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16. Abstract

The following report chronicles the first year's findings of project 0-5684. The report characterizes Texas drayage activity while focusing principally on activity occurring at the Port of Houston Barbours Cut Container Terminal, the UP and BNSF rail yards located in Houston, and the border Ports of Laredo and McAllen. The seaport drayage component of the report draws upon information gained from interviews with dray managers and drivers as well as a database of truck activity provided by the Port of Houston. Patterns of delay at the port are broken into processing times that accrue outside and inside the port gates. The rail section describes the Pearland, Englewood, and Settegast yards in Houston. The border analysis relies on interviews with brokers and analysts in describing the emerging patterns of drayage.

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DRAYAGE ACTIVITY IN TEXAS

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Project Number: 0-5684
Project Title: Impacts of Dray System on Ports, Rail Yards and Border Ports of Entry

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Disclaimers

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Chapter 1. Introduction

1.1 Background

Texas has a large and multifaceted dray sector that facilitates commerce throughout the state. Dray activity is a component of the freight transportation sector in every major urban area but especially in cities that handle large amounts of international containerized trade. This includes the principal rail hubs at Dallas, Fort Worth, El Paso, and San Antonio, as well as Houston due to its extensive port and rail activity. In addition, the border drayage sector has unique characteristics that make it functionally distinct from dray activity in other areas of the state. Some border dray activity is containerized; but the majority of dray trucks use trailers. Therefore, the most salient feature of border drayage is that the activity occurs within the 3 to 20 mile commercial zone.

> The term **drayage** or **cartage**, for the purpose of this study, is defined as a truck pickup from or delivery to a seaport, border port, inland port, or intermodal terminal with both the trip origin and destination in the same urban area.

The terms drayage and cartage originate *from* the heavy horse drawn carts that were used to transport cargo from barges or rail yards. The dray trucks are the "closers" who complete multimodal transportation chains, sometimes stretching thousands of miles. Because the dray component of the overall intermodal shipment is comparatively short, it has typically been regarded as less important, yet in almost all cases when a modal transfer occurs at a port, border port of entry, inland port, or distribution center, dray trucks are involved in the transfer. Many carriers only offer drayage service to capitalize on seaport, rail terminal, or port of entry businesses.

Also, the patterns of dray activity vary markedly from state to state. The dray patterns in Southern California, which received a lot of scrutiny both in the academic and non-academic literature, have been dominated by port activity and specifically by the need to move intermodal cargo from the port to inland distribution centers and rail yards located in Riverside and San Bernadino counties. This system developed due to the inefficient rail system leading out of the Ports of Los Angeles and Long Beach prior to the opening of the Alameda corridor and the comparatively lower land costs in the inland empire, which favored the construction of large inland distribution centers. This development pattern, however, was problematic due to the large amount of dray-related vehicle miles traveled (VMT) that it necessitated on the region's already heavily congested highway corridors. Dray activity in the Chicago area, on the other hand, has been examined principally in relation to rail yard activity, given the high volumes of rail containers that transverse Chicago.

Drayage operations are considerably different from long haul trucking. The technology of dray vehicles has tended to lag behind the technology used in long haul transport. At the individual company or firm level, the usage of older second-hand long haul vehicles for short drays can make financial sense. The low upfront capital cost of dray vehicles are attractive for truckers who wish to become self-reliant owner-operators yet do not have the available capital to purchase a new long haul truck. It is thus financially rational that the sector would be largely dominated by small firms and owner-operators. Dedicated drayage vehicles, however, do not usually need the same horsepower as long haul trucks. Furthermore, the cost and risk premium to avoid mechanical failure is far lower than the comparative cost premium for long haul operators since drays operate in heavily trafficked urban corridors, and they are rarely far from a repair facility or a colleague capable of taking over the delivery. The widespread use of older vehicles or vehicles not properly maintained may introduce safety risks for drivers. Poor maintenance and inefficient vehicles could also result in higher energy consumption and emissions. Thus, the financial factors that make the allocation of capital within the dray industry logical at the micro (i.e., company or firm) level are not always sound when considering societal costs; specifically, safety, noise, and environmental costs, especially given that communities have become increasingly concerned and vocal about the impacts of truck traffic on their communities.

In 2006, the Texas Department of Transportation (TxDOT) contracted with the Center for Transportation Research (CTR) at The University of Texas at Austin to determine how dray operations connected with ports, intermodal yards, and border ports of entry affect the transportation system and the communities that host these activities. The objectives of the first year report were to (a) identify and analyze existing data sources in an attempt to characterize the drayage sectors serving ports, border ports of entry, and intermodal rail terminals, (b) develop appropriate survey methods and gather limited information about the drayage operations at ports, border ports, and intermodal terminals, (c) detail the survey methods and experimental designs to be used in the second year to collect additional drayage information, (d) list and discuss potential impacts of the drayage sector on nearby host communities, and (e) start to identify potential mitigation measures that could be used to address concerns about the impacts of the sector on local communities.

Chapter 2. Drayage Sector Serving Seaports

Container ports receive and distribute essentially all the major categories of consumer goods encountered in daily life. While most ocean containers appear nearly identical except for the painted company logos, their contents and transportation requirements can vary dramatically. Some containers, if packaged with a very heavy commodity, may be far too heavy to move over the roadway without (a) acquiring an overweight permit or (b) dividing and redistributing the load at or near the port. Some containers arriving at the port will have all of their contents shipped to one destination; others will be divided and redivided with the contents perhaps moving to a dozen different states. Containers also do not necessarily contain what is termed "household" goods, such as clothing or electronics. Many commodities that may be assumed to travel in bulk, such as petroleum byproducts, agricultural commodities, and even dangerous and hazardous chemicals can travel by means of container. The choice of using a container or another transportation form such as pallets or break-bulk depends on factors such as the technology available at the port of departure, the balance of container trade, and the ultimate destination of the cargo.

The largest container ports around the country are typically near some of the fastest growing urban areas in the U.S. Container ports benefit from being located near major population centers that have a pre-existing network of land transportation connections. This network enables container ports to efficiently serve a ready-made and reliable local market. The mere existence of a container port should not be seen as a cause of congestion because, to the extent the port serves local and regional demand, it improves the ability of a metro area to receive freight without placing demand on the surface transportation system. For example, the Port of New York-New Jersey is one of the largest ports in the country, yet almost 80 percent of the container traffic received by the port is destined for the New York area. If New York did not have a container port and the containers had to reach the city by means of highway, the traffic impacts would be unimaginable.

As container ports have become more sophisticated and more specialized, economies of scale have allowed larger ports to increase the geographic hinterland that they serve. Therefore, as container ports grow from regional to national significance, their impacts on the transportation network begin to change. For example, although Los Angeles generates a substantial demand for containers, a significant number of containers arriving at the port are destined for the Midwest, which impacts the surface transportation infrastructure serving the ports.

Houston, which is the only city in Texas with a major container port, is currently increasing the geographic hinterland it serves. While the demand for containerized cargo is growing within the Houston region, most of the new cargo growth that the Port of Houston is accommodating is for origins and destinations outside the greater metropolitan area. This has resulted in increased demand for surface freight to deliver containers to and from the Port of Houston. The latter has put increased pressure on the Houston road network and has added to growing concerns about the safety, environmental, and economic costs of truck traffic. Like many transportation assets, container ports can have latent demand. In this case, when a container terminal adopts policies that improve landside efficiency, the short term impact may be a reduction in congestion at the port. However, the long term impact may be to increase the port's competitiveness, thereby increasing the port's geographic hinterland, and the number of potential customers.

2.1 CTR Analysis of Seaport Drayage

CTR analyzed drayage activity at the Port of Houston Barbour's Cut terminal in an effort to further TxDOT's understanding of how the industry supports port activity and the impacts of the sector on the surrounding road network. The principal sources of data used to date for the port terminal analysis were:

- interviews with key stakeholders, including port/rail yard officials and dray firm managers;
- interviews with dray drivers serving the Port of Houston[1];
- a database capturing terminal transactions provided to the researchers by the Port of Houston[2];
- the TxDOT Motor Carrier Database, which provided the age and model of active and inactive trucks sorted by firm;
- the Federal Motor Carrier Safety and Fitness Electronic Records System (SAFER) which provided details on Vehicle and Driver inspections and out-of-service rates, and
- data collected from a GPS device installed on a sample truck, which provided insights into route choice and daily VMT.

The subsequent sections of this chapter provide a description of a typical dray trip to the Port of Houston and the salient findings of the data analysis and surveys.

2.2 Typical Dray Trip Serving the Ports

The dray system at the Port of Houston Barbours Cut Terminal has three primary units of analysis: the container, the dray truck, and the trip, as defined by the route, origin, and destination (Harrison, et al, 2007. Regional consumer demand, crane productivity, and the efficiency of inland distribution networks are factors that determine container terminal throughput.

At seaport terminals, container cargo is unloaded and processed within the terminals prior to their release by U.S. customs. The shipping agent arranges the dray tractor, which enters the terminal, collects the container, and then delivers it

Anatomy of a Truck Move Serving the Ports of Long Beach / Los Angeles

1. Order to pick up import container
2. Go to terminal; wait in line
3. Order verification; enter terminal
4. Pick up chassis
5. Go to container location
6. Wait in line
7. Receive container
8. Exit terminal
9. Deliver container

(Giuliano, Sloane, Southwell & Vasishth, 2006)

1 Because drayage truck drivers serving seaports often spend a significant amount of time queuing, it is possible to sample a statistically significant number of drivers while waiting in line. CTR followed this approach in a 2006 survey of dray drivers at the Port of Houston gates. The results of this survey, which measured characteristics of drivers, terminal performance, and truck characteristics was reported in a chapter of TxDOT Report 0-5068-2

2 The terminal staff gathers information on each container moved, including the container line and drayage firm responsible for transporting the container.

either to the final customer, to a rail terminal, or to a distribution center. In the latter case, the containers are unloaded and the contents reconsolidated into local or regional truck deliveries.

2.3 Time-of-Day Distribution of Dray Traffic

Officials from BCT provided 2 months of data to the researchers to identify major container lines and drayage firms, and to calculate time-of-day distribution of dray traffic and drayage truck turn time. The database compiles the record of every container passing through its gates whether for import or export. For this study, the months of April 2005 and October 2005 were used to evaluate the activity of container lines and drayage carriers. The months of April and October were selected to provide an analysis for non-peak (April) and peak (October) time periods[3]. Figure 2.1 shows the line graph for the number of non-peak, April 2005 transactions, i.e., containers passing through the gates. The transaction counts remain steady from 9:00 a.m. until 4:00 p.m. and drop by more than 2,000 transactions in the final hour before closing. The total number of transactions in April 2005 was 35,610.

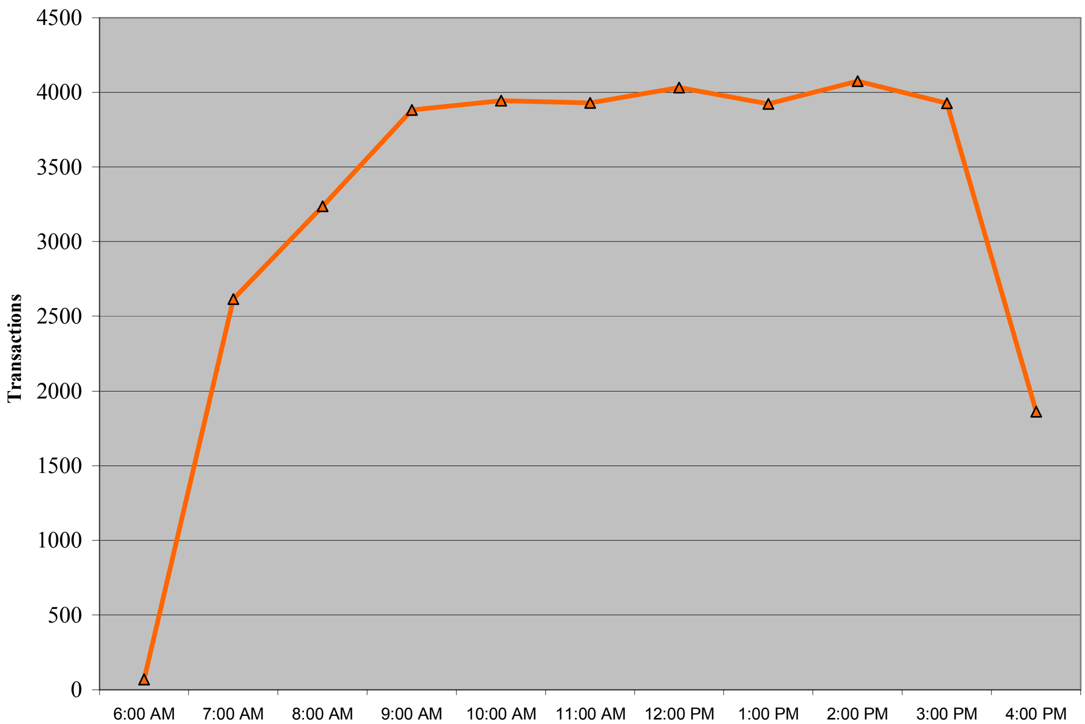

Figure 2.1: April 2005—Hourly Transaction Counts

The peak season had a similar pattern of hourly transactions. Figure 2.2 shows that the number of transactions increased steadily until reaching over 4,500 transactions by 11:00 a.m. Then the number of transactions fluctuated between 4,500 and 5,000 until 4:00 p.m. Terminal

[3] BCT has a peak traffic season that is evident when comparing month to month throughput. The researchers requested 2 months of data from Barbours Cut officials: 1 month that would represent the average demand on the terminal (April) and another that would represent elevated demand (October). The container throughput for October 2005 was 18 percent greater than April 2005 volume. The total number of containers shipped through BCT in October 2005 was 42,406, and in April 2005, 35,610 containers traversed the terminal.

transactions decreased significantly in the final hour prior to closing, similar to what occurred in the non-peak season.

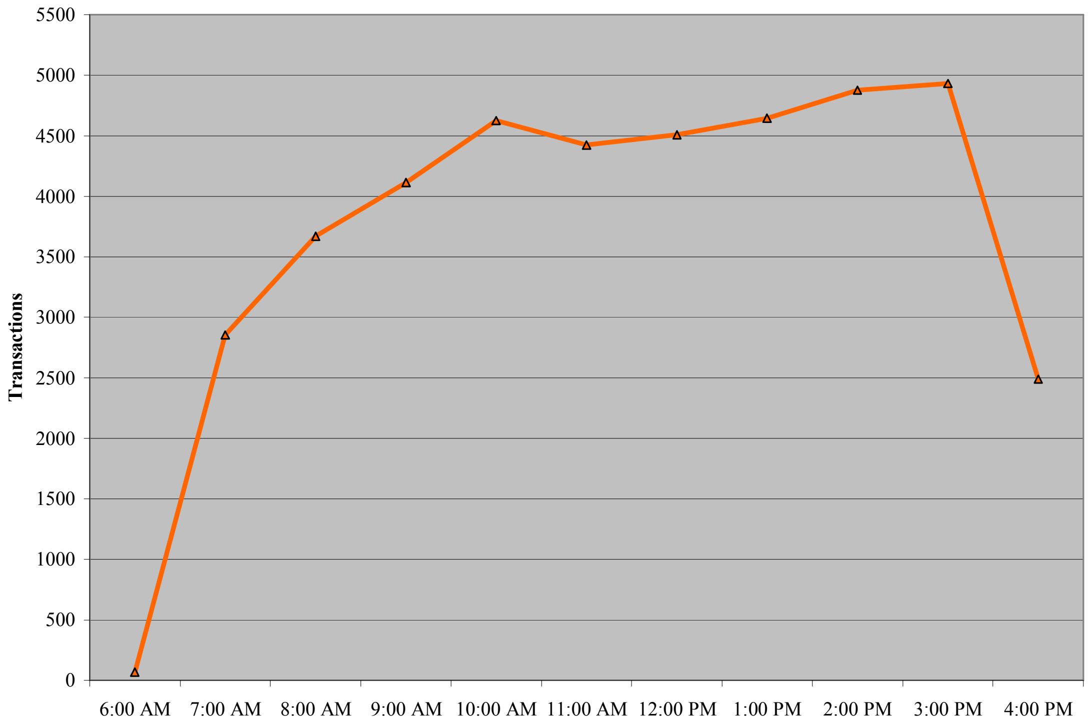

Figure 2.2: October 2005—Hourly Transaction Counts

2.4 Major Drayage Firms Serving the Port

Drayage trucks are used to transport containers from Barbours Cut Terminal (BCT) to a variety of facilities, such as retail distribution centers and rail terminals. The trucks are primarily driven by owner-operators who are associated with a drayage firm that arranges loads for the operator. Drayage firms serving BCT totaled 240 in April 2005 and 261 in October 2005. The increase in drayage firms came primarily from companies that transported fewer than 100 containers. In April 2005, 161 drayage firms moved fewer than 100 containers, but during the peak month of October 2005, 181 drayage firms operating at the port moved fewer than 100 containers. The 100 to 1,000 containers and over 1,000 containers categories increased or decreased by a small number of firms. Table 2.1 lists the number of firms that handled fewer than 100 containers, 100 to 1,000 containers, or over 1,000 containers at BCT.

Table 2.1: Drayage Firm Categories Operating at Barbours Cut Terminal

Category	April 2005	October 2005
Fewer than 100 containers	161	181
100 to 1,000 containers	72	70
1,000+ containers	7	9

The leading firms, Gulf Winds International, Powers Transportation, Canal Cartage, and others, noted gains in containers moved. However, this growth does not seem to have come at the expense of the smaller carriers. The increase in carriers transporting fewer than 100 containers may also be due to more long distance carriers and over the road drivers having to make a rare stop at BCT during the peak season.

The top ten drayage firms do not dominate the market to the same extent as the container shipping lines. The top ten drayage firms shown in Table 2.2 had a 35.4 percent market share in April 2005 and 40.4 percent market share in October 2005, compared to figures around 85 percent for the top ten container lines serving BCT (see Appendix A). The month-to-month trip counts for various drayage companies are impacted to a certain extent by the breadth of their customer profile. If a drayage firm serves a variety of industry customers, the month to month total is not likely to fluctuate to the same extent as a firm that provides service for one customer or several customers in the same industry. For example, firms such as Palletized Trucking, Clark Freight Lines, Transporter Inc., and Canal Cartage service a large number of both industrial and consumer goods customers. Analyzing the leading drayage firms in Table 2.2 can also point to major changes in services due to new entry by major shippers in the local distribution sector. For example, Powers Transportation is responsible for moving containers from BCT to the Wal-Mart import distribution center (IDC). The company transformed from a midsized firm moving 428 containers in April 2005 to the second largest dray carrier at the port in October, 2005 moving 3,191 containers. The increased movements by Gulf Winds International, which had roughly doubled in October as compared to April, were driven primarily by seasonal demand at the Home Depot distribution center, which is located near the Wal-Mart IDC near Baytown.

Table 2.2: Top 10 Drayage Firms—April 2005 & October 2005

April 2005		**October 2005**	
Drayage Firm	**Containers**	**Drayage Firms**	**Containers**
Gulf Winds International	2,056	Gulf Winds International	3,808
Transporter Inc	1,762	Powers Transportation	3,191
Canal Cartage	1,437	Canal Cartage	1,671
Empire Truck Lines Inc	1,206	Clark Freight Lines	1,481
Clark Freight Lines	1,184	Gulf States Intermodal	1,304
Trans Gulf Transportation Inc	1,128	Trans Gulf Transportation Inc	1,208
Maritime Services LTD	1,060	Transporter Inc	1,145
Gulf States Intermodal	962	Rowland, W.W. Trucking Co.	1,127
Palletized Trucking Company	924	Empire Truck Lines Inc	1,086
Sunburst Truckline	887	Palletized Trucking Company	949
Top Ten Total	**12,606**	**Top Ten Total**	**16,970**
Total for Month	**35,610**	**Total for Month**	**42,046**

2.5 Firm Types

Interviews with port employees, rail officials, and drayage companies revealed the following firm types: general drayage companies, company specific dray fleets, and container freight station-based companies.

2.5.1 General Drayage

The majority of the large firms serving the port of Houston perform what can be called *general drayage,* meaning they serve a wide range of customers and cargo types. Firms of this type principally provide transportation services and rarely add value to or interact with the contents of the container. There are several other smaller operators that also perform general drayage services. In almost no case do drivers operate fully independently without membership in a firm. The origins and destinations of general drayage firms can be quite diverse due to the number and variety of customers they serve. Larger firms typically provide both intercity and intracity deliveries of International Standards Organization (ISO) containers. Individual drivers tend to specialize in either performing short haul operations within the greater Houston area or medium haul deliveries (to Dallas, San Antonio, or Louisiana).

2.5.2 Company Specific Dray Fleets

Some drayage companies are tied, either in name or by means of an exclusive contract, to a particular company-owned distribution center. In these cases, the routing of trucks can often be known with great accuracy since the cargo will go exclusively to the one company location. Of the drayage firms surveyed, Powers Transportation, with an exclusive contract to serve the Wal-Mart IDC, was the largest single company specific dray firm. It is of note that Powers is part of the American Ports Services group, which was bought out in 2006 by Schneider Logistics. Schneider is thus the first full truckload carrier to offer port drayage services.

