invited to participate in six Freight Shipper Workshops. Respondents and participants were asked to rank on a scale of 1 (i.e., extremely insignificant) to 5 (i.e., extremely significant) the importance of various modal characteristics or attributes. The objective was to improve the understanding of the characteristics or attributes that businesses consider when procuring freight transportation services. The insight obtained from participants in the Freight Shipper Workshops and the respondents to the mail-out mail-back surveys revealed that on-time reliability was considered the most important service attribute in mode choice decisions. The requirement for reliability is partly a function of the characteristics of the commodity transported. For example, chemical shippers were less concerned about a few days of variability in delivery schedules, while shippers of food and groceries operated within a very narrow delivery time window of 2 hours.

Prompt pick-up and delivery was considered the second most important service attribute or modal characteristic in mode choice decisions. Service availability was considered the third most important service attribute in mode choice decisions. For example, participants commented that they would consider using rail if the service was available. Trucking, on the other hand, was considered a very flexible mode that can provide service to almost anywhere. Minimal loss and damage was considered an important or extremely important consideration by 82% of the respondents and participants. Customer service was considered an important or extremely important factor by 83% of the participants and respondents. Participants emphasized the importance of good customer service from the transportation service provider, because a shipper can quickly lose a client if the selected transportation service is late or unreliable. Other variables/service attributes that were discussed include reasonable rates, fast transit time, relationship with the carrier, tracking service provided, shipment value, shipment size, distance, flexible services to many markets, and specialized equipment.

Although the objective was to improve the understanding of the characteristics or attributes that businesses consider when procuring freight transportation services, some stakeholders cautioned against focusing on individual modes. Rather, they argued that the focus should be on the characteristics or attributes of a combination of modes that will meet customer expectations. For example, companies such as UPS use multiple modes without the customer being aware of the different modal combinations. These participants argued that the individual modes are less relevant. Instead, the key issue is how a combination of modes meets customers' expectations. The emphasis should thus be on ensuring an efficient multimodal freight transportation system in Texas.

12.5 Truck, Rail, Water, and Air Freight Infrastructure: *What Moves Freight?*

Texas's economy depends on its freight transportation infrastructure to facilitate trade and the economic prosperity of the state. Texas's freight transportation infrastructure comprises:

- 79,696 centerline miles of road maintained by TxDOT;
- 10,743 miles of railway, most of which is operated by UP, BNSF, and KCS;
- more than 970 wharves, piers, and docks for handling freight located on 271 miles of deep-draft channels and 750 miles of shallow-draft channels;
- 9 of the nation's top 100 marine ports when accounting for cargo volume;
- 25 commercial service airports, of which 9 qualify as "cargo" airports, because they land more than 100 million pounds of freight per year;

- the inland port—i.e., Alliance Texas Logistics Park—which is a 17,000-acre master planned intermodal facility;
- nearly 200,000 miles of pipeline infrastructure, representing nearly 17% of all hydrocarbon pipeline mileage in the U.S.; and
- 11 land ports-of-entry along the border between Texas and Mexico.

In 2007 Texas shipped an estimated $2,318 billion of freight within, to, and from the state ($281 billion in freight via multiple modes, $1,379 billion via truck, and $166 billion via rail). This figure translated into freight movements of 131 million tons by multiple modes, 1,257 million tons by truck, and 336 million tons by rail. Together truck and rail accounted for more than 64% of the total freight tonnage moved in 2007 within, to, and from Texas (FHWA, 2010). Furthermore, by 2040 Texas will ship an estimated $5,515 billion in freight within, to, and from the state ($1,224 billion in freight via multiple modes, $3,143 billion via truck, and $296 billion via rail). This figure translates into freight movements of 223 million tons by multiple modes, 2,064 million tons by truck, and 546 million tons by rail (FHWA, 2010). Some of the most salient findings in terms of commodities moved by mode are highlighted here.

- Truck: Non-metallic mineral products (12%) topped the list of commodities moved by trucks in 2007, followed by gravel (9%), waste/scrap materials (7%), gasoline (6%), cereal grains (6%), and coal, natural sands, and fuel oils also at 5%. By 2040 the top commodities transported by truck are estimated to be non-metallic mineral products (11%), gravel (7%), waste/scrap material (6%), cereal grains (6%), and gasoline, natural sands, and mixed freight at 5%.
- Rail: 35% of the rail tonnage originating in Texas in 2008 was chemicals, 18% was stone, gravel, and sand, 9% was petroleum products, and 9% was intermodal traffic. In terms of rail tonnage terminating in Texas, 32% was coal, 16% was stone, gravel, and sand, 12% was farm products, and 11% was chemicals (AAR, 2010).
- Ports: Texas's ports are primarily bulk cargo ports, transporting commodities such as dry and liquid bulk, chemicals, petroleum, grains, and forest products. Several Texas ports, including the Ports of Beaumont and Corpus Christi, move a considerable amount of military cargo (Kruse et al., 2007). Only the Ports of Houston, Freeport, and Galveston handle containerized cargo. Both tonnage and the number of containers handled by Texas ports are anticipated to increase significantly between 2008 and 2035, i.e., on average 63% and 359%, respectively.
- Air: Air freight tends to be very high value. In Texas, the 0.03% market share (approximately 0.7 million tons) by weight of air and air and truck shipments represented 4% of the market share by value in 2007. By 2040, the air tonnage moved within, to, and from the state will approach an estimated 2.4 million tons, translating into an increase in the value of these shipments from approximately $88 billion in 2007 to $339 billion in 2040 (FHWA, 2010).
- Pipelines: Products moved by pipeline in Texas typically include crude oil, natural gas, liquefied petroleum, refined products, and petrochemicals. Between 2007 and 2040, pipeline tonnage within the state will increase by an estimated 43%, tonnage

moved from the state will increase by an estimated 17%, and tonnage moved to the state will decrease by an estimated 5% (FHWA, 2010).

- Border Ports of Entry: Laredo and El Paso were ranked first and second both in terms of trade value that crossed the U.S.–Mexico border through Texas from 2000 to 2009 (North American Transborder Freight Data, 2010). The majority of the trade shipments that cross at El Paso and Laredo by truck move on the three primary highway corridors—i.e., IH 10, IH 35, and IH 20—that link these major border crossings with major inland consumption areas (e.g., Dallas/Fort Worth in Texas). A considerable amount of cargo also enters Texas from Mexico via rail. In 2009, 6,406 trains crossed the Texas–Mexico border. Rail is of critical importance for the movement of vehicles and vehicle parts at the Laredo, El Paso, and Eagle Pass ports of entry.

12.6 Truck, Rail, Water, and Air Freight Movements: *Where Does Freight Move?*

Texas's freight corridors are important to the U.S. economy in that a number of critical highway and rail corridors that connect the West Coast, Mexico, and the Port of Houston with the Midwest and northeastern U.S. traverse Texas. The FHWA's recently released $FAF^{3.1}$ data, however, illustrated that anticipated freight flows will result in increased congestion on some of Texas's major highway freight corridors. The data showed that Texas's key trade corridors—i.e., IH 35, IH 10, IH 20, IH 37, IH 30, and IH 45—will experience significant increases in truck flows. Furthermore by 2040, the entire IH 35 corridor from Dallas to San Antonio is expected to be highly congested in contrast to the localized congestion that has been experienced in 2007—i.e., mainly between Austin and Dallas. Congestion on IH 10 will also shift from congested high-volume to highly congested high-volume levels by 2040, with the biggest changes occurring around the Houston suburbs. IH 10 from Houston to New Orleans is also expected to be highly congested by 2040. Furthermore, in 2007, most sections of IH 45, IH 30, and IH 20 from Dallas to Little Rock, Arkansas, were classified as uncongested high-volume roadways, but this is expected to change by 2040 when all will be classified as highly congested high-volume roadways. This situation not only raises concerns in regards to traffic safety, transportation system deficiencies, infrastructure deterioration, multimodal connections, environmental impacts, quality of life, and security, but also affects intermodal supply chains involving air and rail.