2.5.3 Container Freight Station-based

A final broad category of dray operators are those that are employed or contracted to a warehouse where the container is opened on site and value is added, either by reconsolidating cargo from a container to a dry van or the resorting of cargo for different destinations. In most cases, dray drivers will take the container directly to the warehouse rather than taking it to the customer. Gulf Winds International is the largest dray operator of this type currently serving the port of Houston.

2.6 Port Waiting Time

Appendix A describes the variables included in the BCT database that were used and detail the methodology for calculating average gate and yard time. Gate time is the time spent in queue and at the gate kiosk. The yard time is the time that elapses from the time the driver receives approval to enter the yard until the truck leaves the terminal. Total vehicle turn-time[4] equals gate time plus yard time. The overall findings were:

[4] Truck turn times were analyzed by Nathan Huynh and Michael Walton (2005) in a report for the Southwest University Research Center (SWUTC). According to Huynh and Walton, the factors that constitute turn time are quite different depending on whether the container is an import or export container. For export cargo, the turn time for trucks tends to be shorter since the truck only has to wait for an available gantry crane to unload the container. It

- Average gate times and yard times do not change substantially when comparing peak and non-peak seasons.
- Time spent in the container yard tends to be greater than gate time.
- The time-of-day patterns of delay do not vary significantly between the peak and non-peak season.

The data provided by the port can be used to calculate the time trucks spend waiting to get through the gate and in the container yard. Once the driver arrives at the gate, the driver provides documentation to the port employee who then submits the document to the processing location on site. The driver is then given direction where to pick up or drop off the container. The driver finds the container and waits for a gantry crane to lift the container onto or off of the truck chassis. Finally, the driver exits the terminal. Gate time is a performance measure to quantify the amount of time a driver must wait before his shipping documents are processed, while time spent in the yard indicates how long it takes for the import or export shipment to be moved onto or off of the truck chassis.[5]

Table 2.3 and Table 2.4 summarize the calculated average gate time along with the standard deviation for gate time in April and October, respectively. The tables also have average yard time and the yard time standard deviation. The average turn-time, which is the sum of gate time and yard time, and the turn-time standard deviation are also reported Tables 2.3 and 2.4

does not, in other words, have to wait for the gantry to unload a specific container, which can involve multiple re-handles. For both gate clearance and container loading/unloading, the trucker's efficiency is contingent on the efficiency of the port's systems and staff. In cases where a trucker no longer needs the chassis, he must then park the chassis, a process completed without assistance from port personnel, at the chassis parking lot outside the terminal (http://swutc.tamu.edu/publications/technicalreports/167830-1.pdf).

5 The spreadsheet data provided by the port includes several additional fields of information (See Table A.1 in Appendix A). A transaction number is given to each truck entering the container terminal to drop off an export container that has a container unit number (Unit). The shipping line responsible for the container (Ship Co.) and the drayage firm (SCAC Code) transporting the container are also provided in the gate data. The occurrence of a truck moving more than one container in the terminal or making a multiple move is indicated by a Y for yes or an N for no. The start time (Start Day, Start Hour, Start Min) indicates when the truck arrives at the terminal, and the driver provides paperwork to the kiosk employee. The EIR time (EIR Day, EIR Hour, EIR Min) is when the paperwork transaction is completed, and the driver enters the container yard. The stop time (Stop Day, Stop Hour, Stop Min) is when the driver exits the yard in the case of an import or delivers the container to its location in the yard if the container is an export. The total time that elapses from start time to stop time for the transaction is shown in the Hours column.

Table 2.3: April 2005 Monthly Statistics

Hour	Average Gate Time (min)	Gate Time Standard Deviation	Average Yard Time (min)	Yard Time Standard Deviation	Average Turn Time (min)	Turn Time Standard Deviation
6:00 AM	57.37	96.35	42.67	73.17	100.04	119.91
7:00 AM	23.00	31.24	31.96	43.68	54.96	52.68
8:00 AM	19.04	22.38	31.05	48.10	50.08	51.94
9:00 AM	16.98	16.10	29.33	37.26	46.31	40.38
10:00 AM	18.12	20.86	30.00	33.95	48.12	39.13
11:00 AM	19.86	18.63	32.30	38.16	52.17	42.01
12:00 PM	18.83	17.63	34.27	33.33	53.10	36.64
1:00 PM	18.28	17.73	30.42	31.04	48.70	34.42
2:00 PM	17.17	14.93	28.12	25.29	45.29	28.39
3:00 PM	15.51	12.03	25.97	18.65	41.47	20.83
4:00 PM	12.67	8.92	23.96	15.58	36.63	16.32

Table 2.4: October 2005 Monthly Statistics

Hour	Average Gate Time (min)	Gate Time Standard Deviation	Average Yard Time (min)	Yard Time Standard Deviation	Average Turn Time (min)	Turn Time Standard Deviation
6:00 AM	33.71	7.73	31.18	21.42	64.90	23.16
7:00 AM	19.17	37.17	35.04	47.42	54.22	59.28
8:00 AM	14.26	33.64	31.81	46.92	46.07	57.99
9:00 AM	15.92	48.51	30.18	36.09	46.11	61.89
10:00 AM	14.70	45.21	32.36	37.29	47.07	58.63
11:00 AM	17.11	29.65	35.55	43.38	52.66	51.86
12:00 PM	16.70	23.71	34.69	31.37	51.38	38.11
1:00 PM	15.06	19.72	30.75	29.27	45.81	34.35
2:00 PM	14.23	17.58	30.24	24.62	44.47	29.10
3:00 PM	12.98	13.65	28.62	20.00	41.59	23.14
4:00 PM	11.30	12.78	25.21	16.82	36.50	20.27

The average gate time for April 2005 and October 2005 are shown graphically in Figure 2.3. From Figure 2.3 it is evident that gate times during April were longer than during the October peak month. This finding was not expected, since it was assumed that processing more vehicles in the peak month would cause gate times to be longer. Figure 2.3 shows that gate times are much longer for trucks arriving in the 6:00 a.m. to 7:00 a.m. time slot. The reason is that the terminal gates do not open until 7:00 a.m., so trucks arriving before the gates open have longer wait times. The average gate times continue to decrease until around 10:00 a.m. The shortest average gate time for April was the 9:00 a.m. to 10:00 a.m. timeslot at 16.98 minutes. For October was the 8:00 a.m. to 9:00 a.m. hour with an average gate time of 14.26 minutes. The gate times start to increase and peak around the noon hour after which it decreases steadily until the gates close.

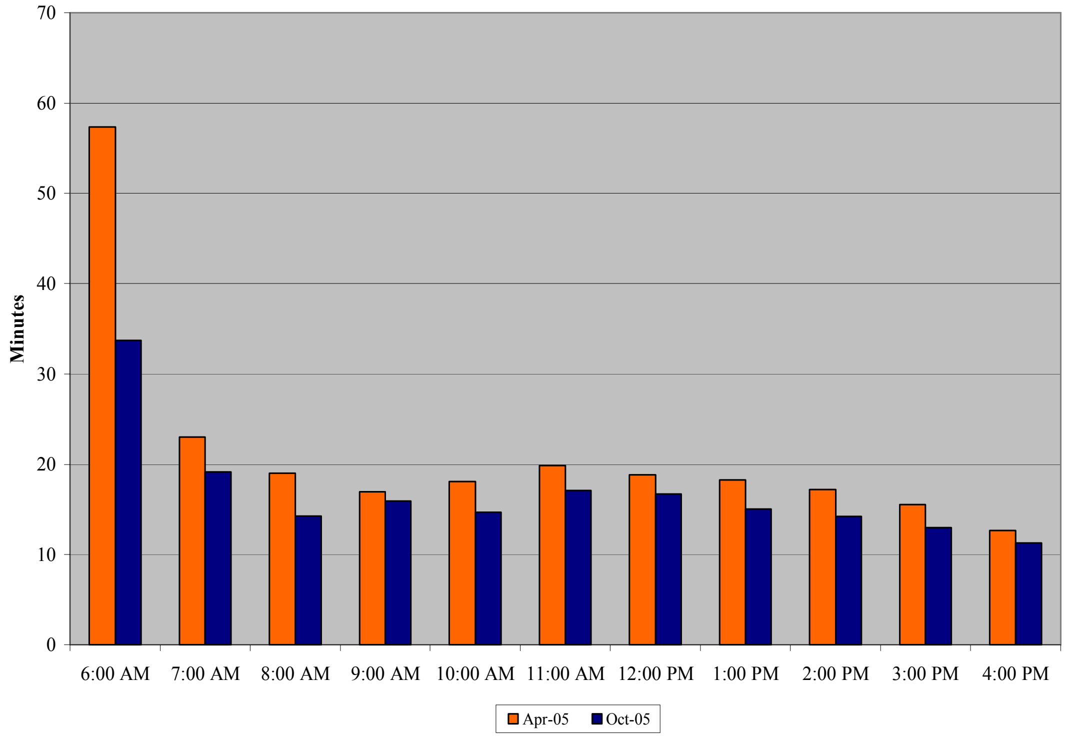

Figure 2.3: Average Gate Time: April and October 2005

The yard times are longer than the gate times for both the peak and non-peak months. The yard times followed a similar trend as the gate times, but the peak month's yard times were generally longer than the non-peak month's times. Figure 2.4 compares average yard times between the peak and non-peak months. The yard times are longer for trucks arriving in the first 2 hours of terminal opening and start to decrease for trucks arriving in the 9:00 and 10:00 a.m. time slots. The average yard times for trucks arriving between 9:00 a.m. and 11:00 a.m. were practically the same at 29.33 minutes in April 2005 and 30.18 minutes in October 2005. The yard time peaks for trucks arriving between 11:00 a.m. and 1:00 p.m.—similar to the average gate time figure. In April 2005, the midday yard time peak was 34.27 minutes for trucks arriving between 12:00 p.m. and 1:00 p.m., and in October 2005, the peak was 35.55 minutes for trucks arriving between 11:00 to 12:00. After noon, the yard time begins to decrease until the terminal closes at 5:00 p.m. The non-peak average yard time was 15.58 minutes for trucks arriving between 4:00 p.m. and 5:00 p.m., and during the peak month for trucks arriving the same hour, the average yard time was 16.82 minutes.

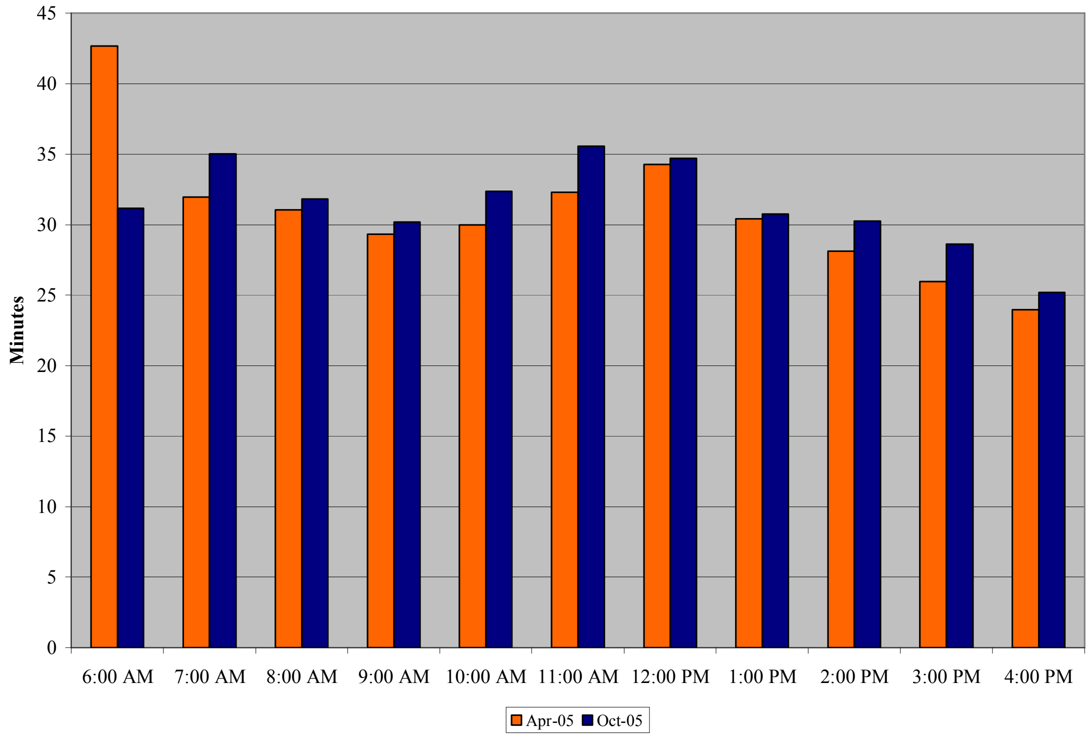

Figure 2.4: Average Yard Time[6]: Comparing Peak and Non-Peak Season

The average total turn time is the sum of the gate time and the yard time (see Table 2.3 and 2.4). The average turn time is graphically shown in Figure 2.5. The average turn times are very similar for the peak and non-peak months. For example, the 9:00 a.m. time slot has an average total turn time of 46.31 minutes in April 2005 and an average total turn time of 46.11 minutes in October 2005. Trucks that arrive in the early morning hours prior to the gate opening experience longer average turn times.

[6] The average yard time that is shown before the port gates open at 7:00 am is attributable to the way information is captured in the database, i.e. each vehicles' yard time is expressed in accordance to when the vehicle arrived at the gate and **does not** reflect the average yard time by hour.

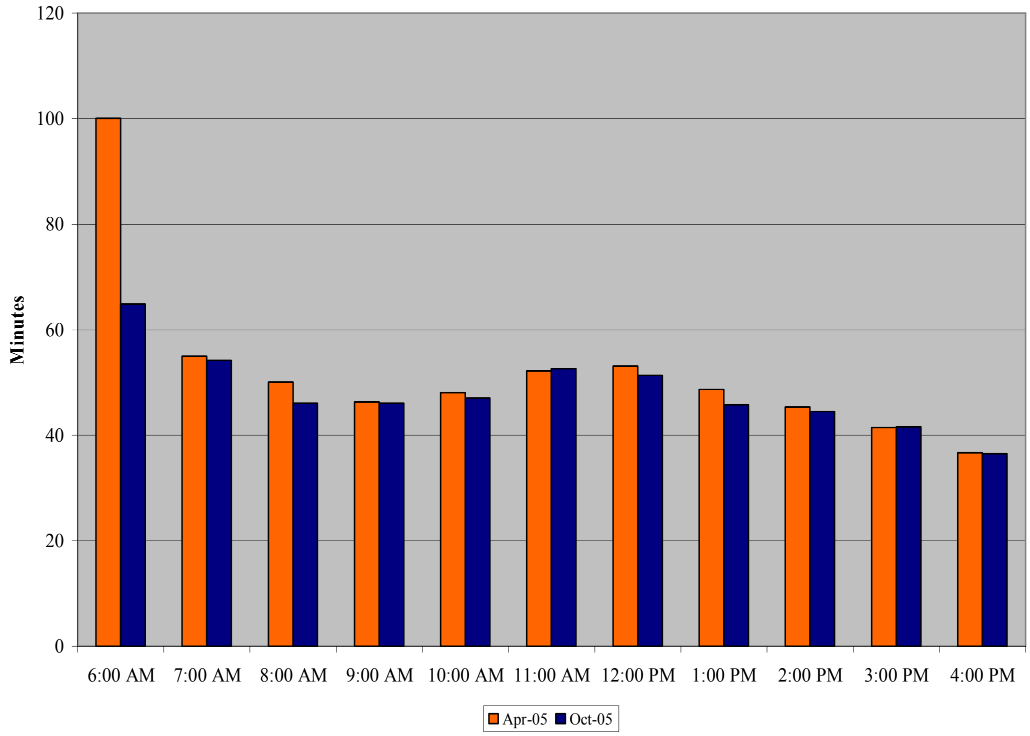

Figure 2.5: Total Turn Time: Comparing Peak and Non-Peak Season

2.7 Route Choice /Dispatch

Interviews with dray companies (i.e., drivers and managers) confirmed that the vast majority of VMT associated with container drayage at the Port of Houston is concentrated on a few key corridors located primarily on the eastern side of the city. Dray drivers who serve the port typically spend a significant percentage of their day in the immediate port area.

Firms have different levels of technology for issuing dispatch orders. Traditionally, drivers were dispatched by radio and some large firms, such as Palletized and Empire Truck lines, still use this method. The majority of the larger firms, however, have switched to a system in which dispatch orders are delivered via Blackberry or text message to cell phones. Issuing dispatch orders via text messaging also allows the firm to more easily give drivers directions to pickup points or to suggest a preferred route. Regardless of the technology used, drivers tend to stay in the “field” for most of their day and do not typically need to return to the depot following deliveries. Therefore, the location of the depot in relation to the port does not typically impact daily VMT. In fact, some firms arrange for their drivers to have the option of parking their tractors at home and driving directly to their first pickup. In these cases the driver may only need to return to the depot at the end of the day to submit their dispatch log. The situation is different if the depot also performs warehousing or transloading functions, in which case the driver will return to the depot more frequently.

2.8 Compensation Systems

> Driver compensation systems are critical when evaluating new policies that could impact dray operations. For example, if drivers are paid on an hourly basis, they will be less impacted by changes in road or gate congestion compared to if they are paid per delivery.

The CTR interviews revealed that the overwhelming majority of dray drivers are currently paid per loaded move. In cases where drivers make almost all of their deliveries to a single destination, the compensation rate is typically based on a fixed amount plus a variable fuel surcharge. In instances where drivers make deliveries to a number of different locations within the urban area, firms set compensation rates based on zones, analogous to the system used by taxis in some cities.

Another driver compensation system is to pay drivers a percentage of the price charged by the firm to the customer. Interviewed firms differed in their treatment of prices for moving loaded and unloaded containers. The majority of interviewed firms that adopted this system did not make a pricing distinction based on whether the container was loaded or unloaded. The reason being that drivers have little control over what type of "job" they receive. In fact, some firms, such as World Trade CES, did not penalize drivers if they were unable to find a return load and paid the same compensation rate to a driver who returned with only a chassis.

Dray company managers noted that the compensation systems used at present could be improved given better technology and more precise accounting systems. The pay-per-load system evolved in response to company managers being unable to monitor truck activity in the field. They therefore adopted a compensation system that is performance-based. As firms have begun to take a more active interest in drivers' activity—in response to stricter security and safety regulations—they have also become more open to new and more precise methods for compensating dray drivers. In the absence of tracking technologies, there is a clear trade-off between precision and simplicity. The simplest compensation system identified by the researchers was used by a firm called "The Intermodal Cartage Company" (IMCC), which has offices in Houston and Dallas. IMCC uses a "flat" rate for all deliveries from any point in the city to any other point. The published rate for Houston deliveries is $105, including a fuel surcharge. At the other extreme, Frontier Logistics, which has several offices around the state, is planning to shift to a system in which drivers would be tracked by GPS. This would allow the company to take into account not only actual loaded miles driven and hours worked, but also factors such as gate congestion. Therefore, drivers would no longer be penalized for arriving at the port during a congested period. On the other hand, drivers could no longer claim they were stuck in a long queue when they were taking an unscheduled break.

Several of the larger firms retain a small fleet of drivers who drive company-owned trucks. In some cases, the company drivers perform a different type of work from the owner-operators. Such is the case at World Trade CES, where owner-operators are responsible for moving sealed containers between the warehouse and the port, while company drivers are responsible for providing pick-up and delivery to the final customers. A reason cited for retaining a mixed fleet in cases where the workload of the two fleets was identical was to prevent owner-operators from overcharging.[7] Also, some firms indicated that the option of driving a

[7] Interview with Ernie MacDonald, Vice President of Southwest Freight. 08/18/06

company truck accommodated a second pool of talented drivers who, for whatever reason, did not relish owning and maintaining their own vehicle.

In some cases, company drivers were paid on a “flat” hourly basis. This compensation system occurred most frequently with drivers of company-owned tractors, but other firms, such as Southwest Freight, have recently moved even their company drivers to a pay-per-delivery system.

2.9 Turnover

Responses for annual driver turnover varied sharply amongst respondents. Some large firms reported annual turnover of 100 percent, while others had turnover rates of under 5 percent. The primary conclusion is that high turnover rates are not necessarily endemic to the industry. Several firms complained of the practice of offering sign-up bonuses to drivers, which then encourages high turnover within the industry, but not out of the industry.

2.10 Vehicle Age and Characteristics

After isolating the major firms that performed drayage at the Port of Houston, the researchers used the TxDOT motor carrier database to profile vehicle types and average age. The motor carrier database is sorted by firm and displays records for every truck that is currently registered under that firm’s name. For firms that exclusively perform local drayage operations, the information contained in the motor carrier database is a complete profile of that firm’s dray fleet. When firms perform long haul trucking in addition to local drayage, separating out the number of trucks that specifically service local drayage becomes more challenging and requires cross-referencing the information in the database with information gained through interviews. The initial gate survey performed by CTR in 2006 indicated that the “average” truck serving the Port of Houston Barbours Cut terminal was a 1996 model year with slightly over 600,000 miles of use. The TxDOT Motor Carrier database, which lists the make and year of all registered trucks in Texas, was used to cross reference the age and make data for firms that are principally engaged in harbor drayage. The motor carrier database showed that the age and make distribution for dray firms is in line with the results of the survey.