Similar to the highway corridors, rail freight demand is also anticipated to exceed capacity on certain key rail corridors in the future as the highway corridors become more congested, and if a modal shift from road to rail is encouraged for environmental and energy efficiency reasons. In 2007, the freight rail routes linking Dallas/Fort Worth and Houston with New Mexico, Colorado, and Kansas through Amarillo, Texas, and Tulsa, Oklahoma, have experienced the highest freight rail densities in the state. Most of these routes are BNSF-owned routes. In addition, BNSF owns the rail lines from El Paso to Sierra Blanca, and the line from Longview, Texas, to Arkansas. More than 60 million tons of rail freight was moved on these two BNSF-owned routes in 2007. Other major rail routes are UP's Amarillo to Dallas/Fort Worth and San Antonio to Houston (i.e., 50–59.9 million tons) segments; UP's Spofford (near Eagle Pass) to San Antonio, Odessa to Dallas/Fort Worth, and Dallas/Fort Worth to Longview; and BNSF's Dallas/Fort Worth to Oklahoma City (i.e., 40–49.9 million tons) segments. Appendix C highlights the freight rail needs in the eight economic regions of Texas. By identifying the major concerns and bottlenecks impacting Texas's freight transportation system, planners and policy makers can adequately evaluate, improve, and proactively plan for investments in a sustainable freight system that will support economic growth in Texas and the U.S.

12.7 Texas's Freight Concerns and Needs

A number of freight concerns and needs were identified as part of this research study. The information was largely obtained from recently completed Texas freight related studies (i.e., specifically for the North IH 35 Corridor and South IH 35 Corridor), the results from the mail-out mail-back shipper survey, the telephone interviews with Chambers of Commerce, Economic Development Agencies, and MPOs, and the insight and input obtained from the Freight Shipper Workshops and the Freight Focus Groups that were conducted in six economic regions in the state. This study thus illustrates some of the concerns as documented and expressed by freight stakeholders engaged in a dialogue to discuss statewide freight concerns and needs and is by no means an exhaustive list of the freight needs and issues in the state. Also, note that the U.S. experienced a recession at the time the study was conducted, which potentially influenced the responses and perceptions of Texas's freight stakeholders.

The identified freight concerns and needs are discussed under the following headings: (1) Texas's road system, (2) Texas's rail system, (3) Texas's multi-modal system, and (4) other.

In terms of Texas's road system, concerns were expressed about the following elements.

- Maintenance of existing infrastructure: In most of Texas's economic regions, freight stakeholders expressed concern about the maintenance of Texas's existing road infrastructure. Stakeholders believe that failure to maintain the existing infrastructure will result in the deterioration of the road network, leading to reduced capacity and increased congestion. Texas's freight stakeholders are particularly concerned that budget shortfalls and inadequate transportation funding will impact the critical freight corridors.

- Delays and congestion in metropolitan areas: A number of freight stakeholders have pointed to congestion in major metropolitan areas in Texas (e.g., Dallas/Fort Worth, Austin, Houston, and San Antonio) that are impacting freight movements to, from, and through the areas.

- Limited options for oversize/overweight freight movements: Some stakeholders argued for the allowance of LCVs on state highways. They argued that the use of these higher productivity vehicles would improve efficiency and reduce overall transportation costs. On the other hand, some stakeholders recommended that oversize/overweight freight be moved by rail rather than trucks, because of the damage caused by oversize/overweight freight to the road pavement. They argued that the latter requires the development of regional rail services, especially the short line railroads.

- Investments in major freight highway corridors: If trucking trends continue, by 2035 key highway links on major freight highway corridors in areas such as Houston, Dallas, Austin, and San Antonio could likely become critical bottlenecks on the corridors. To accommodate increased truck traffic, freight stakeholders generally saw a need for additional freight capacity, technology investments (e.g., ITS), and operational improvements to facilitate freight movements.

- Wind energy impacts on Texas's roads: In the Panhandle and parts of the Central and West Texas Regions, stakeholders expressed concern about the impact of the movement of wind energy equipment, such as wind turbines, on the FM and county roads.
- Improved access to downtown areas: In a number of economic regions, stakeholders pointed to the need for improved access to downtown areas in Texas. For example, some freight stakeholders argued that the geometric design and curve radii in downtown areas are often inappropriate for 18-wheelers.

In terms of Texas's rail system, concerns were expressed about the following factors.