2.11 Inspection and Maintenance Practices

Three distinct approaches to maintenance were identified:

- Perform maintenance in-house
- Arrange maintenance contracts with dedicated providers
- Require drivers to attain and certify their own maintenance

The majority of firms prefer to take a “hands-off” approach to maintenance with the rationale that as owner-operators, the drivers bear full responsibility for their own maintenance needs. While firms are responsible for performing inspections and verifying maintenance, firms such as Gulf Winds stated that they had no interest in providing or coordinating maintenance activity as this could theoretically make them liable in the case of an accident.

One interviewed firm had begun providing maintenance in house even to their owner-operators. The reason given was that the firm felt this practice actually made it less likely the firm would end up receiving a lawsuit because it could ensure that all the vehicles were properly maintained by experienced professionals. Maintaining a more rigorous maintenance schedule also meant that there would be fewer cases of a mechanical breakdown. Providing the guarantee of affordably priced maintenance is also a way to attract and retain drivers.

2.12 Concluding Remarks

The results demonstrate that in 2005, despite the fact that the Barbours Cut Terminal was significantly beyond its nominal capacity, the terminal was still able to provide a consistent level of service when container volumes increase in the peak season. Although the Houston metropolitan area has seen the vast majority of seaport based dray activity in the state, it is expected that small to medium sized cities will be impacted more significantly by an increased number of dray trucks in the future. For example, given the expected growth in smaller cities, such as Corpus Christi and Brownsville, the impacts of drays tied to ports are likely to be felt more strongly at some point in the future. A full analysis of seaport drayage will require an understanding of truck activity after the trucks leave the immediate port area. Patterns of route selection in the field are more difficult to measure but would be of significant value from a planning perspective.

Chapter 3. Drayage Sector Serving Rail Intermodal Terminals

Intermodal rail traffic increased from 6,206,782 trailers and containers in 1990 to 10,993,662 trailers and containers in 2004[8] (Association of American Railroads, 2006). Increased rail intermodal traffic results in more drayage to move trailers and containers between shippers/consignees and the rail terminal. It is thus surprising that very few studies have attempted to characterize the drayage sector serving rail intermodal facilities. The exception has been a study by McGuckin and Christopher (2000). Although the authors defined drayage as *"trips that move between intermodal facilities, such as carrying goods from the airport to a rail yard, or back and forth between rail yards,"* all truck—not only the drayage trucks as defined—serving a sample of rail intermodal facilities on an average weekday were surveyed. This study provided some insight into the characteristics of the drayage sector serving rail intermodal terminals.

For the current study, it also became obvious that the data necessary to characterize the drayage sector serving rail intermodal terminals in Texas had to be collected from primary sources (i.e., either drayage drivers or drayage companies). The research team contacted BNSF and UP to discuss surveying drayage drivers at BNSF and UP rail terminals in Dallas and Houston in an effort to collect information to characterize the drayage sector that serves rail terminals in Texas. UP[9], the largest railroad in Texas, has agreed to participate in this study and will allow CTR staff access to their terminal property to collect driver survey data. The research team met with representatives from UP to request permission to survey dray drivers at UP's Englewood and Settegast terminals in Houston and to discuss the draft survey instruments that the research team prepared. Upon reviewing the proposed questionnaire UP representatives suggested that two questionnaires be designed to administer to dray drivers arriving and leaving the terminal, respectively. Also, a number of questions were added to the two questionnaires. The Englewood surveys were conducted on July 30 and 31, 2007. The Settegast surveys will be conducted in Fall 2007. The text box briefly describes the activities at both UP terminals.

In addition, a questionnaire was prepared to administer to representatives of a small number of drayage companies[10] serving rail terminals in Dallas. Telephone surveys were conducted and the responses received are included in this section of the report. The main objective of these surveys, however, was to pilot the questionnaire and use the responses to improve upon the questionnaire that will be used in the second year of this study. The objectives of this section of the report are thus to (a) describe a typical dray trip to and from a rail intermodal terminal, (b) present the findings of interviews with a select number of drayage companies serving rail intermodal terminals in Dallas, and (c) discuss the salient findings of a dray driver survey that was conducted at UP's Englewood terminal in Houston.

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8 However, these figures hide the fact that this growth was attributable to the movement of intermodal containers as opposed to trailers on piggyback rail cars. In this regard, the number of intermodal rail trailers moved decreased from 3,451,953 in 1990 to 2,928,123 in 2004—a decrease of slightly more than 15 percent. During the same time period the number of intermodal rail containers increased from 2,754,829 to 8,065,539—an increase of almost 300 percent (Association of American Railroads, 2006).

9 The research team's request to survey drayage drivers at BNSF's rail terminals was denied. The BNSF representatives approached stated that they did not want to participate in this research project and that they would not provide permission to conduct any drayage surveys at BNSF rail terminals in Dallas and Houston.

10 Asset Based Intermodal, Genesis Intermodal Delivery, Inc., Knight Transportation, Morgan Southern, Richard Daniels Transportation (RDT)

UP's Englewood Rail Terminal

On average one inbound and one outbound train are loaded each day at UP's Englewood terminal with Fridays being the exception when two outbound trains are loaded at the terminal. Each train is on average 7,700 ft long and is transporting 250 containers. Usually no trains arrive or depart from the Englewood terminal on Saturdays and Sundays.

Mondays, Tuesdays, and Fridays are the busiest at the rail terminal. The terminal is open from 6:00 a.m. to 11:00 p.m. Typically a queue forms between 9:00 a.m. and noon for outgoing container/trailer movements and between 2:00 p.m. and 5:00 p.m. for incoming container/ trailer movements. However, in general, the transaction times are quite short: 1 minute for arriving containers/trailers and 45 seconds for departing containers/trailers.

Only drayage companies that are signatories to the Unified Intermodal Agreement (UIAA) and that have insurance can serve the rail terminal. Furthermore, only dray drivers that are affiliated with a registered drayage company can call at the rail terminal. Approximately twenty-five drayage companies are approved to serve the rail terminal. Currently, the rail terminal does not offer an appointment system where firms can make an appointment for loading or unloading a container/trailer.

Finally, approximately 20-30 percent of all the containers that are delivered to or moved from the Englewood terminal comes from or is destined for the Wallace area.

UP's Settegast Rail Terminal

UP's Settegast rail terminal predominantly handles freight movements between Mexico and Chicago. All containers at Settegast are stored on chassis. In other words, when a train arrives at Settegast, the containers are loaded onto a chassis. The chassis with the container are parked in a designated slot in the terminal. The dray driver is directed to the specific slot upon arrival to collect the container. For outbound trains, the dray driver parks the container and chassis in a designated slot at the terminal. A hostler moves the chassis around in the terminal and positions the chassis and container for loading onto outbound trains. Some of the chassis belong to UP and BNSF while others belong to the steamship lines.

Settegast is located in a low-income area. While the terminal is open between 6:00 a.m. and 11:00 p.m., none of the surrounding communities have thus far expressed formal concerns about impacts from the dray trucks serving the terminal.

3.1 Typical Dray Trip Serving the Ports

Morlok and Spasovic (1994) described the typical dray trip involving truck trailers and containers to and from rail terminals in their paper entitled *"Approaches for Improving Drayage in Rail-Truck Intermodal Service."* Typically drayage trips involving truck trailers consist of the following elements:

A tractor with an empty trailer is dispatched to the shipper's location.

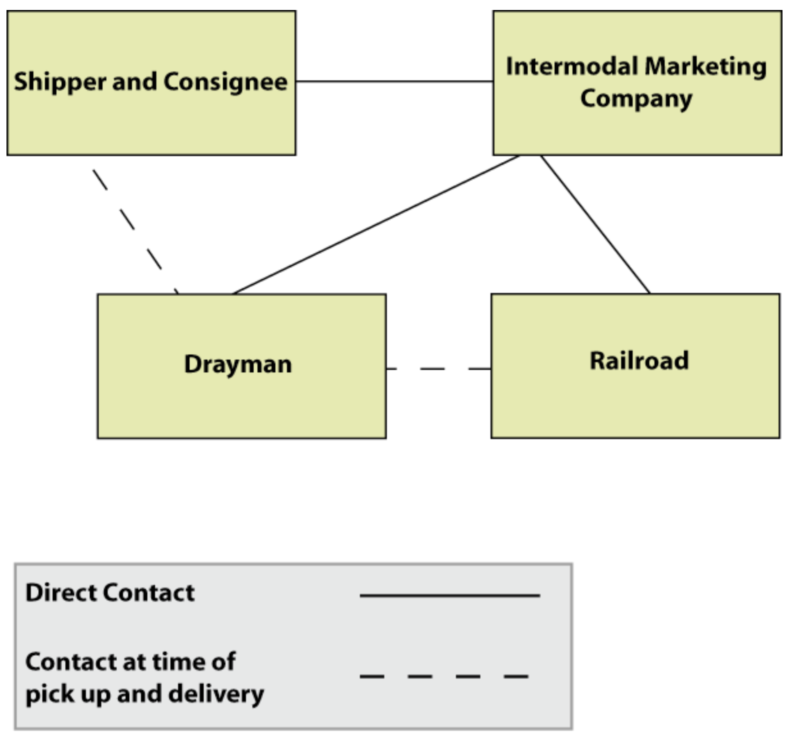
The driver and tractor could either wait for the trailer to be loaded to return the loaded trailer to the rail terminal or the trailer can be left with the shipper. A truck tractor would then be dispatched once the trailer is loaded to return the loaded trailer to the rail terminal.

Trailers are loaded on a piggyback rail car and moved by rail to the destination rail terminal.

The loaded trailer would be delivered to the consignee. The driver and tractor can either wait for the trailer to be unloaded to move the empty trailer to the rail terminal or the loaded trailer can be left with the consignee for unloading at a later stage. A truck tractor would then subsequently be dispatched to pick up the empty trailer and return it to a pool of empty trailers at the rail terminal (Morlok & Spasovic, 1994).

The procedure for container movements is similar. However, only the container is moved on the train with the result that a pool of bogies or chassis have to be available at both the origin and destination terminals to drop and pick up containers (Morlok & Spasovic, 1994).

In the past, the railroads have been responsible for the rail line haul, the rail terminal operations, sales, as well as providing both the equipment and the employees for drayage movements. More recently, the railroads have curtailed the areas over which they have direct control to the line haul component, while contracting out terminal management. Independent drayage companies are responsible for the drayage service and independent sales companies (often called intermodal marketing companies) are responsible for arranging intermodal movements (see Figure 3.1).

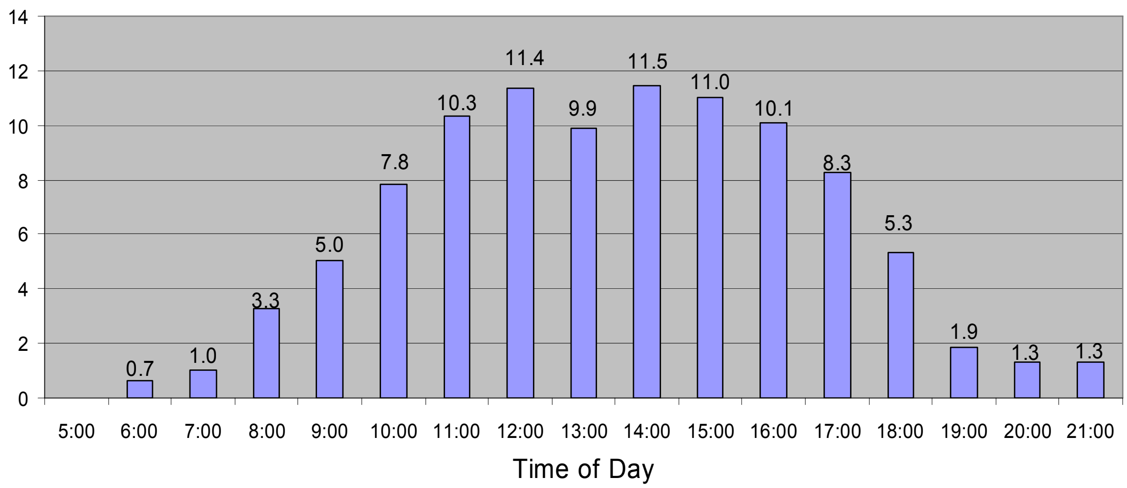


Source: Morlok & Spasovic, 1994

Figure 3.1: Relationship among Railroad, Drayage and Intermodal Marketing Companies

3.2 Time-of-Day Distribution of Dray Traffic

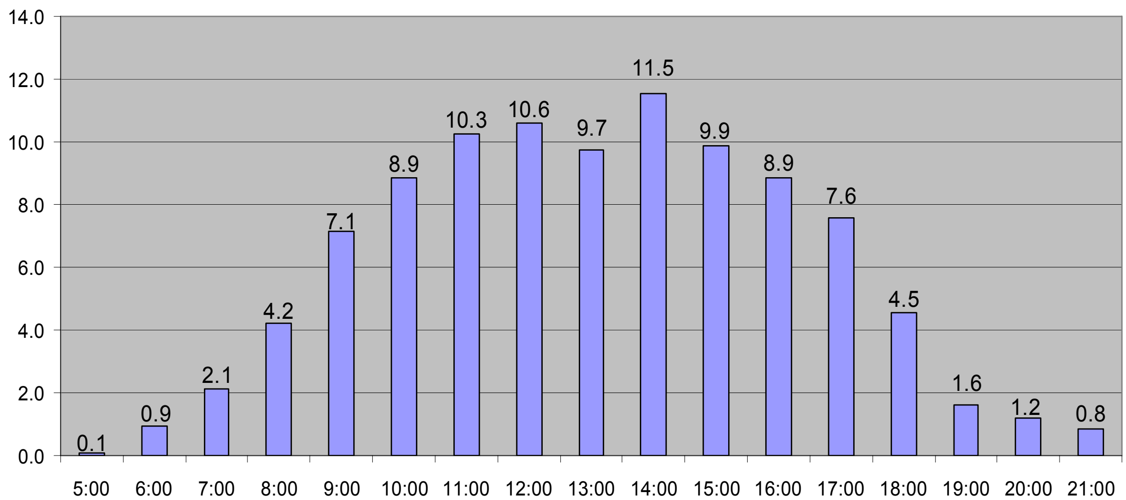
Dray traffic at intermodal terminals correlate to the rail schedules of the major railroads. Data obtained on the number of loaded, empty, and bare chassis truck movements recorded entering and exiting BNSF's Pearland rail terminal near Hobby Airport in Harris County on August 9, 2006 (Wednesday), August 10, 2006 (Thursday), and August 11, 2006 (Friday) are displayed graphically in Figure 3.2. Figure 3.2 illustrates the truck arrivals by time of day over the three day period (i.e., August 9 to 11, 2006). From Figure 3.2, it is evident that trucks arrived more or less consistently from 10:00 a.m. until 5:00 p.m. with the highest average truck arrivals occurring between 11:00 and 12:00 a.m. (11.4 percent) and between 1:00 and 2:00 p.m. (11.5 percent).



Source: BNSF, 2006

Figure 3.2: Percent of Truck Arrivals by Time of Day (Pearland Terminal)

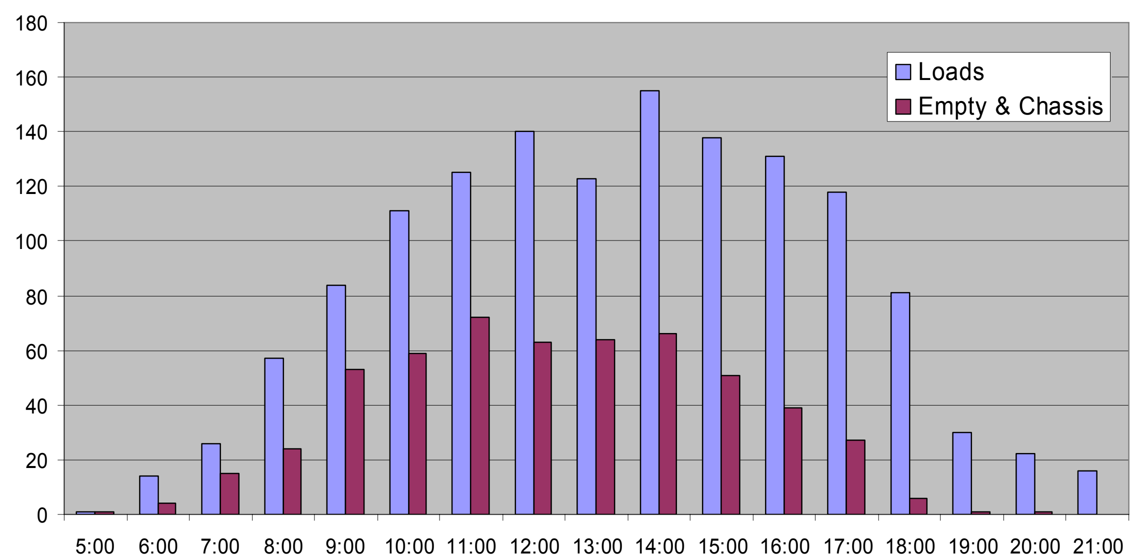
Similarly, Figure 3.3 illustrates the percent of trucks arriving and exiting the Pearland Terminal by time of day. From Figure 3.3, it is evident that the busiest hour at the rail terminal in terms of trucks arriving and leaving the terminal is between 1:00 and 2:00 p.m.



Source: BNSF, 2006

Figure 3.3: Percent of Total Trucks (Entering + Exiting) by Time of Day (Pearland)

Further analysis of the truck arrival and departure data obtained from BNSF also indicates that a significant number of the trucks arriving are either empty or are moving a bare chassis. The empty/bare chassis movements—arriving and exiting the terminal—as a percentage of total truck movements between 7:00 a.m. and 6:00 p.m. vary between 19 and 39 percent. On average, 28 percent of all trucks arriving at or exiting Pearland are empty or are moving a bare chassis (see Figure 3.4). This data thus suggest a significant percentage of deadheading.



Source: BNSF, 2006

Figure 3.4: Number of Loaded and Empty/Bare Chassis Trucks by Time of Day (Pearland)

3.3 Firm Types

Five firms completed the pilot questionnaire during the last two weeks of May 2007. The companies serve rail terminals in the Dallas and Fort Worth region with main offices in Dallas (Genesis Intermodal Delivery, Inc. and Richard Daniels Transportation), Garland (Asset Based Intermodal), Seagoville (Morgan Southern), and Texarkana, Arkansas (Knight Transportation Inc.). Intermodal drayage shipping was the main service provided. Morgan Southern cited that it also conducts over the road operations. The drayage companies primarily hire owner-operators. Richard Daniels Transportation was the smallest company surveyed having fifteen owner-operators, and Asset Based Intermodal was the largest with sixty owner-operators. Only Morgan Southern had company drivers in addition to having owner-operators. Morgan Southern has thirteen company drivers and seventeen owner-operators.

3.4 Driver Characteristics

The questionnaire asked company representatives about driver age, education, experience, health insurance, and driver turnover. Driver age ranged from 30 to 60 years old for Genesis Intermodal Delivery, Inc. Other companies reported an average age of 38 years to 45 years. Morgan Southern reported the same average age for company drivers and owner-operators. Driver education also varied widely. Some drivers had only an 8th grade education, while some had taken college courses. Knight Transportation reported that those who did not graduate from high school at least have a GED. Average driver experience was over 10 years for Knight Transportation and Morgan Southern. Morgan Southern indicated that driver experience was the same for company drivers and owner-operators. Richard Daniels Transportation reported driver experience to be two to five years. The findings regarding owner-operator health insurance were as expected. The drayage companies do not offer health care for owner-operators, but Morgan Southern does offer health care to company drivers. This finding is the first major difference given between company drivers and owner-operators. Morgan Southern also stated that turnover was different for company drivers and owner-operators. Company driver turnover was 15 percent and owner-operator turnover was 30 percent. Driver turnover for other companies surveyed ranged from 10 percent to as high as 40 percent. These initial results need to be corroborated with additional surveys to gain more conclusive findings, but the questionnaire responses indicate that driver education and experience vary considerably among firms but not against company drivers and owner-operators. Differences between company drivers and owner-operators do start to emerge on matters of health insurance and driver turnover.

3.5 Compensation Systems

Driver compensation is either delivered as percentage pay or per mile. Asset Based Intermodal said that it uses both methods. Knight Transportation pays per mile with a fuel surcharge while Morgan Southern and Richard Daniels Transportation use percentage pay. Gross driver revenue ranged from $70,000 to $130,000, and drivers work from 40 to 50 hours per week for Genesis Intermodal Delivery, Inc and Morgan Southern. Knight Transportation owner-operators work 55 hours per week, and Richard Daniels Transportation reported that drivers work 60 hours per week.

3.6 Vehicle Age and Characteristics

Drayage firms were asked to describe vehicle model, age, and mileage on trucks. The responses varied based on how the question was perceived by the company representative since some preferred electronic or faxed submissions versus phone interviews. Asset Based Intermodal, Inc. owner-operators have trucks with approximately 450,000 miles and are, on average, 2000 year models. Genesis Intermodal Delivery, Inc. noted that owner-operators use trucks with a range of 250,000 to 500,000 miles. Three out of the five firms stated that their owner-operators drive Freightliner tractors (Genesis Intermodal Delivery, Inc., Knight Transportation, and Richard Daniels Transportation). Morgan Southern reported that their company vehicles are International while most of their owner-operators drive Volvo. Knight Transportation and Richard Daniels Transportation owner-operator fleets are late '90s year models.

3.7 Trip Characteristics

Survey questions also focused on what percentage of trips were local or long-haul and what percentage of trips involved a truck traveling empty to or from the rail terminal. Asset Based Intermodal, Inc. was the only company interviewed that had a greater percentage of its loads as long haul (70 percent) versus local deliveries (30 percent). Genesis Intermodal Delivery, Inc. stated that half of its operations are long haul and half are local drayage. Morgan Southern and Richard Daniels Transportation reported that they conduct more local drayage (60 to 75 percent) than long haul loads (25 to 40 percent). Deadheading was a part of operations for all companies. The percentage of shipments that included deadheading ranged from 10 percent to 20 percent for all companies except Knight Transportation, which reported that deadheading comprised one percent of all loads.

3.8 Rail Terminal Waiting Times

Most companies experience some wait time at rail terminals in the Dallas and Fort Worth region. Queue wait times ranged from 5 to 10 minutes for Asset Based Intermodal, Inc. and Knight Transportation deliveries or pickups. Richard Daniels Transportation reported a queue wait time of 15 minutes, and Morgan Southern said wait times could be as high as 30 minutes. The Genesis Intermodal Delivery, Inc. representative said drivers do not have to wait at gates. Wait times inside the terminal also varied with each company. Genesis Intermodal Delivery, Inc. said that drivers do not have to wait inside the terminal, while Richard Daniels Transportation cited a wait time of 30 minutes to an hour. One problem cited by two companies is that a majority of wait time inside a terminal is finding a roadworthy chassis or reloading the container on the correct chassis. Some companies said that wait times do not vary depending on day of the week, while others cited that some days are more congested than others. As found in the 2006 CTR port drayage study, the perception of wait times varies among drivers or companies. The responses to rail terminal waiting times questions as presented earlier also support this finding.

3.9 Concluding Remarks

Dray driver surveys were conducted at the UP Englewood terminal in July 2007 and will be conducted at UP's Settegast rail terminal in Fall 2007. In addition, it is expected that data collected from surveys in the first year will be supplemented with data from other UP terminals (including Dallas) in the second year. The data will provide evidence on the radius of influence, VMT, truck types and company characteristics that will allow a wide range of analysis to be undertaken in the second year. In the second year, it is expected that UP will publicly announce their intention to build a new intermodal terminal at Rosenberg, which may shift the current patterns of drayage, raising total VMT by the Houston dray sector. Data collected are expected to allow an estimate of this effect to be made.

Chapter 4. Dray Operations at the Texas-Mexico Border

4.1 Background

Trucks play a vital role in the movement of NAFTA trade between the U.S. and Mexico, despite the early promise of rail intermodal growth. A recent study commissioned by TxDOT on NAFTA flows stated that "in 2003, the Texas highway system carried more than $196 billion in trade between the two countries—roughly equivalent to 83 percent of all U.S.-Mexico trade and 10 percent of all international trade that year" (Cambridge Systematics, 2007). The study report went on to find that substantial numbers of NAFTA trucks pass through Texas—52 percent by tonnage and 62 percent by value—en route to other U.S. states and Mexico. These trucks comprise a significant portion of truck traffic on the small number of highways they use—the so-called "rivers of trade," first coined by the McCray analysis circa early 1990s (McCray, 1998). In fact, it is remarkable how robust the first trade patterns of McCray have remained throughout a somewhat tumultuous period of international trade, as evidenced by the findings of subsequent studies, including the first TxDOT NAFTA study (Berger et al, 1998), the USDOT Freight Analysis Framework (FHWA, 1998), other researchers (Figliozzi and Harrison, 2000) and the Cambridge Systematics study (Cambridge Systematics, 2007).

Trucking may dominate the NAFTA landscape but are they efficient at the two borders? It should be recalled that NAFTA came in two stages—first U.S.-Canada (1989) and then U.S.-Canada-Mexico (1994). The economic, cultural, legislative, and historic relationships between the U.S. and Canada resulted in an "open" border between the two countries so that full cross border trucking could be adopted by the companies providing transportation services. There was not a similar harmony between the U.S. and Mexico treaty negotiators due to a wide variety of issues and objections raised on both sides of the border (6). The 1994 NAFTA treaty kept the border "closed" and sought a path towards "opening" that would be developed by the signatories at trilateral meetings to be held during a period culminating in an open border in 2001. In the treaty process, the border was to open in late 1995 for contiguous border state cross trucking (essentially an extension of the traditional ICC border zone to the boundaries of both U.S. and Mexican border states) while the various issues—safety, size and weight, driver hours—were to be debated during a 7-year period without any loss of sovereignty on the part of any country.

Had the border opened to contiguous operations, it is likely that a more efficient trucking system would now be in place at the southern border, but the decision of the White House to postpone the opening of the first stage in 1995 soured the relationship between the two countries on this subject. Subsequent bilateral meetings lacked trust and the Mexican government finally sought, and won, legal redress through the NAFTA arbitration process in 2002. Recent attempts to redress this situation by the U.S. government have led the USDOT to support a pilot study of Mexican and U.S. truckers to see how effectively the various safety and security procedures function and to allay fears on the part of U.S. and Mexican citizens. This pilot study is now underway but it is too early to draw any conclusions, whether economic or political.

4.2 Laredo Dray Operations

What would those familiar with the Texas-Mexico border in 1995 find today if they revisited it for the first time in more than 10 years? The first, and overwhelming, impression is one of urban growth. Many of the fastest growing small and medium sized cities in Texas lie on, or near, the southern border. This is reflected in extended city boundaries, retail expansion, warehouse growth, and higher vehicle (auto and truck) volumes. The second is the improvement in infrastructure, particularly highways and international bridge systems. TxDOT has provided important links between the interstates or state highways and the international bridges. It has upgraded two lane arterials into divided four lane systems and also built large interchanges at critical highway junctions. The combination of urban growth and infrastructure investment has transformed the border cities so that they now reflect many of the characteristics of other Texas communities.

As in all border towns, there remains strong evidence on the continuing importance of trade—that has not changed. Truck numbers are still high, though they are beginning to be concentrated on key highway links rather than over much of the system. At the border itself, trade appears to have changed little in the last decade. Trade is still predominantly moved by trucks; trailers are moved by a three-stage process across the border and the authority of the broker remains pre-eminent in the actual cross border mechanism. In addition, a new federal authority—Customs and Border Protection (CBP)—now sets the rules for processing the trade flows on the U.S. side of the border and has introduced a number of post-9/11 systems to insure the security of the United States. These, at times, create periods of delay when trucking is slowed as more thorough inspections are adopted. These are sometimes created on a random basis, making it difficult to incorporate into trucking schedules. As a consequence, the dray vehicle system is still used to cross the trailers since it has the lowest costs and can best absorb unpredictable delays due to CBP operations.

But they are not the dray vehicles, nor is it the same dray system seen at the border in the early 1990s. The CTR/UTSA team met with Tom Wade of Emerson, the third largest manufacturer in Mexico, in Laredo. Mr. Wade stated that few, if any, U.S. domiciled dray operators are now crossing trailers at the border. This is a major change from the dray system that existed around the time of the NAFTA negotiations. Dray operations were structured for one-way operations only, with Mexican tractors returning without trailers (termed "dead-heading") after taking a load north and U.S. tractors returning in the same condition after delivering a trailer at a Mexican location. A further meeting with Frank Vida, a U.S. drayage operator, confirmed that the small Laredo dray sector now concentrates operations on inter-Laredo switching (between warehouses, for example), Valley transfers (to McAllen and Brownsville) and San Antonio intermodal and dry van hauls. This suggests that dray operations, typically defined as short hauls, have become much longer and more typical of regional inter-city trucking.

This situation was corroborated by Drew Claes, Controller of Southern Enterprises, a long established warehouse and distribution business in Laredo. Draying built the company up from its formation in the 1940s and he confirmed that, until the signing of the NAFTA, the dray tractor had to be domiciled in the country of the good's origin, thereby resulting in the "dead-heading" described earlier. It is noteworthy that this situation raises costs, puts more VMT on the TxDOT network and city streets and creates more emissions per trailer move, so was not necessarily beneficial to the community, though it maintained profit margins by reducing competition. The advent of NAFTA changed the picture for Laredo dray companies. Sothern Enterprises maintained a smaller dray fleet, in part because they had an important customer that needed reliable service. They used Mexican drivers and estimated that currently around 80 percent of the current U.S. dray fleet drivers are Mexican commercial driver license holders. In

2007 rising costs forced them to cease dray operations at a time when they were handling 40 percent dry van and 60 percent intermodal loads. Although the company felt that there are challenges that complicate operations in Mexico—police fines being a frequent issue—the main reason is cost. Mexican dray operations are simply cheaper than those of U.S. operators. The momentum passed to the Mexican broker and dray operator in the late 1990s, and currently Mexican dray operators can cover their full cost on the outward trip (north) and make their profit on the return trip (south). The company stated that using Mexican dray vehicles to move product across the border saves it $40 per trip, something that resulted in the closing of its own dray operations.

Finally, Union Pacific Railroad (UP) operations were noted at two locations, first at the UP downtown offices on Farragut Street yard and secondly at Port Laredo, UP's intermodal yard. John Hopkins and Robert Polka (Marketing and Sales) described some issues related to rail intermodal NAFTA traffic at the gateway. First, the research team had heard about a new rail bridge (at various locations) but the officials thought it was a low priority on UP's strategic plan. UP would not pay new tolls unless KCS follows suit. Furthermore, they argued that the current bridge could be improved by moving the location where crews are changed to either the Nuevo Laredo or Laredo yards, not on the bridge as at present. They strongly argued that no staging of trains (as the switch is termed) should take place on the bridge.

At the Laredo gateway, about twenty trains a day are handled by UP, including a PacerStack train in each direction. UP regards it as a company train on the schedule because they sometimes add cars to the PacerStack cars. They confirmed that Port Laredo has remained unchanged in size and operations (track, cranes etc) for the last 4 years. In part this is due to traffic demand but also constraints on their line to San Antonio have cut capacity. UP have responded by upgrading the entire Laredo-San Antonio segment (track, ballast, bridges) to meet 60 mph operations and increased capacity by lengthening some sidings. UP favors using longer trains to drive up capacity

The officials confirmed that San Antonio is currently not working well for intermodal boxes. As confirmed in other studies, many Asian-originating container traffic moving to San Antonio through Los Angeles or Long Beach is currently first taken through to Houston then drayed back, a clearly inefficient process. In addition, train delays at the two small yards they currently have in San Antonio convinced UP management to build a new intermodal yard on the south side, with ground breaking that was due to begin in late August 2007. UP expects to grow San Antonio intermodal traffic with this new yard, which will make Laredo gateway easier and faster. Finally, they confirmed that intermodal traffic was flat out of Laredo but that it had grown modestly at Piedras Negras, El Paso, and Brownsville—all in the 3-7 percent range.

4.3 Further Research

The first-year work related to the border focused on determining the trade background—since it forms the demand for dray services—and current conditions at Laredo and McAllen. The background is provided in Appendix D, which covers a broad review of trade groups and border practices at Laredo. In addition to the Laredo field visit, calls were made to officials and managers at the McAllen gateway, in the TxDOT Pharr District. That gateway currently has no rail access into Mexico although it has a rail line that parallels State Highway 83, which originally was part of the UP system and is now operated by a short line railroad. The team was informed that all trade was moving on the gateway highways and that the dray system was working well, without encountering many delays at the customs inspection facilities. The main complaint was the impact of the DPS truck safety inspection station at Pharr, which is creating concerns among the dray companies. This is an issue which deserves more investigation in the second year since an operator interview may complement the DPS safety data reported in this document.

In the second year, analysis will be expanded to other gateways since they will differ in their dray processes and their impact on modal choice and efficiencies. The findings that Laredo domiciled dray companies are now rarely crossing the border is a critical issue. It is likely that comparative advantage lies at the heart of this situation. If, for example, Mexican tractors are dominating the northbound traffic, they can then easily compete for return loads, especially if their costs are lower in certain cost categories. If dray trucks are somewhat older than over-the-highway tractors, then owners will experience higher parts and maintenance costs. Such costs—particularly those related to mechanic's labor—are lower in Mexico, so driving down the Mexican domiciled ton-mile costs. And it should not be forgotten that broker-dray company relationships might also favor Mexican truckers. All this combines to make Mexican dray companies formidable competitors and it is reflected in the market—$85 versus $125 for a U.S. domiciled company on identical trips.

Finally, as with Texas port and rail terminal dray operations examined as part of this research project, it appears that U.S. dray companies are now operating throughout the state from their Laredo bases. Their operations are no longer constrained to intermodal moves but include dry van runs and as the utilization of the tractors making these trips increases, operators move to younger vehicles in terms of age and mileage. This, in turn, raises safety and emission standards, so negating the traditional image of the dray vehicle being inherently at risk of failing a safety check and creating more atmospheric pollution per mile of operation. This will also be investigated in the second year of the study.

Chapter 5. Defining Potential Community Concerns

Because many intermodal terminals are located in mixed-use areas alongside nearby residential communities, the impacts imposed on host communities[11] could become a concern, especially if trucks are forced to travel on local streets that have not been designed or constructed for use by heavy vehicles (I-95 Corridor Coalition, 2004). A 2003 National Cooperative Highway Research Program (NCHRP) project entitled "Integrating Freight Facilities and Operations with Community Goals" listed the following potential community issues concerning increases in the growth of freight traffic:

- Traffic flow and congestion,
- Safety and security,
- Air quality and the environment,
- Economic development,
- Noise and vibrations,
- Excessive light pollution, and
- Land use and value (Strauss-Wieder, 2003).

The objectives of the study were to "identify the successful efforts in the location and operation of freight transportation facilities and to compile information on practices that enable freight transportation facilities and operations to be good neighbors within their communities" (Straus-Wieder, 2003). Although the objective of this study was broader than the drayage sector, the list of community concerns could be used as a starting point when discussing the impact of drayage transportation on local communities.

5.1 Traffic Flow and Congestion

Some of the potential community concerns identified by Straus-Wieder (2003) that could be relevant to the drayage sector include:

- "*Volume—The volume of trucks affects available road capacity for other transportation users.*
- *Operational characteristics—Trucks accelerate and decelerate at different speeds than passenger vehicles.*
- *Road geometrics—Trucks, especially larger trucks, require different lane widths, turning radii, and turning lane requirements"*
- *Damage caused to pavement, especially from heavier trucks and more frequent truck movements on local roads"*

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11 Strauss-Wieder (2003) defines a host community *"as a neighborhood containing one or more freight facilities or subject to freight transportation operations."*

- *Truck hours of operation affecting peak period traffic flows (Straus-Wieder, 2003), and*
- *Poor access routes to rail terminals, resulting in the need to use local streets to access rail terminals*.

In general, because trucks require more road space and more time to accelerate or decelerate, they have a greater impact on road capacity compared with passenger vehicles. The capacity of a road segment can thus be reduced significantly given increased truck traffic as a percentage of total traffic. For example, peak-period lane capacity can be reduced by one-third of the design capacity when the traffic stream constitutes 32.8 percent and 24.6 percent trucks for freeways and multilane highways, respectively. Increased truck traffic, including drayage trucks, thus aggravates congestion on certain key highway links.

> Congestion is becoming a major challenge in the fifty largest urban areas of the U.S. Delay caused by congestion doubled between 1982 and 1994—from 7.25 million person-hours per day in 1982 to 14.5 million in 1994 (Douglas, 1999). The Texas Transportation Institute's 2005 Urban Mobility Study indicates that, in 2003 two Texas regions, Houston and Dallas-Fort Worth- Arlington, were ranked in the top ten (fifth and sixth, respectively) in terms of "annual delay per traveler" (Shrank and Lomax, 2005). In addition, the 2005 Urban Mobility Study points to rising roadway congestion in the region, showing that San Antonio and Austin rank third and fifth, respectively, among the nation's metropolitan areas in terms of how fast traffic delays are rising.

In Houston alone, the cost of congestion was estimated to total $2.7 billion, representing 155.5 million extra hours of travel time and 239 million gallons of fuel wasted idling (Texas Department of Transportation, 2001). Dray trucks conceivably contribute and aggravate congestion when traveling during peak passenger hours. However, the impact of drayage trucks in terms of vehicle miles and routes traveled have not been studied and are not well understood.

CTR has demonstrated the use of a GPS device or transponder, manufactured by @Road, which can be used to collect instantaneous data on vehicle location and speed. Such data would be highly effective in describing patterns of dray activity in terms of describing the routes used by dray drivers and the time spent if performed on a statistically representative sample of vehicles (See Appendix A for a description of the test performed and results obtained). The data will have several planning uses. Aspects of interest to TxDOT include the potential to (a) characterize dray operations by mileage and type of work, (b) derive VMT for each segment derived and (c) factor the market shares for each segment on the total container business to estimate total VMT on the highways networks used by the industry. This technology will permit an estimate of VMT to be produced from the forecasted volume of TEU container traffic.

5.2 Safety and Security

Some of the potential community concerns identified by Straus-Wieder (2003) that could be relevant to the drayage sector include *"Safety concerns on roadways with heavy truck volumes"* (Straus-Wieder, 2003)—in other words, the safety concerns caused by freight vehicles sharing infrastructure with passenger vehicles and pedestrians.

It is well known that the mix of heavy trucks and passenger vehicles represents a significant safety concern. Statistics have shown that trucks are involved in 12 percent of all passenger vehicle occupant fatalities and in 23 percent of multi-vehicle fatalities, but account for approximately 3 percent of registered vehicles and 7 percent of VMT. Furthermore, in fatal two-vehicle accidents involving a truck and a passenger vehicle, 98 percent of the victims are occupants of the passenger vehicle[12] (Douglas, 1999).

Preliminary analysis of the Texas DPS inspection data indicates that drayage trucks and drivers are not less safe than non-drayage trucks and drivers. As a matter of fact, it was found that the drayage sector out-of-service rates were lower than those of the non-drayage trucking sector, and the difference was significant. These findings are described in detail in Appendix E. Nevertheless, heavy truck traffic on neighborhood streets does pose a significant safety hazard to host communities, especially pedestrians and cyclists. The safety impacts of dray vehicles on host communities thus warrant further consideration.

5.3 Air Quality Concerns

In general, depending on travel speed, a single heavy-duty truck generates 15 to 20 times as much nitrogen oxide (NOx) emissions as a passenger car, 4 to 8 times as many volatile organic compounds (VOCs), and up to 3 times as much carbon monoxide (CO). In congested conditions (15-20 mph) compared to free-flow conditions (55 mph) heavy duty trucks generate slightly less NOx, but 3 times the amount of VOC and 2 to 3 times the amount of CO (Douglas, 1999). Heavy-duty diesel vehicles are also notorious for their contribution to high ambient levels of fine particulate matter (PM). Therefore, as peak period congestion increases and lengthens and if dray vehicles contribute significantly to peak period congestion, it is foreseeable that dray trucks could have a substantial impact on air quality. In practice, however, the quantity of emissions from a truck, including a dray truck, will be a function of (1) the type of fuel consumed, (2) age and condition of the equipment, (3) model, (4) weight, (5) technology, and (6) tampering occurrences with the engine or emissions technologies. The externality costs imposed by dray vehicles on the broader society in the form of diminished air quality are thus not well understood or quantified—at least for the drayage sectors serving ports and intermodal rail terminals.

5.4 Noise and Vibrations

Some of the potential community concerns identified by Straus-Wieder (2003) that could be relevant to the drayage sector include:

> *"Noise associated with the loading and unloading of trucks at retail stores and freight facilities abutting residential areas"*
>
> *"Noise and vibrations associated with higher levels of freight traffic"* (Straus-Wieder, 2003).

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[12] On the other hand, the FMCSA has argued that *"the majority of car-truck crashes are related more to the errors and misbehaviors of car drivers than to those of truck drivers. However, because of the high mileage exposure of trucks and the oftentimes severe consequences of their crashes, there is a premium on making trucks, and truck drivers, safer"* (Straus-Wieder, 2003).

Noise impacts the quality of life of communities by interrupting residents' sleep, causing irritation, and reducing the amount of time residents spend outside. At low speeds, engine noise is the dominant source of disturbance. At higher speeds, rolling and aerodynamic noise is more of a concern (Brons et al. 2003). Noise pollution tends to be a function of local conditions, duration, frequency, and regularity, which makes it complicated and sometimes expensive to estimate. Quantifying these potential impacts and creating win-win solutions to mitigate these impacts warrants a better understanding of the dray industry, especially since most sea ports, major border crossings, and distribution terminals are located in or near urban areas.