- Inadequate rail capacity: Inadequate rail capacity is a growing concern in Texas. The National Rail Freight Infrastructure Capacity and Investment Study anticipated that Texas's rail level of service rating—i.e., capacity versus usage—will reduce from a concerning average "D" rating to a critical average "F" rating (Cambridge Systematics, 2007). This finding was largely supported by the concerns expressed by freight stakeholders in all but the West Texas Region.
- At-grade crossing/safety improvements: Safety at rail grade crossings is a major issue in Texas. Texas ranks first among the states with the highest number of grade crossing incidents, fatalities, and injuries. At-grade crossings, however, not only pose a potential safety issue but also impact the community and rail operations. For example, at-grade crossings and the high land use density of commercial and residential activity near the rail lines adversely impact rail operations.
- Single tracks/rail sidings: Shippers have seen an increase in the use of longer and heavier trains by the Class I railroads to maximize existing capacity and improve rail efficiency. However, concern was expressed in a number of regions that the longer trains cannot be handled without investments to lengthen sidings to permit trains to meet and pass—and without providing additional yard capacity to assemble and accommodate the longer trains.
- Improved rail track condition: Freight stakeholders in a number of regions expressed concern about the condition of rail track in their areas. They felt that throughout Texas the existing short line rail infrastructure required maintenance and repair to improve overall rail system efficiency. Texas's freight stakeholders in the Panhandle, Piney Woods, and Central Regions specifically were very supportive of short line rail investments and argued that a more efficient short line rail system will make rail more competitive with trucking in the state.
- Railroad customer service: Stakeholders in the Central Texas Region cited the need for better communication with Class I railroads regarding investment needs in the region as that region currently lacks a UP/BNSF interchange, despite the rail lines crossing each other at Sweetwater, which is approximately 70 miles from San Angelo and 40 miles from Abilene. In the Piney Woods Region, stakeholders

reported on the difficulty of dealing with the Class I rail lines, especially concerning movement of smaller volumes of goods.

- Lack of rail competition: Stakeholders in the Panhandle and Piney Woods Regions cited the need for alternative modes of transport to trucking. A more efficient short haul rail system that will make rail movement competitive with trucking is highly desired in the Piney Woods Region.
- Improved connections to railroads: Stakeholders in the Panhandle and Central Regions expressed the need for better rail connections with the Class I railroads.

In terms of Texas's multi-modal system, concerns were expressed about the following issues.

- Delays and congestion on interstates/major rail corridors: A major concern during the stakeholder workshop in the North Coastal Region was delays and congestion on major interstates and on major rail corridors. This concern is also reflected in studies in the North IH 35 Corridor Region. Stakeholders in the Central Region also stated that that rail congestion in Houston, Fort Worth, and El Paso impacts the Central Texas Region as shippers experience delays when these cities are backlogged.
- Inadequate access to rail yards and ports: Texas freight stakeholders expressed concern about inadequate access to rail yards and ports in a number of economic regions. The historical location of yards in some areas, for example, hinders good truck access and limits space for infrastructure expansion—i.e., increasing the capacity of the rail yards or increasing the capacity of the access roads.
- Enhanced intermodal options: In general, Texas's freight stakeholders were very supportive of investments to enhance intermodal options in Texas.
- Rail border crossing bottlenecks and congestion: Texas's border regions (i.e., the West Texas and South Coastal Regions) expressed concern about the following issues that adversely impact the operation of rail at and near border crossings: (a) inadequate rail infrastructure; (b) limited hours of operation; and (c) lengthy border inspections.
- Improved barge infrastructure/barge reliability: Freight stakeholders expressed concern about erosion along the GIWW and a lack of investment to update facilities on the GIWW. Some argued that the latter has slowed commercial barge traffic significantly on the GIWW over the past few decades.

In addition to these concerns, other major concerns among Texas freight stakeholders related to funding and the movement of hazardous materials on Texas's transportation system. Specifically, freight stakeholders were concerned that, without addressing the funding shortfall, any proposed policies and strategies to add capacity, address bottlenecks, or maintain existing infrastructure are moot. Finally, in almost all of Texas's economic regions where the major rail lines traverse through heavily populated regions of the metropolitan areas, the safe and timely transportation of hazardous materials and containers was a major source of concern.

12.8 Policies, Strategies, and Improvements for Enhancing Freight in Texas

A number of freight policies and strategies have also been proposed by Texas freight stakeholders to enhance the movement of freight in the state. To some extent this discussion was tempered by the economic climate and inadequate transportation funding at the time when the freight stakeholders were consulted. Some freight stakeholders, for example, argued that any discussion of policies and strategies are premature given the lack of funding to implement the proposals. The proposed policies, strategies, and improvements that were discussed, however, are presented under the following headings: (1) Texas's road system, (2) Texas's rail system, and (3) Texas's multi-modal system.