5.5 Pavement Deterioration

The contribution of port activity to pavement deterioration is one area of increasing concern amongst Houston policymakers. In July 2007, a Houston City Council member put forward a proposal to require city issued permits for all overweight or oversized loads moving over city roadways—a broad ranging category that would impact many types of port-related trucking, including some containerized shipments. These fees would be assessed on top of fees already required by the TxDOT. The implicit message of this proposed new ordinance is that the infrastructure impacts of trucking activity are not being adequately internalized in the existing fee structure.

5.6 Concluding Remarks

Dray activity, like all forms of transportation, can produce impacts on the surrounding population. The emissions impacts of dray vehicles typically make up a small component of total emissions within an air shed, however given the high numbers of VMT that each dray vehicle accrues in a year and the fact that many of the vehicles are older models, the emissions per vehicle can be quite significant. Other impacts, such as noise emanating from dray to the extent that older engines are used when compared with the better understanding of the impacts of the drayage sector in terms of the volumes, VMT, and the routes used would allow for the quantification of some of these impacts. The latter is important when evaluating different mitigation options.

Chapter 6. Potential Mitigation Options

Mitigating the impacts of freight trucks on safety, air quality, and congestion is both a state and national goal. A number of practices were identified by Straus-Wieder (2003) in NCHRP Synthesis 320 entitled *"Integrating Freight Facilities and Operations with Community Goals: A Synthesis of Highway Practice"* that could be considered for addressing community concerns associated with dray truck operations. For the purposes of this study, potential mitigation measures were grouped into one of the following categories:

- initiatives to improve terminal operations,
- initiatives to improve drayage operations,
- initiatives to modernize (i.e., new technologies) the drayage fleet,
- initiatives to enhance the use of cleaner fuels,
- initiatives to minimize the interaction of dray vehicles with other traffic, and
- initiatives to improve intermodal connections.

6.1 Improved Terminal Operations

Dray operations at the U.S.-Mexico border are not generally adversely affected by terminal operations. The transfer is relatively seamless and creates little or no congestion although congestion does exist at major border crossings. At rail and port terminals, the picture is different. Here, dray vehicles are booked into and out of the terminal through gates, where a variety of activities are undertaken. No terminal in Texas offers dray vehicles a defined gateway time booking. Dray drivers are told by the broker/forwarder to go and pick up or take a load, and they arrive at the gates in a random fashion. These arrivals are not spread evenly over a shift, and they tend to create peaks in gate demand, when a certain amount of congestion is created. Apparently, this congestion is judged to be non-critical at this time by most terminal operators, but it could become so if overall terminal demand continues to grow strongly over the next decade. Experience gained from the Wal-Mart operations at Barbours Cut in 2005 has demonstrated that dray productivity can be substantially improved through improvements to terminal rather than dray operations. Containers are processed in a manner that cuts dray waiting time within the terminal and improves the numbers of trips that dray vehicles complete in a typical shift. And if dray productivity increases, some of the critical social costs, like idling and noise, must be reduced. Moreover, an increase in dray truck utilization inevitably puts pressure on an operator to invest in a more modern, cleaner tractor to provide more reliable service. Terminal improvements to facilitate service improvements to shippers, therefore, will impact dray operations in a powerful, market-driven fashion, avoiding the need for more trucking regulations.

6.1.1 Centralized Mandatory Reservation Systems

Excessive truck queues at rail terminal gates can cause the same type of air quality concerns as those at maritime terminals. A centralized mandatory reservation system[13] requires trucks to reserve pick up or delivery appointments to serve rail intermodal facilities in an effort to prevent excessive truck queues and any negative air quality effects. However, in 2006, it was reported that these measures had a very limited impact on reducing either queues at the marine terminals or cargo processing times. Truckers were reported to have perceived no change in their waiting time or in the transaction times with or without the appointment system. It, however, sets the stage for the introduction of PierPass that is discussed in Section 6.1.3 (Giuliano, Sloane, Southwell & Vasishth, 2006).

6.1.2 Extended Gate Hours and Peak Period Pricing

The ability of drayage operators to make night deliveries is dependent on the operating hours of the seaports, border ports of entry, inland ports, and intermodal terminals, as well as the operating hours of the pickup and delivery destinations. In the summer of 2005, the OffPeak program, administered by PierPASS, was implemented at the ports of Los Angeles and Long Beach. The OffPeak program extends port operating hours to include new night and weekend shifts. OffPeak hours are Monday through Thursday from 6:00 p.m. to 3:00 a.m. and Saturday from 8:00 a.m. to 6:00 p.m. To encourage the use of the extended hours, the program charges a traffic mitigation fee for freight moved through the port peak hours. Peak hours are Monday through Friday, 3:00 a.m. to 6:00 p.m. The OffPeak program has been a major success. In the first 4 weeks of the program, more than 188,000 truck trips were diverted to off-peak hours (http://www.pierpass.org/).

> "Port of Montreal: The Port of Montreal handled 1,226,296 TEU's in 2004 (loaded and empty) or 760,837 boxes (20' and 40'). Most of this traffic is handled by Montreal Gateway Terminals at two separate container terminals—Racine and Cast. Both are common user terminals and are under the same management structure and information systems but serve different container lines. Montreal Gateway Terminals operates Monday to Friday from 6:00 am to 11:00 pm. Montreal Gateway Terminals increased truck gate hours by moving the closing time from 4:00 pm to 11:00 pm in April of this year (2005) to relieve truck congestion at the two terminals. After a slow start, approximately 18 % of the gate transactions now take place in the 4 to 11 time period and this percentage is expected to further increase to closer to 25 % in the near term. Mostly, the long-haul operators have taken advantage of these extended hours. Queuing delays are currently minimal (as long as the weather does not interfere and shipping lines are on schedule). Wait times of 5 to 10 minutes are now the norm while the terminal checks the paperwork submitted by the driver. Dwell times inside the two terminals are 30 minutes on average" (Transport Canada, Nd).

On the other hand, drayage truck movements in the evening hours could create noise impacts on surrounding host communities. In the past, noise ordinances and agreements have been used by host communities to limit truck operations at night (Straus-Wieder, 2003).

[13] In 2002 the California State legislature passed Assembly Bill 2650 that allowed for fines to be imposed on container terminals in cases where trucks are queuing for more than 30 minutes outside the terminal gates. To alleviate these truck queues, the legislation exempted terminals that adopted gate appointments or extended gate (e.g., off-peak operating) hours. A number of container terminals thus adopted a reservation system and extended their gate hours (Transport Canada, Nd).

It has been reported that the drayage sector is not as supportive of the OffPeak Peak period pricing program. According to Prince (2006), the program has resulted in "*a change in work hours without any appreciable benefit.*" Although the shipper could save $100 if the containers are moved in the off-peak period, the trucking community has not shared in this financial incentive and has not perceived an improvement in the waiting and processing times at the inefficient terminals (Prince, 2006).

6.1.3 ITS Technologies

ITS technologies—similar to the International Border Clearance Program[14]—can be used at rail terminals to reduce delays at gates. Morlok and Spasovic (1995) advocated the use of Electronic Data Transfer (EDT) and Automatic Equipment Identification (AEI) to expedite drayage trucks entering and exiting rail terminals. EDI can be used to inform the rail terminal that the drayage driver has picked up the load and the expected time of arrival at the rail terminal, while AEI can be used to identify tractors and trailers entering the rail terminal, checks paperwork automatically, and directs the tractor to the drop-off location in the terminal. Similarly, the technology can be used to inform drayage drivers about a load that has arrived at the rail terminal, the expected time the load will be available for pick-up, any special handling and delivery instructions, and to expedite the entry and exit of the tractors and trailers entering the rail terminal (Morlok and Spasovic, 1995).

6.1.4 Improved Management of Chassis

According to Prince (2006), the U.S. is the only country in the world where chassis are primarily owned by the ocean carriers, and to some extent, the railroads. In most other countries, the chassis belong to the trucking companies. In the case of the railroads, this results in valuable terminal space being used for storing these chassis and results in additional drayage movements to reposition them. The latter is further aggravated by the fact that each ocean carrier requires that its container be moved on a chassis that belongs to that ocean carrier. UP wants to move to a chassis pool that can be used by all ocean carriers (personal communication with Joe Adams, UP).

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[14] The program *"directs and coordinates the deployment of ITS technologies at international border crossing sites for the facilitation of trade and the enhancement of commercial vehicle safety"* (Federal Highway Administration and Federal Transit Administration. 2001.

6.2 Improved Drayage Operations

6.2.1 Centralized Planning of Drayage Operations

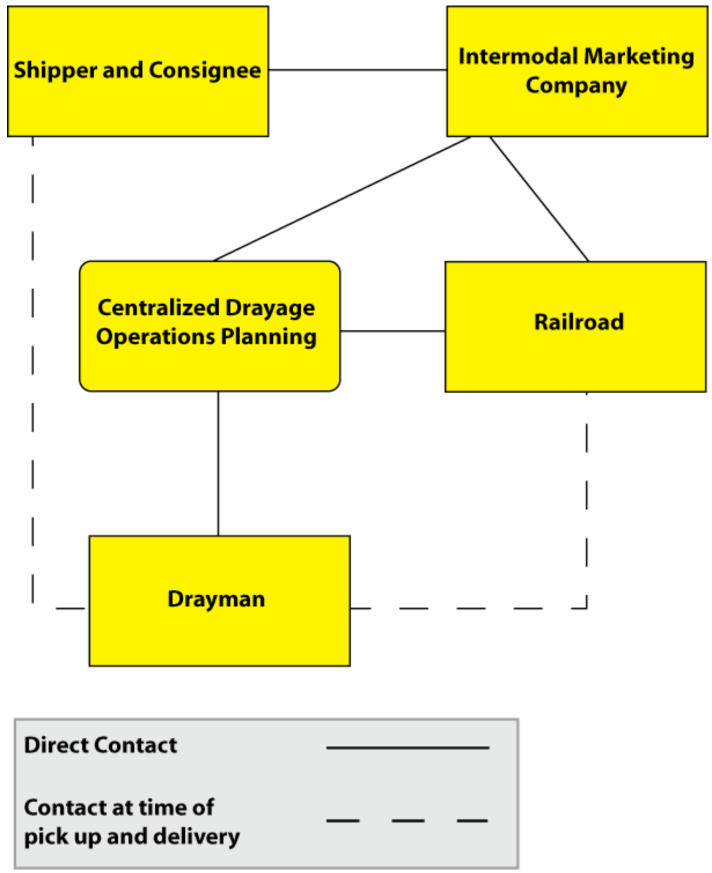
According to the literature, drayage operations involve a significant percentage of deadheading and bobtailing, increasing both the cost of drayage operations as well as resulting in an increased number of dray trips. According to Morlok and Spasovic (1994), the industry could benefit from a more centralized system responsible for overseeing and scheduling drayage movements at a specific rail terminal (illustrated in Figure 6.1). Morlok and Spasovic claimed that the fragmentation of control over drayage *"means that tractors often move into and out of the same area, at about the same time (or within the same time window of a couple of hours) hauling loads of different IMCs [Intermodal Marketing Companies] in opposite directions and returning empty"* (Morlok and Spasovic, 1994). The authors proposed that instead *"the drayage associated with an entire terminal must be viewed as a system, and the drayage operation planned so as to meet the demands and service requirements at a minimum cost"* (Morlok and Spasovic, 1994). In essence, this would involve determining each day the number of loaded and empty trailers (or containers) to be moved from and to the rail terminal. This system will allow for assigning drivers and tractors (and chassis in the case of containers) considering the total demand and irrespective of a specific drayage company, thereby minimizing total cost. By considering the total demand for drayage movements, the optimum repositioning of empty trailers and containers between consignees and shippers can also be determined. Draymen would be given a master plan to allow them to execute the different movements (Morlok and Spasovic, 1994).

Although the situation in the drayage sector has changed significantly since the 1990s when the Morlok and Spasovic research was done on drayage operations[15], it is foreseeable that the centralized planning and scheduling of drayage movements could result in improved equipment utilization (i.e., reduced deadheading and bobtailing) and thereby fewer drayage trips.

Centralized Planning of Drayage Operations

"To achieve this it would be necessary to have complete information on all consignees' and shippers' demands in the terminal service area, and to treat using all tractors and trailers as a pool with assignments to loads and movements as appropriate to optimize the system regardless of which intermodal retailer obtained the load. The intent is to increase the utilization of tractors and trailers and thus the efficiency of the operation. Such improvement would arise by, for example, scheduling delivery of loaded trailers at times when return loads from the same area are available (as long as the service constraints on delivery times are not violated), and repositioning empty trailers to nearby shippers needing empties rather than returning them to the terminal and providing the empties directly from the terminal" (Morlok and Spasovic, 1994).

[15] For example, Morlok and Spasovic assumed that draymen are compensated on an hourly basis, i.e., \$40/hour. The authors further assumed drayage to require 4 hours at the origin and another 4 hours at the destination terminal, resulting in a total cost of \$320 for the drayage movements required for picking up and delivering a container (or trailer) (Morlok and Spasovic, 1994)



Source: Morlok & Spasovic, 1994

Figure 6.1: Proposed Redesign of Relationship among Parties with Centralized Drayage Operations Planning

One example of a trend towards greater centralized planning for dray operations involves the BNSF's newly proposed 180-acre Southern California International Gateway (SCIG) facility. This facility would generate a substantial amount of drayage activity, and as such, has raised concerns from local communities over traffic and air quality impacts. After exploring several options, the BNSF has proposed that the 400 dray trucks that make deliveries between the docks and the rail head be owned by the railroad as opposed to using third-party owner-operators. All trucks would use EPA certified 2007 or later engines in order to ensure that emissions are limited. Finally, the trucks would be tracked by GPS in order to ensure that they do not venture from the pre-approved routes and venture into neighborhood streets. This example and the steps that were taken by BNSF to control dray activity both encapsulates and potentially refutes several of the recurrent complaints regarding the allegedly uncontrolled and presumed uncontrollable nature of dray activity. If the BNSF model proves successful, it may indicate that a re-imagining of the basic structure is possible, at least on a case by case basis. It is likely not a coincidence that the BNSF proposal mandating 2007 engines, controlling trucks through a centralized firm, and tracking them through GPS is quite similar to the broader strategy that has been envisioned for all harbor drayage trucks by the newly proposed Clean Air Action plan, as was described earlier in this report.

6.3 Fleet Modernization

Recent research by the Texas Environmental Research Consortium has concluded that ozone nonattainment in the Houston-Galveston and Dallas-Fort Worth areas is dominated by NOx emissions from existing (i.e., generally older) heavy-duty diesel vehicles.[16] On-road vehicles in the heavy-duty category include many classes of individually owned and operated vehicles ranging from mobile lunch stands to Class 8 trucks.

The dray fleet serving Texas is comprised almost entirely of retired long haul trucks. The structure of the dray industry, in which most drivers own their own trucks, favors low capital entry requirements. Substantial opportunities exist to provide incentives for the modernization of this fleet, which would lead to benefits in air quality and safety. The researchers believe that the structure of the Texas Emissions Reduction Plan (TERP) and various associated local initiatives already provides sufficient financial basis for the modernization of the fleet.

The use of early retirement programs, otherwise known as scrappage, is a key method for eliminating the oldest, most polluting vehicles from the fleet, thereby improving overall air quality. Scrappage programs have been used in several instances around the country for both light duty and heavy duty vehicles. The essential concept underlying scrappage is that when the social costs of future emissions from a certain subset of vehicles outweigh the market value of these vehicles, the state can purchase the projected future emissions and thereby benefit both the vehicle owners and the public.

There are three distinct generations of scrappage programs that have evolved in the United States since the 1980s, and these differ based on the amount of information they require to identify high emitters:

First Generation: The state offers vehicle owners a scrappage package based on pre-determined measures, such as vehicle age and model. All vehicles meeting these characteristics are eligible for scrappage. The program terminates when the fund is exhausted.

Second Generation: Incorporates standardized emission testing into the decision matrix regarding which vehicles to target. The heavy administrative costs of these programs can be covered by user fees. The Low Income Vehicle Repair Assistance, Retrofit, and Accelerated Vehicle Retirement Program (LIRAP) program currently in place in Texas belongs in this category.

Third Generation: Uses probability models to more effectively target high-emissions vehicles. The program factors in variables such as vehicle value and useful future life. In some cases, these probabilistic models can be complemented by Remote Sensing Device (RSD) technology that allows the state to identify high emitters outside the normal emissions inspection regime. California is currently developing this type of program.

The State of Texas, through the TERP, has now committed substantial resources to retire and replace older vehicles. The initial funding for heavy vehicles came after the 77th legislature,

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16 Hall, J., R. Smaling, and G. Beaty (2006), "Strategic Plan Concerning the Texas New Technology Research and Development (NTRD) Program for Reducing Oxides of Nitrogen Emissions from On- and Non-Road Diesel Vehicles in 8-Hour Ozone Nonattainment Areas in Texas", draft Strategic Plan, Texas Environmental Research Consortium

which established the TERP. Through 2007, TERP grants in the amount of $407 million had been given to retrofit or replace heavy duty diesel engines with cleaner alternatives. In most cases the replacement engine was a more modern diesel; however, in some cases diesels have been replaced with cleaner fuels such as compressed natural gas. In dollar terms, locomotives have received the greatest share of the funding. Trucks and other on-road projects have received $119 million for the replacement or retrofit of 3,000 vehicles. The TERP estimates that the benefits in terms of NOx reduction from on-road sources to be 14 tons per day.[17]

Other scrappage programs have specifically targeted dray vehicles and their air quality impacts on surrounding communities. The Gateway Cities program, for example, is an attempt to modernize the drayage fleet serving the Port of Los Angeles by providing incentives for drayage operators to retire and scrap the oldest and most polluting vehicles. The program has had limited success, removing only 220 vehicles from the roads since its inception in 2002. A number of those vehicles would likely have left in service had the program not been in place. For these reasons, the Port has recently been relaxing the criteria necessary for a vehicle to be eligible for the program. When the program first started, vehicles had to make 700 calls to the port per year to be eligible. This number has now dropped to 500 calls and will soon drop to 250. More recently, the Port of Los Angeles and Long Beach have put forward a multifaceted plan to improve the emissions impact of all port related activity by adopting best available technologies. Appendix X briefly highlights some of the salient aspects of the plan.

Texas Senate Bill 12

In the most recent legislative session, the states commitment to emissions reduction through vehicle retirement incentives was expanded. The passage of Senate Bill 12, sponsored by Kip Averitt in 80th Texas legislature, significantly expanded TERP funding and delayed the expiration of the program from 2010 to 2013.

Several provisions in this bill are expected to have particular relevance for the dray sector. The bill lowers the threshold for percentage of time and percentage of miles that vehicles must spend within nonattainment counties in order to qualify for the grants. Previously, vehicle owners were required to prove that their vehicles logged 75 percent of total miles within designated nonattainment counties. This percentage has now been reduced to 50 percent. This change is expected to aid the eligibility of the dray fleet in three ways. First, it will expand the number of trucks that are eligible to participate in the programs. Second, it will makes it easier for trucks that already spend 75 percent of their miles in nonattainment areas to prove that they log at least 50 percent of their miles in these counties. Third, it will mean that in many cases. A substantial share of a trucking firm’s total fleet will be eligible, which may persuade managers to assist drivers in completing the process. The criteria for use refer to either miles driven or fuel consumed. Therefore, a driver who made short haul deliveries in the Houston area but also made occasional interstate deliveries might be penalized by these criteria.

As stated in the bill analysis “The bill sets forth provisions related to providing funding for and promoting idle reduction technologies. The bill requires TCEQ to encourage the use of external power units at ports and border crossings.”[18] Although Alternative Power Units are principally found at rest areas for long haul trucking, the placing of APUs at ports and border

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17 http://www.tceq.state.tx.us/assets/public/implementation/air/terp/erig/FINAL_Summary_by%20ES.xls

18 Bill Analysis of SB 12 at Texas Legislature Online,
www.capitol.state.tx.us

crossing areas could be helpful in improving working conditions for dray drivers. Current TCEQ rules at the Barbours Cut and Bayport terminals forbid dray drivers from idling their engines for more than 5 minutes during the spring and summer months.

Under the TERP, the grant amount for vehicle replacement is determined by the difference in NOx emissions of the vehicle (or engine) and the vehicle (or engine) that replaces it. To be eligible, the replacement vehicle must emit at least 25 percent less NOx than the vehicle pending replacement.

There is a second set of standards for issuing grants for cleaner new vehicles, regardless of whether or not they replace an existing vehicle. If the applicant purchases or leases a new vehicle that emits "at least 25 percent less NOx than required under the current federal standard for that vehicle," then the vehicle is eligible for a grant without specifying whether the purchase will replace an existing, older vehicle. [19] This provision is helpful in assuaging the concern that replacement grants are biased in favor of owner-operators who are already in the industry as opposed to company drivers who wish to purchase their own truck. Senate Bill 12 increases the incentive for scrappage or truck replacement by raising the maximum compensation for NOx abatement from $13,000 to $15,000 per ton.

Texas's commitment to funding vehicle retirement is not open ended. The practice of the TCEQ for the last few years has been to issue calls for grant applications when funding becomes available. Applications that meet the eligible criteria for NOx abatement and usage within the nonattainment area are processed until the point when funding is exhausted and the program is temporarily suspended to wait for the next funding allotment. In this sense, the heavy duty vehicle retirement program under the TERP most closely matches the definition of a first generation scrappage program.

The history of the emissions standards for heavy-duty vehicles is illustrated in Figure 6.2. Prior to 1988, particulate matter mass emissions standards for heavy-duty diesels did not exist. The 10.7 g/bhp-hr NOx standard began in 1984. Therefore, a heavy-duty truck manufactured between 1991 and 1997 emits less than half the NOx as a nominally identical truck manufactured prior to 1990. As shown in Figure 6.2, the NOx benefits from replacements of older trucks with trucks that are newer than 1997 and are even more substantial.[20]

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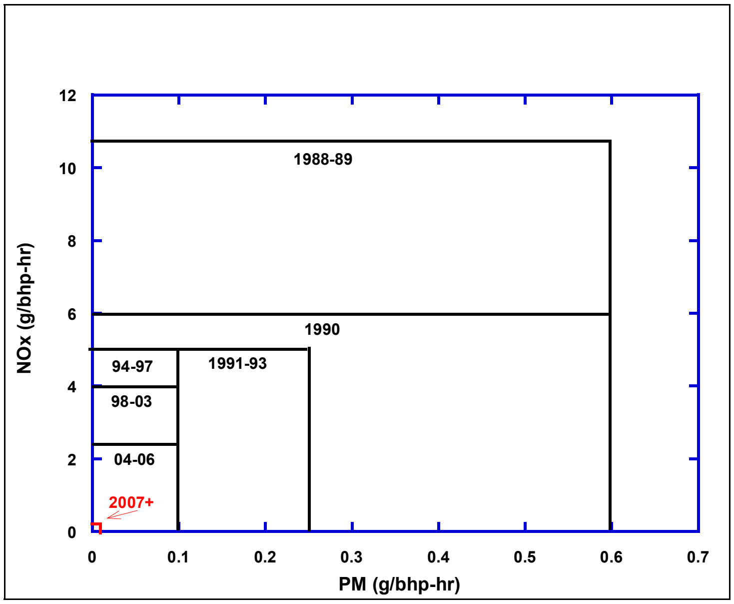
19 http://www.tceq.state.tx.us/assets/public/implementation/air/terp/guidelines/ch5.pdf

20 Figure and associated text provided by Dr. Ron Matthews through email, 05/23/07



Diesels easily meet standards for CO and hydrocarbons but all methods for in-cylinder emissions control involve a tradeoff between NOx emissions and particulate matter (PM) emissions. The 2004-06 MY standard is an NMHC+NOx standard of 2.4 g/bhp-hr but these engines must also meet an NMHC standard of 0.5 g/bhp-hr.

Figure 6.2: Heavy-duty diesel emissions standards since 1988

Unlike with light-duty gasoline vehicles, emissions deterioration with mileage accumulation is not a significant concern for heavy-duty diesel vehicles because such vehicles did not incorporate exhaust catalysts prior to 2007. Thus, up until now diesel candidates for scrappage/replacement could be determined in large part from their date of manufacture.

With the introduction of various emissions control devices in modern diesel engines such as electronically controlled injection, particulate traps, and catalytic converters, the profile of emissions from the diesel fleet is expected to become more heterogeneous in the future. For this reason, accelerated vehicle retirement programs targeting diesel trucks will need to become more adaptable in order to generate the maximum amount of emissions abatement per dollar allocated. A recent analysis by the Eastern Research Group on strategies for improving vehicle inspections and scrappage in California developed several methods that could be used in the future to more scientifically target potentially high emitting vehicles. Most of these techniques are modifications of the existing annual inspection and maintenance regime.

Emerging Technologies

Given that the grant amount is tied to difference in NOx emissions between the old vehicle and the replacement vehicle, the structure of the program should encourage the adoption of newer engine designs, such as hybrids, that would generate even lower levels of NOx. In the past year, the development of economical heavy duty hybrid engines for Class 8 tractors has been promising. Wal-Mart has started to make deliveries using Class 8 Hybrid constructed by Peterbilt in conjunction with Eaton Corporation. The 386 model, which is expected to go into full production in 2009 or 2010, is estimated to lower fuel consumption by 5 to 7 percent compared to an equivalent diesel. The hybrid’s battery pack also serves as a built in APU, allowing the vehicle to run air conditioning or other on board equipment without idling the engine.[21] A recent white paper published by the Tioga Group, which is currently developing air

[21] The Pete Store Delivers the industry's first Class 8 Hybrid truck to Wal-Mart Stores, Inc.

quality metrics for the Environmental Protection Agency, argued that the dray engine cycle, with its frequent starts and stops, is a natural area for the development of Hybrid engines. In the following chart, Tioga demonstrates the differences in the engine cycle patterns between normal heavy duty cycle and estimated drayage cycles from California vehicles with the associated emissions impacts.[22]

The higher emissions impacts from dray vehicle, according to the Tioga analysis, are tied in large part to the high level of idling (Figure 6.3).

Cycle	Time Shares				Weighted Averages			
	Idle	Creep	Transient	Cruise	EC+OC mg/min	MPH	EC+OC mg/mi	Excess over HHDDT
CARB HHDDT	17%	7%	19%	58%	77.1	26	176.6	
Conceptual Drayage 1	25%	25%	25%	25%	67.2	14	282.3	60%
Conceptual Drayage 2	50%	20%	10%	20%	54.5	10	331.2	88%
Conceptual Drayage 3	50%	15%	25%	10%	63.5	8	469.7	166%

Figure 6.3: Emissions Implications of Conceptual Drayage Activity Cycles

6.4 Cleaner Fuels

The adoption of ultra low sulfur diesel (ULSD) in 2006 laid the groundwork for the eventual standardization of emissions control systems on diesel burning trucks. As such, the gulf that previously separated the emissions performance of vehicles that used diesel fuel with those that used alternative fuels such as propane or natural gas, has grown significantly narrower. Because dray trucks are individually owned and operated, it would be comparatively more difficult to introduce vehicles powered by an alternative fuel, particularly if the fuel resulted in higher capital cost or reduced range. Other than low sulfur diesel, which is already widely used due to federal law, the only other alternative fuels which may have an impact on dray operations

> The contribution of port-related activity to Houston's air quality non-attainment status has been an area of growing concern and is repeatedly noted by the Texas Commission for Environmental Quality (TCEQ). The Port of Houston has taken a series of steps in recent years, many in conjunction with the Texas Emissions Reduction Plan, in order to improve port-related emissions impacts. After the Port of Houston commission directed staff to implement clean air technologies, the staff specifically targeted off-road diesel engines. The PHA felt that off-road diesels presented the biggest opportunity for cost effective improvements, and were easier to control given that the vehicles were owned and operated by the PHA. This included new yard tractors and empty container handlers with certified Tier II emissions standards. The PHA also began using emulsified diesel in its yard equipment. For the most part, emissions from the drayage fleet have not been addressed. Despite the fact that dray trucks spend a significant percentage of their time within the port gates, they have not been targeted, for emissions reduction purposes.

http://www.thepetestore.com/news-002.php

[22] Comments on Evaluation of Port Trucks and Possible Mitigation Strategies http://www.arb.ca.gov/msprog/onroad/porttruck/reportcomments/tiogagroup.pdf

in the near future are alternative diesel blends, which could include emulsified fuels such as PuriNox, or biofuel blends such as bio-diesel or ethanol blended ediesel.

The use of emulsified diesel fuels, such as PuriNOx, by the drayage sector could produce significant benefits in the reduction of NOx and PM emissions. CTR's 2004 analysis of PuriNOx, which contains 20 percent water and 3 percent additive, concluded that PuriNOx works best in regularly used equipment which can tolerate a marginal reduction in power (Baker et al, 2005). The potential for a cost penalty will, however, require some type of economic incentive to motivate drayage operators to use PuriNOx. The Port of Houston has already used PuriNOx in order to power its in-terminal fleet. The availability of biodiesel is increasing in most metro areas of the state; however, the researchers did not find any instances in which dray fleets were using biodiesel blended fuel, as it is still marginally more expensive than petroleum diesel and is not typically sold in areas that are easy for dray trucks to access.

6.5 Separating Dray Trucks from Passenger Traffic

Certain community impacts could be alleviated by either the physical (e.g., dedicated facilities, including truck only toll lanes) or temporal separation (e.g., providing incentives for dray trucks to make deliveries at night). In most contexts within Texas, the possibility for shifting to off peak deliveries is complicated by limited operating hours at major warehouses and Intermodal facilities.

In certain contexts it may be possible to designate specific truck routes leading to intermodal rail facilities. Dedicated truck lanes have been most discussed in the context of reducing delays at border ports of entry with associated time, congestion, and emissions benefits. More recently, however, Governor Arnold Schwarzenegger has proposed the building of dedicated truck lanes on the Long Beach Freeway to provide access to the ports of Long Beach and Los Angeles (Halper and Morain, 2006). It is still unclear whether (a) sufficient intermodal volumes leading to and from Texas Intermodal terminals will exist to justify such lanes and, (b) whether sufficient land use controls exist to direct industrial activity into pre-designated corridors.

As stated by Strauss-Wieder, "Developing buffer zones to transition between freight/industrial uses and residential uses, creating neighborhood investment funds, and requiring developers to make the necessary highway access improvements for trucks" is one of the principal strategies for reducing the likelihood of adverse impacts from dray related activity on neighboring communities (Strauss-Wieder, 2003). In this area, planners can borrow many of the lessons that have been learned in accommodating increased freight rail traffic through urban areas. Report 0-5546-1 *Protecting and Preserving Rail Corridors against Encroachment of Incompatible Uses* (Loftus-Otway et al., 2007) contains an extensive discussion of the strategies planners can use to prevent community opposition to industrial activity by incorporating mitigation strategies for noise and emissions into the planning process from the beginning.

6.6 Improved Intermodal Connections

Experience has shown that certain "spot" improvements to arterials and highways could significantly improve traffic flows and reduce the impacts on nearby communities (see text box). *"Road geometry issues such as inadequate turning radii, number of turning lanes, and ramp configurations can be mitigated through spot improvements to the roadway system. These improvements can increase both truck and overall traffic flow conditions"* (Strauss-Wieder, 2003).

On the other extreme, the Alameda corridor was envisioned as a solution to the congested highway access routes and the projected rail capacity constraints attributable to the forecasted increases in traffic originating at or destined for the ports of Los Angeles and Long Beach. By linking these ports to the transcontinental rail yards near downtown Los Angeles—a distance of 20 miles—shippers have the option to eliminate the dray by switching to rail, thereby reducing congestion, improving safety, reducing truck emissions, capturing multi-modal efficiencies, and deferring pavement expenses.

"For example, connections between the Santa Fe Railway intermodal terminal in Chicago—perhaps the world's largest—and the nearby Interstate highway is good in one direction, but because of the lack of entry and exit ramps in the other, trucks must use local streets for many miles of congested running. Two ramps would make a tremendous difference! Other examples where adding turning lanes, or traffic lights would aid truck access abound" (Morlok and Spasovic, 1995).

Chapter 7. Conclusions

This first year report documents the initial efforts to collect data for project 0-5684, Impacts of Dray System along Ports Intermodal Yards and Border Ports of Entry. To date, the research team has used several different techniques to gain insight into the structure and operating characteristics of Texas dray vehicles. The study recognizes three different categories of dray operations in the state—at deep water container terminals, rail intermodal terminals, and at ports of entry along the border with Mexico. The most extensive data collection accomplishments at this time lie with deep water terminals and the border. A pilot rail terminal survey and drayage company survey were conducted. The data already collected and reported in this report suggests that this research is illuminating several issues of relevance to the research topic and, more importantly, to TxDOT planning and operations.

7.1 Ports

The port analysis, as covered in Chapter 2, profiles the dray sector serving the Port of Houston. Dray trucks are responsible for handling almost all of the 1.5 million TEUs that pass through the Port of Houston each year. Drawing upon information collected from surveys and interviews, several criteria necessary for understanding dray activity are described. These criteria include the structure and size of firms, compensation practices, route choice, dispatching, vehicle age, safety, and maintenance practices. The memo also analyzes activity at the Barbours Cut gate derived from a database provided by the Port of Houston. The impacts of port-related dray activity on the Houston area is currently in flux due to the recent opening of the Bayport Container terminal. This will be examined and reported in year two of the study.

7.2 Rail

The rail chapter of the report describes the time-of-day distribution of dray truck traffic at the BNSF Pearland Facility, the UP Englewood Yard, and the UP Settegast yard, all of which are located in Houston. BNSF provided significant data on truck throughput from the Pearland facility but did not allow the researchers to conduct a survey of dray drivers at the gates. CTR researchers worked with UP staff to develop a survey that considers location and time constraints for rail terminal gate operations. Surveys were conducted at UP's Englewood yard in July 2007. Subsequent surveys will be conducted at UP's Settegast terminal in Fall 2007. This chapter also includes the salient findings of a pilot telephone survey of a small number of drayage companies that serve rail terminals in Dallas.

7.3 Border

Arguably, the most important impact of US-Mexico dray operations in recent history was the decision to construct permanent state truck inspection stations adjacent to the federal entry facilities. All trucks entering the eight largest ports must travel through these facilities where Department of Public Safety (DPS) officials and their staff can fully inspect and weigh vehicles. These inspections have resulted in some dray vehicles traveling through those facilities several times a day—an unprecedented level of scrutiny. Naturally, this has caused dray operators to change their business model, most typically removing the oldest tractors from their fleet and maintaining higher standards than before. The DPS data suggest that out of service rates are now perhaps lower than seen on most Texas highways, a testament to this impact. The study team therefore obtained DPS safety data and will process the data for the border for inclusion in the second year report.

Border interviews were completed during the summer and are presented in this first year report. Contact has been made at the Laredo and Pharr ports of entry and a method for conducting interviews and reporting the data agreed. At Pharr, the McAllen Development Corporation is offering its facilities to host a meeting with its dray members and this will form the basis of the report for that port of entry. The team has not yet agreed on the approach at Laredo but, in the past, good relations with the Laredo Development Foundation suggest that we should work through that entity. Finally, the team will address the issue of the opening of the border which is likely to impact Laredo—the largest of the truck crossings—the most during the summer months and will be included in the first year report.

To summarize, during the first year, the researchers have characterized the basic architecture of the drayage industry by profiling dray operations at the Port of Houston's Barbours Cut Terminal, the UP Englewood Yard, the McAllen Port of Entry, and a sample of firms serving intermodal yards in Dallas and Houston. The objectives of the second year are to (a) expand and analyze the data collected during the first year, (b) to quantify the impacts of dray operations occurring in different areas of the state in terms of total generated VMT placed on the system and associated congestion impacts on urban transportation networks; associated external impacts such as emissions, safety, and noise on Texas cities, and (c) provide guidance for accommodating dray activity from projected future generators such as new marine or rail terminals.

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Appendix A: Proof of Concept: Tracking Dray Vehicles using @ROAD Mobile Resource Management

The proliferation of affordable and accurate GPS technologies has made it possible for fleet managers to retain a far higher level of detail regarding trucks in the field. This technology opens up new possibilities for performance based compensation and can help managers ensure that their drivers are following safe practices while on the road. Dray fleets in Houston are only beginning to experiment with GPS technologies.

To demonstrate how such an analysis might function, CTR reviewed the types of GPS fleet management options that were potentially viable and had already been used in certain Texas dray fleets. After selecting an appropriate option, CTR acquired a trial unit from the manufacturer, @Road, in February 2007. CTR then contacted Canal Cartage, one of the largest dray operators in the city, and asked to arrange a test with a driver.

Diego Tenorio was selected as the test driver because the Canal Cartage management believed that his daily dispatch duties would be similar to many other drivers serving the Port of Houston. CTR hopes that the data collected from such a sample, while insufficient to draw any definitive conclusions, would demonstrate the types of information and results that would be available if the experiment was conducted on a statistically defensible scale.

Nathan Hutson and Rob Harrison arrived at Canal Cartage on February 21 shortly before 7:00 a.m. After meeting Mr. Tenorio, Mr. Hutson installed the @Road test unit in Mr. Tenorio's 1997 Freightliner. At 7:20 a.m., Mr. Tenorio left Canal Cartage to perform his first run: picking up an empty container from a local rail yard and delivering it to the Barbours Cut container terminal. The GPS unit in Mr. Tenorio's truck 'pinged' his location and speed every 5 minutes from 7:20 a.m. until 3:15 p.m., when he finished his last run of the day. These locations are reported as a detailed activity log according to the nearest intersection. In total, on February 21, Mr. Tenorio traveled 143 miles. All of these miles were accrued on the eastern side of Houston, primarily on major corridors such as IH 610 and SH 225, in addition to the roads in the immediate port area. The data shows that Mr. Tenorio's driving day was almost exactly 8 hours and that he spent 5 hours driving and 3 hours stopped (including time spent at traffic lights).

Throughout his day, Mr. Tenorio only experienced three instances in which he was parked for more than 15 minutes (71 minutes total). One of these instances occurred at the Canal Office, one in the Barbours Cut area, and one at Bayport. Figure A.1 presents the results from the GPS tracking.

Summary	
Total Time	8H:0M
Total Travel Time	5H:3M
Total Distance (M)	142.8
Number of Stops	26
Total Stop Time	2H:57M

Stop Color Legend	
Green	stops >= 3 & < 15 min
Yellow	stops >= 15 & < 60 min
Red	stops >= 60 min

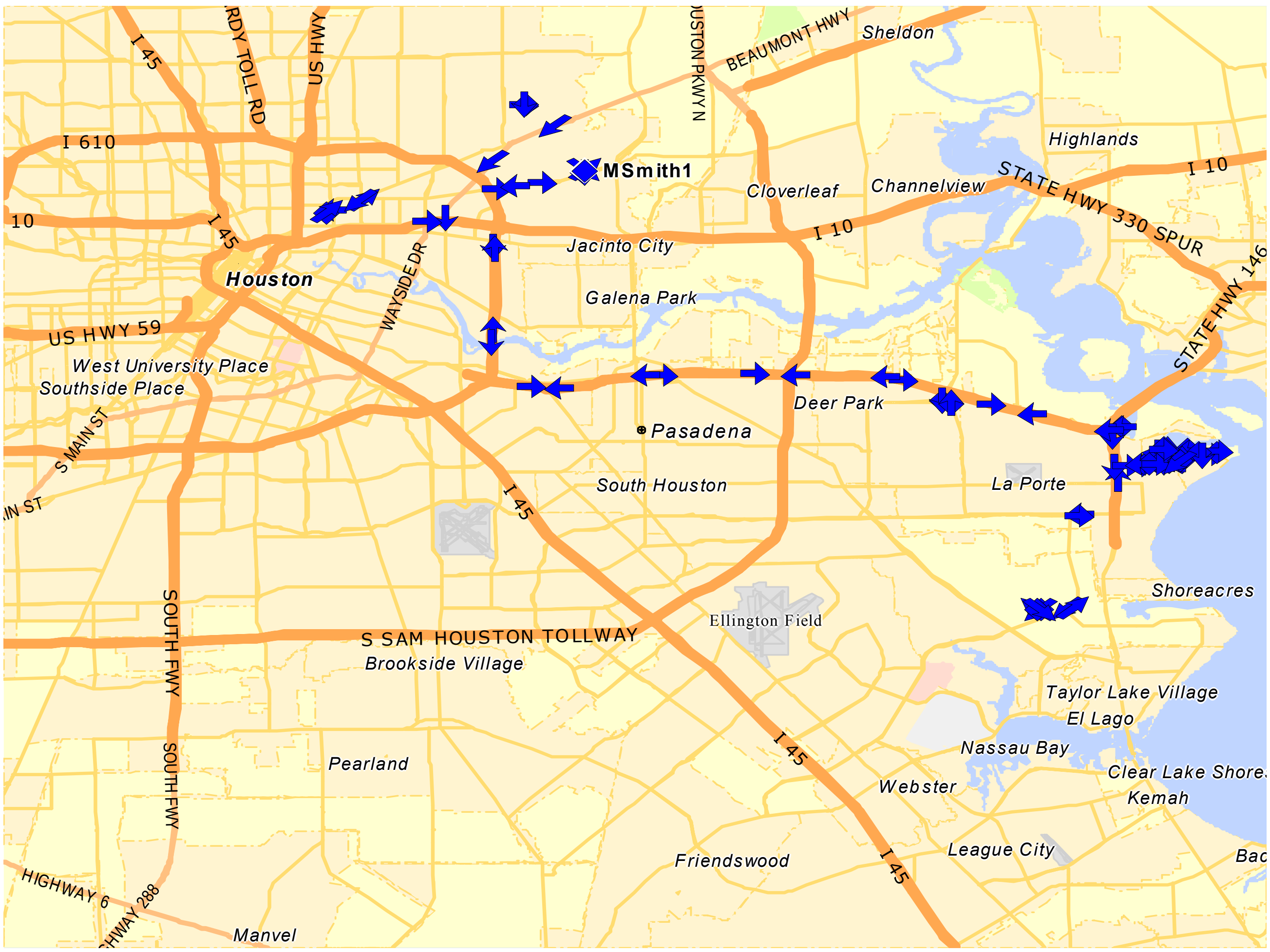


Figure A.1: Activity profile for Diego Tenorio, February 21, 2007

Appendix B: Barbours Cut Gate Activity Analysis

Barbours Cut records truck movement through the terminal by noting when trucks arrive at the gate, when the truck is processed at the entry gate, and when it leaves the terminal. All of this information is stored in a database. The researchers requested 2 months of this data from Barbours Cut officials: 1 month that would represent the average demand on the terminal and another that would represent elevated demand. Officials from BCT provided the data to allow the researchers to identify major container lines calling the port, determine what drayage firms drop off and pick up containers at the terminal, and calculate drayage truck turn time[23].