In terms of Texas's road system, most of the proposed road-related policies, strategies, and improvements focused on using existing road infrastructure more efficiently by, for example, implementing ITS technologies, allowing higher productivity vehicles, providing incentives to trucking companies to travel during off-peak hours, and enhancing incident management systems. This can partly be attributed to the stakeholders' concern about securing adequate transportation funding. Specifically, the proposed road-related policies, strategies, and improvements comprise the following suggestions.

- Conduct critical road capacity projects: Although most of the proposed road-related policies, strategies, and improvements focused on using existing road infrastructure more efficiently, critical road capacity projects were identified in all Texas's economic regions. These critical capacity projects ranged from capacity enhancement projects to alleviate congestion on major freight corridors to new capacity projects to improve system connectivity.

- Invest in ITS: ITS investments varied from the implementation of dynamic message signs and speed detectors in the Dallas/Fort Worth area to traffic signal coordination in the El Paso area. In general, ITS investments in systems that monitor congestion (e.g., trip time), incidents (e.g., indicating location of incident and available route alternatives), and weather information were well supported.

- Improve incident management systems: Freight stakeholders in the El Paso region supported investments to improve incident management systems. Some argued that improved incident management systems will help avoid delays at El Paso's border crossing facilities and on surrounding roadways.

- Allow higher productivity vehicles: Some stakeholders argued for permitting to allow for the operation of higher productivity vehicles—i.e., LCVs—in Texas. The benefits of allowing higher productivity vehicles are fewer trucks, fuel savings, and lower emissions to move the same amount of freight. On the other hand, concern has been expressed about the impact on bridges and pavements, as well as competition with the rail mode.

- Implement dedicated truck lanes: In the North Coastal and the North IH 35 Corridor Regions, which include the large metroplexes of Houston and Dallas/Fort Worth, support has been expressed for implementing dedicated truck lanes—although not necessarily truck toll lanes. Dedicated truck lanes are believed to alleviate the impacts of congestion on goods movement, reduce pavement consumption, alleviate passenger truck safety concerns, and potentially allow for efficiency gains if larger trucks can be accommodated.

- Provide incentives to divert truck travel to off-peak hours: Freight stakeholders in the North Coastal Region recommended providing incentives to trucking companies to divert truck travel from peak to off-peak hours. Participants pointed out that if the incentives were substantial enough, truck travel could be diverted to off-peak hours, alleviating congestion during peak hours in large metropolitan areas, such as Houston.

As opposed to most of the proposed road-related policies, strategies, and improvements that focused on using existing road infrastructure more efficiently, most of the proposed rail-related strategies and improvements require significant investments. Specifically, the proposed rail-related policies, strategies, and improvements comprise the following suggestions.

- Invest in short line railroads: Freight stakeholders in four of Texas's economic regions supported investments in short line rail track. In general, participants felt that the Class I rail lines are well-maintained in Texas, but track upgrades and maintenance are required in the short line railroad industry.
- Rehabilitate abandoned rail tracks: Freight stakeholders also recommended the possible rehabilitation of rail lines that have been abandoned or fallen into disrepair. This move was argued to be a potentially cost effective strategy as the railroad companies would only have to invest in the infrastructure. The right-of-way has already been acquired.
- Accommodate seasonal shippers: Freight stakeholders want railroads to provide quality service to shippers during peak seasons.
- Improve access to rail yards: Freight stakeholders supported investments to improve access to existing rail yards.
- Invest in at-grade crossings: Freight stakeholders supported investments to address at-grade crossing concerns.

In terms of Texas's multi-modal system, freight stakeholders supported these steps:

- Invest in intermodal facilities: Freight stakeholders in six of Texas's economic regions supported additional investments in Texas's intermodal facilities. Intermodal facilities are viewed as an important element in achieving an efficient and "seamless" intermodal freight transportation service that ultimately enhances the economic competitiveness of a region.
- Invest in port facilities: Freight stakeholders in both the South and North Coastal Regions supported additional investments in port facilities as ports are viewed as a critical component of Texas's freight transportation system.
- Promote short-sea routes: Freight stakeholders in the South Coastal Region were also very supportive of promoting short-sea shipping. They argued that as the demand for surface modes (i.e., truck and rail) increasingly exceeds capacity over

the next 20 years, there will be an increasing need to utilize water-based modes, particularly for the movement of intra-continent freight.

12.9 Freight Performance Measures for Texas

Performance measures can assist transportation agencies in the development, implementation, and management of their transportation plans and programs. They can (a) provide greater insight into the performance of the current transportation system, (b) provide a means to establish suitable goals and targets, (c) allow agencies to rank capital investments and evaluate alternative programs, (d) provide a rationale for allocating resources, and (e) assist an agency in monitoring progress towards achieving specific transportation goals and targets. For the purpose of this research study, the study team aimed to identify suitable FPMs that can be used to (a) assess the current performance of Texas's freight transportation system (i.e., identify bottlenecks or areas where freight performance is constrained) and (b) select or prioritize freight improvement projects. Furthermore, the identified FPMs had to be easy to understand and communicate to a wide range of stakeholders, and the necessary data to quantify the FPMs needed to be readily available or at least the potential needed to exist to obtain the information (e.g., from the private sector or through surveys).

FPMs that met these requirements were identified from the literature and grouped into four categories:

- maintenance and preservation;
- mobility, reliability, and congestion;
- safety/environmental impact; and
- accessibility and connectivity.

These FPMs were presented to freight stakeholders that participated in the Freight Stakeholder Focus Groups.

The maintenance and preservation FPMs aim to identify areas where a lack of maintenance expenditures or preservation investments is constraining freight movements on existing highway and rail corridors in Texas. The following three highway FPMs were presented to Texas freight stakeholders as a means to identify any areas where freight movement is constrained or to prioritize *maintenance or preservation* investments in major highway corridors:

- percentage of major freight corridor pavement in "good" condition (or unacceptable condition),
- number of weight-restricted bridges divided by total number of bridges by major freight corridor, and
- number of bridges scheduled for repair or replacement by major freight corridor.

The data needed to quantify these FPMs are collected and regularly updated by TxDOT.

Two FPMs were presented to Texas freight stakeholders as a means to identify any areas where rail freight movement is constrained by the condition or quality of the rail infrastructure on important rail corridors:

- miles of excepted (or FRA Class 1) track divided by total miles of Class I rail track by rail corridor, and
- railroad track capacity or service levels.

Rail track capacity data are not publicly available and would need to be obtained from the railroad companies. Participants in the Freight Focus Groups were, however, unsure whether the railroads would be willing to share this information with TxDOT. Service levels, in general, are viewed as proprietary information and regarded as confidential by the railroad companies.

In addition to these measures, freight stakeholders in El Paso recommended the consideration of a FPM that will determine the impact of heavy truck traffic on Texas's major highway corridors, such as maintenance cost per truck or maintenance cost per truck-mile. Also, freight stakeholders in the Panhandle Region recommended a FPM that pertains to the short line railroad industry, such as the *"percentage of rail track-miles that can accommodate 286,000 lbs rail cars."* The information for the latter measure is available from the railroad companies and the FRA.

Three FPMs related to highway *mobility, reliability, and congestion* were presented to the freight stakeholders that could be used to determine whether congestion is impacting mobility and the reliability of Texas's major highway freight corridors:

- hours of congested conditions per day by major highway corridor (expressed in terms of the average speed on major freight corridors by time-of-day and or the average hours of delay per day on important freight segments of the corridor);
- level of service of major highway corridors expressed in terms of the ratio of peak travel time to free-flow travel time; and
- average travel time by major highway corridor.

The quantification of these three recommended FPMs is a function of the availability of accurate travel speed information by time-of-day. Travel speed information is collected in Texas's major metropolitan areas. This information, however, will need to be reviewed for consistency and may have to be supplemented to ensure all Texas's major highway corridors are covered.

Four rail FPMs were presented to the freight stakeholders that could potentially be used to determine whether congestion or landside access issues are impacting Texas's freight rail system:

- average terminal dwell time (train-hours of delay);
- average train travel time by corridor;
- landside access to facility (expressed in terms of queuing time of trucks entering the facility and or the turning radius into the facility); and
- delay of trucks at facilities (i.e., total transfer time).