Truck Turn Time Database

The database compiles the record of every container passing through its gates whether for import or export. For this study, the months of April 2005 and October 2005 were used to evaluate the activity of container lines and drayage carriers. The months of April and October were selected to provide an analysis for non-peak (April) and peak (October) time periods. The database also includes information on the shipper that transported the container and the drayage company moving it to a distribution center or its final destination. The data can also be grouped based on time of day and day of the week. Table B.l lists the data fields recorded in the database and a brief description of each field.

Table B.1: Barbours Cut Terminal: Fields in Truck Turn Time Database

Field	Description
EIR	Identification number for transaction
ShipCo	Container line
Unit	Container identification number
SCACCode	Abbreviation for drayage company transporting container
Multiple	Y = yes, N = no. Trucks moving more than one container at the terminal are marked as Y.
StartYear, StartMonth, StartDay, StartHour, StartMin	The start time designates when the container arrives at BCT.
EIRYear, EIRMonth, EIRDay, EIRHour, EIRMin	The EIR time designates when the document processing at the gates are complete. The truck can enter the terminal.
StopYear, StopMonth, StopDay, StopHour, StopMin	The Stop time designates when the truck has received or dropped off the container and left the facility
Hours	Total turn time including gate time and yard time

Container line information was determined through entries in the ShipCo field, and drayage firms were identified through the SCACCode field. The top ten shipping companies that

[23] CTR researchers conducted a driver survey and included questions on gate time. The researchers concluded that the driver perceptions of wait time varied widely and limited the usefulness of the survey information. The information on turn time provided by the BCT staff proved to be a more reliable method. BCT staff collects information on every truck that enters the facility and the container. BCT staff then uses that information to communicate to the drayage companies a turn time estimate.

delivered containers to Houston in April 2005 and October 2005 are listed in Table B.2. These shipping companies deliver most containers transported through BCT at rates of 85 percent in April and 87 percent in October. Each container owner had an increase in shipped containers, but the greatest changes between April and October were for companies ranked 6^{th} thru 10^{th} in April. For example, CMA CGM increased container throughput by 293 percent and Orient Overseas Container containers rose by 21.8 percent. An important note when examining Table B.2 is that Hapag Lloyd and CP Ships have merged since 2005.

The CMA CGM 293 percent increase is noteworthy because the shipping company is transporting primarily Wal-Mart freight. Once the containers are at Barbours Cut Terminal, Powers Transportation, a drayage firm, schedules drayage trucks to deliver the containers to the 4 million square feet Wal-Mart Import Distribution Center (IDC). The shipping demands generated by a distribution center are substantial and can immediately introduce new transport providers like CMA CGM as a leader in the regional market. CMA CGM transported 983 containers in April 2005, but the monthly total increased to 3,872 containers in October 2005 due to the Wal-Mart IDC opening.

Table B.2: Top Ten Container Owners at Barbours Cut Terminal

April 2005		October 2005	
Container Owner	**Containers**	**Container Owner**	**Containers**
CP Ships	9,165	CP Ships	9,926
Mediterranean Shipping Co.	7,005	Mediterranean Shipping Co.	7,581
Hapag Lloyd	3,059	CMA CGM SA	3,872
P&O Nedlloyd	2,336	Hapag Lloyd	3,399
APL Ltd	2,329	MTM	2,658
MTM	1,976	P&O Nedlloyd	2,560
Niyac Corp	1,391	APL Ltd	2,515
Orient Overseas Container	1,125	Niyac Corp	1,646
Zim Integrated Shipping Services Ltd	1,034	Orient Overseas Container	1,370
CMA CGM SA	983	Degussa SA	1,335
Top Ten Total	30,403	Top Ten Total	36,862
Total for Month	35,610	Total for Month	42,046

Calculating Average Gate, Yard, and Total Turn Time

Table B.3 is a sample of the database for selected fields used to calculate gate time and yard time. Each EIR number is a unique transaction. Gate time and yard times were found by comparing start time fields, EIR time fields, and Stop time fields.

Table B.3: April 2005 Gate Data

EIR	Unit	Multiple	Start Day	Start Hour	Start Min	EIR Day	EIR Hour	EIR Min	Gate Time	Stop Day	Stop Hour	Stop Min	Hours
400284	GSTU7890339	N	1	8	40	1	8	56	16	1	9	33	0.88
400285	CAXU4966090	N	1	8	47	1	8	47	0	1	9	16	0.48
400286	GESU4029326	N	1	8	55	1	9	4	9	1	9	37	0.7
400287	MSCU9696175	N	1	9	12	1	9	20	8	1	9	39	0.45

The gate time includes not only the time that a truck driver waits in the queue but includes the time when the driver interacts with the kiosk clerk to gain clearance to enter the terminal. As a truck approaches the gates, the driver decides what lane to enter. The lane may only include the truck being processed, so the truck arriving is the next in line to be processed. During daily peak times, more than one truck may be waiting to be processed in each open lane, and on these occasions, the approaching driver would have to wait in the queue to have their load documentation processed. An average gate time was used to compare gate times between the peak and non-peak seasons for each daytime hour the BCT gates are open. The gate time calculation requires sorting the raw data to remove multiple transactions made by the same truck. This information is marked by a Y in the Multiple column. Next, the gate time is calculated by taking the difference between the EIR time and the Start time (Equation 1). For example, the gate time for EIR 400284 (Table B.3, Row 1) is 16 minutes. Any transaction with a gate time that is 0 or negative was deleted from the data set, so EIR 400285 (Table B.3, Row 2) would be removed from the analysis. These transactions represent occasions when the truck was not assigned a start time based on when it joined the queue. The remaining entries were sorted by Start Hour for every day of the month, and the average gate time was calculated for each hour of the day over the entire month. A similar method was used to calculate the yard time by taking the difference between the Stop time and the EIR time.

Equation 1: Gate Time = EIR Time – Start Time

The yard time equals the difference between the total time spent at the terminal represented by the Hours column in Table B.3 and the calculated gate time for each transaction (Equation 2).[24]

Equation 2: Yard Time = Total time – Gate Time

The total turn time is the sum of gate time and yard time (Equation 3).

Equation 3: Total Turn Time = Gate Time + Yard Time

Figures B.1 and B.2 illustrate the average gate, yard, and total turn time for April and October 2005, respectively.

[24] The yard time is another descriptor of dray truck activity in the container yard. After receiving clearance to enter the terminal, the yard time begins. Then, the driver heads to the container stacks where the driver waits for a gantry crane to unload or load the container. The yard time ends at the transaction close when the dray truck leaves the yard for single moves or begins a second transaction for multiple moves. The yard time calculation utilizes the sorted worksheets from the gate time calculation.

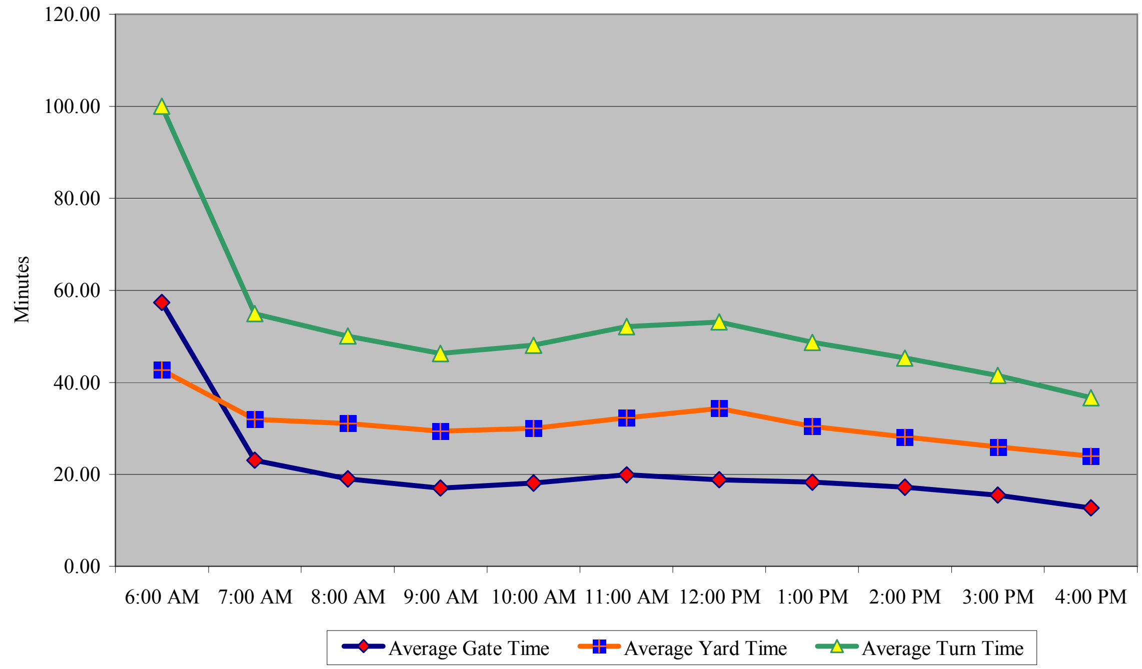


Figure B.1: April 2005 Barbours Cut Gate Data

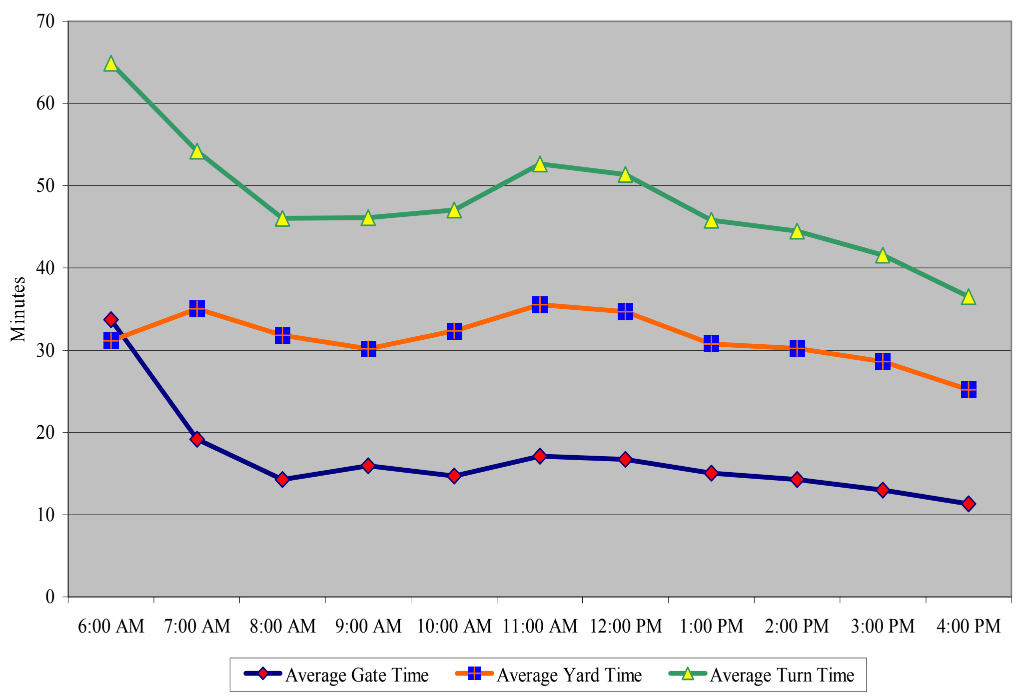


Figure B.2: October 2005 Barbours Cut Gate Data

Appendix C: Documented Literature Characterizing the Drayage Sector Serving Rail Intermodal Facilities

One of the few studies that attempted to characterize the drayage sector serving rail intermodal facilities was documented in the Institute of Transportation Engineers (ITE) journal published in December 2000. Although the authors defined drayage as *"trips that move between intermodal facilities, such as carrying goods from the airport to a rail yard, or back and forth between rail yards",* all trucks—not only the drayage trucks as defined—serving a sample of rail intermodal facilities on an average weekday were surveyed. This method was motivated by the concern that drayage trucks spent a lot of time queuing and were larger and heavier than other freight trucks.

The journal article thus highlighted the salient findings of a truck survey that was conducted to characterize the trips, truck types, and number of trips made on an average weekday to intermodal rail yards in Chicago (McGuckin and Christopher, 2000). The surveys were conducted between 6:00 a.m. and 6:00 p.m. mostly on Tuesdays, Wednesdays, or Thursdays. Although the survey is somewhat dated—it was conducted in the Fall of 1996—it is unique in attempting to characterize the truck trips and the trucks used to serve both older urban rail facilities and newer modern suburban rail terminals. The study also estimated the number of truck trips to each site given an average 24-hour weekday (i.e., Tuesday, Wednesday, or Thursday). A sample of drivers was intercepted as they arrived at the rail terminals and a short interview (approximately a minute and a half in duration) was conducted to collect information about:

- *"Truck type (silhouette);*
- *Trucking company name and location;*
- *Unloaded vehicle weight;*
- *Trailer length/height;*
- *Whether the trailer is a container;*
- *Whether vehicle is carrying cargo or empty;*
- *Major commodity on-board (coded to Standard Transportation Commodity Codes);*
- *Weight of cargo;*
- *Origin of trip to the site (city, region, or outside of region);*
- *Origin kind of place (truck terminal, intermodal facility, or other business);*
- *Origin address;*
- *Destination of trip from the site (city, region, or outside of region);*
- *Destination kind of place (truck terminal, intermodal facility, or other business);*
- *Destination address;*
- *Route taken from origin to site (three roadways); and*
- *Frequency of this trip in last week (seven days)"* (McGuckin and Christopher, 2000).

A total of 2,213 interviews were conducted during the study. In addition, each of the rail terminals surveyed were described in detail with respect to size in acres, number of employees, including regular and contract employees, and the number of lifts per day (see Table C.1), manual classification counts were conducted of all the trucks entering the site during the 12-hour survey period, and 24-hour axle counts were conducted during the survey days of all vehicles entering the site, using tubes to estimate the total number of trucks in conjunction with the manual classification counts entering the site. This strategy was necessary because gate counts were found to underestimate the number of trucks arriving at the terminal as certain trucks[25] did need to check-in at the gate (McGuckin and Christopher, 2000).

Table C.1: Characteristics of the Intermodal Rail-Yards Surveyed

Intermodal Rail-Yard	**Area Occupied (Acres)**	**# of Inbound Trains/Day**	**# of Outbound Trains/Day**	**# of Containers/ Trailers Handled (1995)**	**# of Containers/ Trailers Handled/ Day (1995)**
BNSF (Corwith Yard) in Chicago	357	10	10	660,000	**1,808**
BNSF in Hodgkins/Willow Springs	260	9	8	325,000	**890**
BNSF Cicero Yard	80	11	11	437,000	**1,197**
Union Pacific, Global I in Chicago	103	4*	4*	360,000	**986**
Union Pacific, Global II in Northlake	100	4*	5*	216,000	**592**
Union Pacific, Yard Center in Dolton	75	4*	5*	205,000	**562**
Norfolk Southern, Landers Yard in Chicago	98	5	7	260,000	**712**
CSX in Bedford Park	250	10	10	615,000	**1,685**
Markham Yard (the Moyers Facility) in Harvey	32	4	4	144,000	**395**
Conrail in Chicago	**85**	**12****		**286,000**	**784**

* Number of inbound and outbound trains on an average weekday
** Average number of inbound or outbound trains loaded/unloaded per day

Source: Adapted from McGuckin and Christopher, 2000

Analysis of the survey results revealed that the average trailer length was 42 ft 8 in. and the average height was 13 ft 6 inches. From Table C.2, it is also evident that approximately 60 percent of the surveyed vehicles weighed between 8,001 and 24,000 lbs when unloaded.

[25] For example, trucks that do not pick-up or drop off a load

Table C.2: Unloaded Vehicle Weight Distribution

Vehicle Weight Range	Number	Percent of Total
Less than 8,000 lbs	135	**6.5**
8,001 to 24,000 lbs	1,246	**59.8**
24,001 to 63,999 lbs	641	**30.7**
64,000 plus	63	**3.0**
Total	**2,085***	**100**

* Excluding 128 surveys where an unloaded vehicle weight was not provided by the driver (i.e., "Don't know").

Source: Adapted from McGuckin and Christopher, 2000

In addition, McGuckin and Christopher (2000) reported that in the case of 56.2 percent of the sampled trucks, the trailer was a container and that 64 percent of the sampled trucks carried cargo as opposed to 36 percent of the trucks being empty. Also, the average weight of the cargo on the trucks interviewed was 22,500 pounds.

Table C.3 shows that nearly half of the sampled trucks originated from a local business, warehouse, or factory. It is also evident that more than 33 percent of the sampled truck drivers did not know the destination of their trip, because it was reported that many drivers only contact their dispatcher after completing a drop-off or pickup to obtain the details for their next trip. Of those that did indicate a "destination kind of place," 27.3 percent indicated a local business, warehouse or factory and 23.1 percent reported a truck terminal (McGuckin and Christopher, 2000).

Table C.3: Origin/ Destination Kind of Place

Kind of Place	Origin		Destination	
	Number	**Percent**	**Number**	**Percent**
A truck terminal	585	26.4	511	**23.1**
An intermodal facility	464	21.0	357	**16.1**
A local business, warehouse, factory	1,103	49.8	605	**27.3**
Don't know	61	2.8	740	**33.4**
Total	**2,213**	**100**	**2,213**	**100**

Source: Adapted from McGuckin and Christopher, 2000

Table C.4 presents the calculated truck trip estimates (a) per daily lifts, (b) per employee and (c) per acre for each of the rail intermodal terminals, respectively. From Table C.4, it is evident that the average number of truck trips (a) per daily lift is slightly more than two, i.e., one arrival at and one departure from the site, (b) per employee is 12.1, and (c) per acre is 15.29 (McGuckin and Christopher, 2000).

Table C.4: Estimated 24-hour Truck Trip Rates by Intermodal Rail-Yard

Intermodal Rail-Yard	**Truck Trips*/ Daily Lifts**	**Truck Trips*/ Employee****	**Truck Trips*/ Acre**
BNSF Corwith	2.19	15.66	**11.14**
BNSF Hodgkins	3.77	22.67	**12.91**
BNSF Cicero Yard	1.17	4.36	**17.45**
Union Pacific Global I	2.20	14.88	**21.24**
Union Pacific Global II	2.95	17.45	**17.45**
Union Pacific Yard Center	2.41	N/A	**18.05**
Norfolk Southern Landers Yard	2.29	10.21	**16.87**
CSX	2.11	8.39	**14.26**
Illinois Central Markham Yard	2.57	22.50	**31.65**
Conrail	2.27	8.46	**20.90**
Average	**2.39**	**12.10**	**15.29**

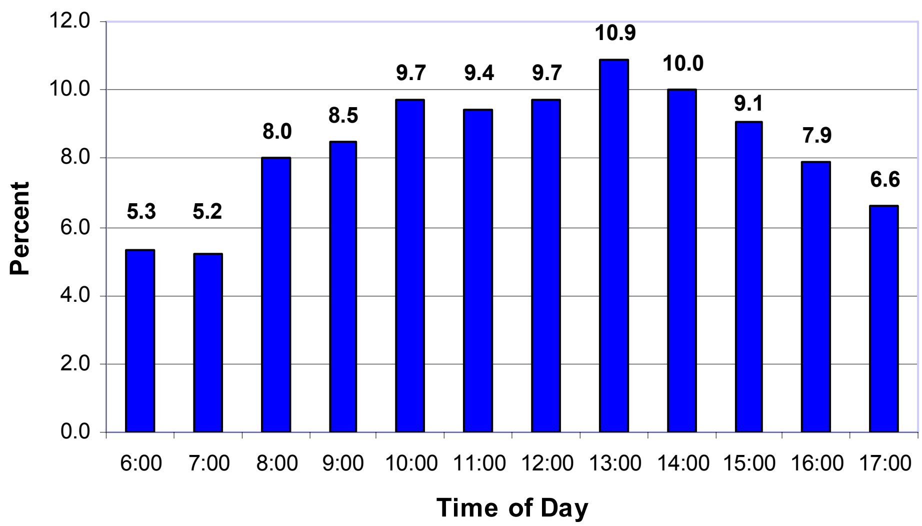
* Daily truck trips were calculated by doubling the estimated number of trucks that arrived at the terminal in a 24-hour period. The implicit assumption is that within 24 hours, the same number of trucks that arrive at the yard will leave the yard.

** Employees include regular and contract employees.

N/A Data on total employment not available.