The data required to quantify these recommended FPMs have to be collected through surveys (i.e., the landside access to facility and the total transfer time FPMs) and obtained from the private rail companies (i.e., average terminal dwell time and average train travel time by corridor FPMs). In the case of all these FPMs, an agreement will have to be established with the private rail companies to collect and obtain the necessary information. Those that participated in the freight stakeholder focus groups, however, pointed out that it is highly unlikely that the railroad companies would be willing to share this information with transportation agencies.

In addition, freight stakeholders also recommended the inclusion of a FPM that measures delay at border ports-of-entry, i.e., average travel time and delay time at border crossings by time-of-day.

Three highway FPMs were presented to the freight stakeholders that can be used to assess any *safety* concerns on Texas's major truck corridors and to inform safety investments:

- number of accidents/fatalities involving trucks;
- number of accidents/fatalities involving trucks, where the truck was at fault; and
- freight loss and damage costs from accidents/VMT.

These FPMs would be calculated by major highway corridor. For the first two FPMs, incident information can be obtained from filed police reports. The information is, however, not necessarily comprehensive or captured in a format that facilitates the calculation of the FPMs. Information on freight loss and damage costs from crashes can potentially be obtained from the National Association of Insurance Commissioners and the American Insurance Association. However, considerable resources would likely be required to extract the needed information in a format that facilitates the calculation of the recommended FPMs.

Four rail FPMs were presented to the freight stakeholders that can be used to assess any safety concerns impacting Texas's freight rail system and to inform safety investments:

- loss and damage from accidents per mile;
- loss and damage from accidents per tons moved;
- train derailments per tons moved; and
- number of at-grade crossing accidents.

These FPMs would also be calculated for each major rail corridor. Participants mentioned that these indicators are already quantified by the railroad companies, but that the information may be sensitive. If comparable FPMs are, however, calculated for the highway mode, some railroad companies may be willing to provide the information for the rail mode. Finally, detailed information is already available on the number of annual at-grade crossing accidents that can be used in quantifying the last FPM.

In addition to the above FPMs, freight stakeholders also recommended the addition of the *"number of hazmat incidents/truck ton-mile"* by highway corridor.

Given the expectation of an increased emphasis on energy efficiency and reduced emissions associated with Texas's freight transportation system, the following two *environmental* FPMs were presented to Texas freight stakeholders:

- an emissions measure expressed in terms of GHG emissions/mile or GHG emissions/ton-mile; and
- an energy efficiency measure expressed in gallons/mile or gallons/ton-mile.

To calculate the FPMs by highway or rail corridor, data is needed about the age of the equipment using the corridor, the fuel and emissions characteristics of the equipment, the miles driven, and the tonnage moved over the corridor. Although these measures have been estimated for the highway mode, the data for the rail mode will have to be obtained from the railroad companies and whether the railroad companies would be willing to share this information is unclear.

Three FPMs were presented to Texas's freight stakeholders to assess the need for an intermodal facility or to prioritize investments in intermodal facilities:

- percentage of shippers within x miles of an intermodal facility;
- number or capacity of intermodal facilities; and
- intermodal train services by city pair.

Similar to most of the FPMs that pertain to the rail mode, two of the recommended FPMs (number or capacity of intermodal facilities and intermodal train services by city pair) require information and data from the rail companies. Apparently, this information may potentially be less sensitive than the data required for the maintenance and preservation, and the mobility, reliability, and congestion FPMs. The data for the first FPM need to be collected, but in general, Texas's freight stakeholders were not clear as to the value in quantifying and tracking this FPM. Rather, some felt that a FPM that tracks the adequacy of existing intermodal facilities is a more valuable measure.

12.10 Texas Freight Stakeholder Working Group

A number of states have entered into a dialogue and working relationship with the private sector as stakeholders when conducting statewide freight planning. Input from the private sector can arguably be invaluable to a transportation agency. By engaging representatives from the freight railroad companies, the trucking industry, air cargo carriers, ports, airports, border ports-of-entry, private businesses, third-party logistics suppliers, economic development agencies, chambers of commerce, universities, and industry shippers, a transportation planning agency can obtain input and feedback on issues and needs that have to be addressed. For example, involving the private sector has been demonstrated to (a) enhance the sector's acceptance of transportation programs, (b) assist in promoting the role of freight to a region's competitiveness, (c) improve the support and cooperation of industry when agencies are collecting data, (d) facilitate the creation of public private partnerships, and (e) assist in securing political support for freight investments (FHWA, 2009).

During this study the potential interest in implementing a Texas Freight Stakeholder effort was raised with representatives of the freight railroads, the trucking industry, ports, border ports of entry, private businesses, third-party logistics suppliers, economic development agencies, chambers of commerce, and industry shippers, among others. These representatives were asked whether they would be interested in a stakeholder effort that could have the following role:

- liaise with TxDOT in identifying freight issues, concerns, or bottlenecks concerning Texas's freight transportation system,
- work with TxDOT in identifying and securing available freight data, and

- liaise with TxDOT in identifying and prioritizing freight improvements, policies, strategies, and freight performance measures.

Approximately 35 companies and agencies expressed an interest in working with TxDOT in developing and implementing a Freight Stakeholder Working Group for Texas. These companies and agencies present a diverse range of freight perspectives and interests in the various economic regions of Texas. These companies and agencies thus represent a good starting point for the establishment of a Texas Freight Stakeholder Working Group.

12.11 Recommendations

TxDOT has invested in a number of models, such as the Statewide Analysis Model (SAM), to inform transportation policies. The understanding of freight demand and the evaluation of current and future freight transportation capacity are, however, not only determined by sound models, but is critically contingent on the availability of accurate freight data. In this regard, insufficient and inferior quality data is the most commonly cited challenge in the development of freight models. In addition, this research study presented a list of recommended freight performance measures for Texas. Reliable and robust freight data are also critical to the development of these freight performance measures—whether they are used to assess concerns and deficiencies or to prioritize investments. Specifically, most of the data needed to quantify the rail performance measures needs to come from the railroad companies. Some of this information is sensitive and some stakeholders pointed out that the rail companies would be unwilling to make the information available. *It is thus recommended that TxDOT develops and populates an architecture that will facilitate the collection of reliable, comprehensive, and robust freight data.* The requirement for data and the importance of developing appropriate freight performance measures for Texas need to be communicated with the private railroad industry and an agreement for information needs to be reached to enable TxDOT to plan and facilitate a multimodal freight transportation system that meets the needs of Texas shippers.

> *"Better and more timely data are essential, not only to make policies, programs, and implementing agencies more accountable, but to shift to a more outcome-oriented system"* (New Transportation Agenda Conference Report, ND).

In Texas, freight movements have and are expected to continue to increase substantially due to sustained and anticipated economic and population growth combined with Texas's optimal location along critical trade corridors. The forecasts of freight demand included in this report clearly demonstrate that freight transportation by all modes will continue to grow in Texas. Good freight planning will thus become critical to ensure that Texas's infrastructure can accommodate the estimated increases in freight demand. *It is thus recommended that the work that has been conducted as part of this research study be extended and that a detailed "standalone" freight plan be developed for Texas.*

Finally, a number of states have benefitted from engaging the private sector as stakeholders (i.e., Freight Advisory Committee/Stakeholder Working Group) when conducting statewide freight planning. The potential role of a Freight Advisory Committee/Stakeholder Working Group can be to (a) assist an agency in identifying freight transportation needs, (b) provide input on freight transportation policies and the development of freight performance measures, (c) assist in the identification of funding opportunities and partnerships between the public and private sectors, (d) assist in the prioritization of freight concerns, (e) communicate the importance of freight investments to the public, elected officials and other public agencies, and (f) recommend freight research areas and needs. During this research study, 35 companies and agencies expressed an interest in working with TxDOT in developing and implementing a Freight Stakeholder Working Group for Texas. Finally, it is thus recommended that *the mission, purpose, objectives, and mandate of a Texas Freight Stakeholder Working Group be explored during a meeting of interested freight stakeholders*. During such a meeting, a FHWA freight peer exchange can be hosted that would allow other state DOTs that have an established Freight Advisory Committee or Stakeholder Group to share, their mandates, roles, and objectives, as well as successes, benefits, and challenges that have been experienced. At the conclusion of the peer exchange, attending stakeholders can work together with TxDOT to decide on the concept for Texas, as well as the mandate, role, and objectives of a Texas Working Group.

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