Source: Adapted from McGuckin and Christopher, 2000

Figure C.1 illustrates the percent of truck arrivals—the average across all sites surveyed—by time of day for the time period that the surveys were conducted. From Figure C.1, it is evident that the trucks arrived more or less consistently from 8:00 a.m. until 5:00 p.m., with the highest average truck arrivals occurring between 1:00 and 2:00 p.m.



Source: McGuckin and Christopher, 2000

Figure C.1: Percent of Truck Arrivals by Time of Day

Appendix D: Additional Context for Border Drayage Activity at Laredo and McAllen by Dr. John McCray

Laredo

To understand the impact of drayage operations on emissions, congestion, noise, and safety in Laredo, the first year of the study concentrated on establishing the area in which drayage trucks move and the type of drayage truck movements. The literature was searched and TxDOT personnel, Truck Load (TL) and Less Than Truck Load (LTL) trucking firms, intermodal operators, bridge operators and major shippers were interviewed to develop the information in this first year report. The second year report will develop this pattern further and deal with mitigation of emissions, congestion, noise, and safety as a result of drayage operations.

The Drayage Area in Laredo

Drayage at Laredo is primarily conducted within the border commercial zone. This zone extends on both sides of the border. On the U.S. side the zone has been established to be the area within 8 miles of the Laredo city limit boundaries. The boundary of the Mexican border zone usually extends to 18 kilometers from the U.S.–Mexico border, where vehicle registration and immigration status is verified before entry into the interior of Mexico. In the combined U.S. and Mexican commercial zones, U.S. and Mexican regulations permit U.S. trucks and drivers in Mexico and Mexican trucks and drivers to operate in the U.S. All trucks and drivers must meet the safety standards of both countries.

Although U.S. trucks and drivers are permitted to operate in the border commercial zone in Mexico, we could not identify any U.S. firm doing so. The reasons for this appeared to be the economic cost and liability. All of the persons interviewed responded that Mexicans firms employing Mexican trucks and Mexican drivers can do drayage of cross border trailer loads at lower costs than U.S. trucks with U.S. drivers. Additionally U.S. trucking firms are reluctant to face the liability of having U.S. trucks and U.S. drivers in Mexico. The net result of the economics and liability of cross border trucking is that Mexican drayage firms using Mexican drivers now dominate all cross border drayage at Laredo.

Drayage Operations at Laredo

Drayage operations in Laredo take truck trailers across the U.S.–Mexico border and move truckload (TL) and less than truckload (LTL) shipments from one location to another within Laredo. Several studies have been conducted which include drayage in Laredo and almost all emphasize only two types of movements—whole trailer movements between interior locations in the U.S. and interior locations in Mexico and movements between Maquiladora factories in Mexico close to the U.S.–Mexico border and the interior of the U.S. These movements account for only the most efficient cross border movements. Also these movements alone would not seem capable of creating the current level of emissions, congestion, and noise caused by truck traffic. Very important and often overlooked are intermodal drayage movements, drayage of sea containers, and point to point drayage within Laredo. In the following section the five types of drayage believed to be most important will be described. These will be classified as "Deep Trade

Movements," U.S. Interior to Border Maquila" movements, "Intermodal Drayage," "Sea Container Drayage," and "Laredo Point to Point" drayage.

The most simple and direct case is "Deep Trade Movement" drayage. This deals with the movement of full trailer loads that are bound to and from interior origins and destinations in the U.S. and Mexico. To move the trailer between origin and destination, this operation employs a line haul tractor in the U.S., a drayage tractor at the border, and a Mexican line haul tractor. A southbound shipment from the interior of the U.S. to the interior of Mexico loads the trailer in the U.S. and a U.S. tractor pulls the trailer to Laredo. At Laredo the trailer is dropped at the yard of the U.S. truck load carrier. Later, when the shipment has cleared Mexican Customs, the trailer will be drayed to a Mexican line haul truck yard in Nuevo Laredo, Mexico. Then, a Mexican line haul tractor will take the trailer to the destination in the interior of Mexico. This process is reversed for north bound shipments. While the "Deep Trade Movement" explains the general movement of trade across the border, it does not capture other movements that are very important.

"U.S. Interior to Border Maquila" is employed when the maquila factory in Mexico is close to the U.S.–Mexico border. This important drayage operation supports movements from the U.S. interior to or from a Maquiladora factory. The pattern is similar to the "Deep Trade Movement" with the exception that a Mexican line haul truck company is not necessary. In this case the drayage truck takes the trailer to the Maquiladora factory. The reverse will also be true when the maquila factory has a full trailer of finished products to send to a distribution facility in the interior of the U.S. Both the Deep Trade Movement and U.S. Interior to Border Maquila employ full trailer loads and are the most straight forward drayage movements to understand. However, more complex movements, including "Intermodal Drayage," "Sea Container Drayage," and "Laredo Point to Pont" drayage within Laredo are critical to an overall understanding of drayage movements in Laredo.

"Intermodal Container Drayage" primarily involves containers and trailers that are shipped long distances over land by rail and then drayed to or from their final destination. Two Intermodal ramps are available in Laredo, the Union Pacific Ramp, which is called "Port Laredo," and the ramp at the Kansas City Southern rail yard. Currently, approximately 80 percent of the Intermodal operations are conducted at Port Laredo. Drayage to support intermodal operations at the two railroad ramps involves full trailers south to Laredo and full and empty trailers northbound to the interior of the U.S. Southbound into Laredo trailers and containers are de-ramped and sent to Maquiladora factories close to the border or to consolidation and distribution operations within Laredo to consolidate and load northbound or southbound whole containers. It should be noted that in this process, considerable point to point drayage within Laredo may be required.

"Sea Container Drayage" accounts for approximately 90 percent of the sea containers in Laredo and are processed by Transmaritime Inc. a sea container shipment broker that represents the vessel shipping lines. Sea containers create two significantly different types of drayage operations. The first is to or from the seaport at Houston or to or from the rail intermodal yard in San Antonio for rail shipment to or from Los Angeles/Long Beach (LA/LB). While this is technically a drayage operation, it takes place beyond the border commercial zone. The second and most significant drayage for this study is the movement of the container within Laredo. Management personnel at Transmaritime informed the research team that virtually all of the contents of container shipments that arrive in Laredo are bound for Mexico. However, only about 5 percent of the containers are sent directly to Mexico. Of the containers that arrive in Laredo, 95 percent are unpacked and consolidated in Laredo before the contents are repacked into truck trailers and taken to Mexico. Although a small portion of the total shipments to and from Laredo sea containers appear to make a significant contribution to the point to point drayage within Laredo. During the second year of the study the movement of container contents within Laredo will be investigated further.

"Point to Point" drayage within Laredo is the most difficult to quantify or understand and likely the most important. As mentioned earlier, drayage associated with "Deep Trade Movement" between the interiors of the U.S. and Mexico would not seem to account for the total truck emissions, congestion, and noise in Laredo. Some point to point drayage occurs as a result of the need to re-combine intermodal or sea containers and trailers as explained earlier. However, there are additional point to point movements that involve value adding processing such as the unloading and re-arranging of loads, storage, labeling, and light manufacturing. In recent years the growth of warehousing operations in Laredo has grown very dramatically. Virtually all the trailers at warehouses are receiving cargo that needs some value adding function performed. Trainers are loaded at these same warehouses with cargo that has been re-combined for shipment or cargo that has undergone other value adding operations. All of these trailers at warehouses require point to point drayage within Laredo.

Appendix E: Port of Houston Drayage Safety Analysis

Introduction

Describing several transportation areas is necessary to comprehensively characterize seaport drayage operations. Previous sections have evaluated mobility and efficiency issues, and this section introduces drayage carrier safety fitness with an emphasis on carriers serving the Port of Houston as an example. Typically, drayage is viewed as an enterprise that uses older trucks emitting more pollutants on a per mile basis than trucks used for long haul operations, and because these trucks and trailers are assumed to be in worse condition than newer models, drayage carriers are believed to present a greater safety concern than long haul commercial vehicles.

Results from a Center for Transportation Research (CTR) seaport drayage survey countered several assumptions, including that trucks used in drayage are not as old as would be expected. Drayage trucks at the Port of Houston were, on average, 3 years younger than drayage vehicles serving the Port of Los Angeles and the Port of Long Beach.[26] Following the results of the survey, the researchers decided to perform a more extensive analysis of dray safety data. While vehicle age can be a factor in the safety performance of trucks, an age profile alone is not sufficient to make a determination of the safety performance of a fleet given that, in an operational setting, safety is influenced by driver experience and abilities, weather conditions, and infrastructure condition. While the most obvious measure of fleet safety is accident data, a profile of vehicle and driver out of service rates can serve as a more complete inventory of specific weaknesses and can do more to describe drayage safety. This study attempts to determine the safety fitness of vehicles associated with drayage carriers by introducing sources that can provide safety data and presenting findings for drayage carriers serving the Port of Houston.

A brief overview of the general truck safety literature is presented along with a discussion of studies that have analyzed seaport drayage and local delivery safety issues. Data sources that are available to identify drayage carrier safety performance and to characterize drayage safety compared to other trucking sectors are also introduced. Datasets of inspections compiled by the Texas Department of Public Safety are possible sources to compare drayage companies' out-of-service rates against all other (non-drayage) truck carriers' out-of-service rates. Data from Chambers and Harris counties was used due to the high amount of dray activity in these two counties. Drayage companies serving the Port of Houston are used to show how out-of-service rates differ for vehicle and driver inspections.

Issue

The large size and weight difference separating commercial trucks from the passenger vehicle fleet makes the safety performance of large trucks particularly important. A commercial vehicle is most commonly designated as any vehicle over 10,000 pounds. Nearly 7 percent of all

[26] Harrison, Robert, Nathan Hutson, Jason West, and Julie Wilke. Characteristics of Drayage Operations at the Port of Houston. Pending publication in Transportation Research Record. Transportation Research Board.

crashes and around 11 percent of all traffic fatalities nationwide involve a commercial vehicle.[27] The *Large Truck Causation Study* conducted by the Federal Motor Carrier Safety Administration (FMCSA) found that trucks are the responsible vehicle for 44 percent of all crashes with a passenger vehicle.[28] Most truck safety and crash analysis use driver, vehicle, and environmental factors to determine crash causation. The study concluded that driver factors were responsible for 87.2 percent of all crashes when the truck was the reason the crash occurred. Vehicle factors accounted for 10.1 percent, and environmental factors caused 2.3 percent of all crashes involving a truck and passenger vehicle. The International Road Transport Union, the global road transport industry representative, found similar results in its European truck crash study.[29] The study purpose was to determine why crashes with trucks occur, and data from over 600 accident reports indicate that human error is responsible for 85.2 percent of all crashes. The truck driver is responsible for 25 percent of the cases.

Drayage is an emerging topic in intermodal freight research. Most of the early research has focused on enhancing the operational efficiency of dray vehicles. While safety has been a major area of attention for dray vehicles operating at the border, safety issues have been examined to a similar extent for dray operations connected with ports or rail yards. The availability of appropriate data tied specifically to dray fleets has been a key limitation. Safety concerns were one of the issues addressed in a drayage study for the Port of Los Angeles and the Port of Long Beach.[30] Researchers surveyed 175 port drivers on operations, wages, demographics, and safety. The safety questions addressed moving violations and chassis conditions. The researchers concluded that drivers who have had a moving violation are also prone to accept an unsafe chassis. Approximately one-half of drivers had received an unsafe chassis within 30 days prior to the survey, and 22 percent said they accepted it. This study is one of the only known research efforts that explicitly examined port drayage safety issues. The goal for this study is to identify data sources for evaluating drayage operations in the safety context and provide experimental designs for working with the data to describe safety of drayage carriers versus all other carriers. The Port of Houston is used as an example for how these programs can be implemented.

Study Scope and Data

The Texas Department of Public Safety (DPS) Commercial Vehicle Enforcement (CVE) personnel typically inspects commercial vehicles, but city and county police officers can also conduct inspections. CVE troopers inspect trucks and issue violations during roving patrols or at weigh stations. Some safety or credentials violations like driver fatigue, operating for too many hours, and brakes out of adjustment are violations that can result in the driver or vehicle being placed out of service. Out-of-service rates, a key carrier safety fitness measure, are the

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[27] Transportation Research Circular. *The Domain of Truck and Bus Safety Research.* Transportation Research Board. May 2007. Online. Available: onlinepubs.trb.org/onlinepubs/circulars/ec/17.pdf. Accessed: June 18, 2007.

[28] Report to Congress on the Large Truck Crash Causation Study. United States Department of Transportation. March 2006. Online. Available: http://ai.volpe.dot.gov/ltccs/documents/reportcongress_11_05.pdf. Accessed: May 29, 2007.

[29] *A Scientific Study: European Truck Accident Causation.* International Road Transport Union. Online. Available: http://www.iru.org/index/cms-filesystem-action?file=mix-publications/2007_ETACstudy.pdf. Accessed: June 18, 2007.

[30] Monaco, Kristen and Lisa Grobar. *A Study of Drayage at the Ports of Los Angeles and Long Beach*. AR 04-01. December 15, 2004. Online. Available: www.metrans.org/research/final/AR%2004-01_final_draft.pdf. Accessed May 30, 2007.

percentage of inspections for a carrier that result in the driver or vehicle being placed out of service. The FMCSA provides this information for carriers with a Department of Transportation (DOT) number through the SafeStat online feature.[31] A shortfall with this data source is that it does not provide concise information on where the inspections occurred, which is important when attempting to emphasize a specific region and service. The Texas DPS Motor Carrier Bureau (MCB) offers a data source that compiles inspection reports every year for all commercial vehicle inspections into a single database. The information fields include the county where the inspection occurred and fields that describe the driver, truck, and motor carrier. This database was used to calculate annual vehicle and driver out-of-service rates for drayage vehicles and nondrayage vehicles from 2003 to 2006. A t-test determines whether the drayage out-of-service rates are significantly different than nondrayage out-of-service rates and fail to reject or reject the assumption that the rates should be significantly different.

Commercial vehicle inspections are the basic element of this study. Because this study is focused on container drayage safety around the Port of Houston, inspection reports for Harris County and Chambers County were considered due to their proximity to Barbours Cut Terminal (BCT). BCT is located in Chambers County, and most initial destinations for containers include distribution centers in Harris County and Chambers County. All inspections are divided into two categories: drayage and nondrayage. Carriers were classified as drayage if they were one of the top forty-five companies servicing BCT, as identified through the April 2005 and October 2005 databases provided by the BCT management. The database includes every transaction made at the terminal. Tables E.1 through E.4 list the companies classified as drayage from 2003 to 2006. The tables also show company vehicle and driver out-of-service rates.

[31] Federal Motor Carrier Safety Administration, "SafeStat Online" database. Online. Available: http://ai.fmcsa.dot.gov/safestat/safestatmain.asp.

Table E.1: 2003 Drayage Company Inspection Data

Drayage Company	Inspections	Vehicles Out-of-Service	Vehicle Out-of-Service Rate	Driver Out-of-Service	Driver Out-of-Service Rate
Ace Transportation Inc	164	49	0.2988	7	0.0427
Best Transportation Services Inc	15	6	0.4000	1	0.0667
Bridge Terminal Transport Inc	75	23	0.3067	1	0.0133
Bryan Logistics Company Llc	1	0	0.0000	0	0
C B S L Transportation Services Inc	5	1	0.2000	0	0
C Truck (Cast North America Transport)	30	9	0.3000	0	0
Canal Cartage Company	115	40	0.3478	0	0
Century Transportation Inc	15	3	0.2000	0	0
Clark Freight Lines Inc	112	20	0.1786	0	0
Container Transportation Inc	21	5	0.2381	3	0.1429
Core Trucking Of Texas	24	7	0.2917	0	0
Cowan Systems Inc	15	7	0.4667	1	0.0667
Eagle Transportation Services Inc	45	20	0.4444	1	0.0222
Empire Truck Lines Inc	87	26	0.2989	5	0.0575
Excargo Services Inc	18	2	0.1111	1	0.0556
Frontier Logistics Llc	3	2	0.6667	1	0.3333
Gulf States Intermodal	31	9	0.2903	0	0
Gulf Winds International Inc	134	53	0.3955	4	0.0299
Horizon Freight Systems Inc	7	2	0.2857	0	0
Maritime Services Inc	42	17	0.4048	2	0.0476
Overland Express Company	14	4	0.2857	0	0
Palletized Trucking Inc	134	32	0.2388	1	0.0075
Southern Carriers Inc	11	2	0.1818	0	0
Southwest Freight Inc	24	10	0.4167	1	0.0417
Sunburst Truck Lines Inc	59	20	0.3390	2	0.0339
Team Transport Inc	25	11	0.4400	2	0.0800
Terrier Transportation Inc	20	8	0.4000	0	0
Texan Transporter (Ted Jones Llc)	16	3	0.1875	2	0.1250
Texas National Transport Inc	13	4	0.3077	0	0
Trans Gulf Transportation Inc	50	8	0.1600	0	0
Transmar Trucking Inc	16	6	0.3750	0	0
Transporter Inc (The)	39	13	0.3333	2	0.0513
Tri Star Freight Systems Inc	19	1	0.0526	1	0.0526
Unlimited Trucking Inc	47	10	0.2128	3	0.0638
W W Rowland Trucking Co Inc	53	16	0.3019	1	0.0189

Table E.2: 2004 Drayage Company Inspection Data

Drayage Company	Inspections	Vehicle Out-of-Service	Vehicle Out-of-Service Rate	Driver Out-of-Service	Driver Out-of-Service Rate
Ace Transportation Inc	199	77	0.3869	12	0.0603
Best Transportation Services Inc	15	6	0.4000	0	0
Bridge Terminal Transport Inc	62	20	0.3226	3	0.0484
Bryan Logistics Company Llc	6	3	0.5000	0	0
C Truck (Cast North America Transport)	37	14	0.3784	0	0
Canal Cartage Company	110	29	0.2636	1	0.0091
Cbsl Transportation Services Inc	21	0	0	0	0
Century Transportation Inc	13	1	0.0769	0	0
Clark Freight Lines Inc	110	19	0.1727	0	0
Container Transportation Inc	18	7	0.3889	0	0
Core Trucking Of Texas	20	3	0.1500	0	0
Cowan Systems Llc	10	1	0.1000	1	0.1000
Eagle Transportation Services Inc	22	12	0.5455	1	0.0455
Empire Truck Lines Inc	77	22	0.2857	1	0.0130
Excargo Services Inc	22	5	0.2273	0	0
Frontier Logistics Llc	3	3	1.0000	2	0.6667
Gulf States Intermodal	28	5	0.1786	1	0.0357
Gulf Systems Inc	4	0	0	0	0
Gulf Winds International Inc	112	33	8.2500	2	0.5000
Horizon Freight System Inc	13	1	0.0089	1	0.0089
Maritime Services Inc	49	22	1.6923	1	0.0769
Overland Express Company Inc	20	4	0.0816	0	0
Palletized Trucking Inc	82	20	1.0000	0	0
Pinch Distribution Inc	3	0	0.0000	1	0.0122
Powers Transportation Systems Inc	17	5	1.6667	0	0
Southern Carriers Inc	8	4	0.2353	2	0.1176
Southwest Freight Inc	26	4	0.5000	0	0
Sunburst Truck Lines Inc	65	24	0.9231	1	0.0385
Team Transport Inc	34	11	0.1692	1	0.0154
Terrier Transportation Inc	23	8	0.2353	0	0
Texan Transporter	16	4	0.1739	1	0.0435
Texas National Transport Inc	16	7	0.4375	0	0
Trans Gulf Transportation Inc	57	9	0.1579	1	0.0175
Transmar Distribution Services Inc	9	3	0.3333	0	0
Transporter Inc (The)	43	17	1.0625	0	0
Tri Star Freight Systems Inc	16	2	0.0465	2	0.0465
Txn Logistics (Txn Management Inc)	13	2	0.1250	0	0
Unlimited Trucking Inc	30	10	0.7692	0	0
W W Rowland Trucking Co Inc	53	17	0.5667	3	0.1000

Table E.3: 2005 Drayage Company Inspection Data

Drayage Company	Inspections	Vehicle out-of-service	Vehicle out-of-service Rate	Driver out-of-service	Driver out-of-service Rate
Ace Transportation Inc	172	71	0.4128	8	0.0465
Best Transportation Services Inc	12	4	0.3333	1	0.0833
Bridge Terminal Transport Inc	77	25	0.3247	5	0.0649
Bryan Logistics Company Llc	16	6	0.3750	0	0
C Truck (Cp Ships Trucking Limited)	26	16	0.6154	1	0.0385
Canal Cartage Company	118	32	0.2712	1	0.0085
Cbsl Transportation Services Inc	21	4	0.1905	0	0
Century Transportation Inc	18	6	0.3333	0	0
Clark Freight Lines Inc	125	32	0.2560	3	0.0240
Container Transportation Inc (C T I)	20	11	0.5500	0	0
Core Trucking Of Texas	21	7	0.3333	0	0
Cowan Systems Llc	16	7	0.4375	1	0.0625
Eagle Transportation Services Inc	29	11	0.3793	0	0
Empire Truck Lines Inc	70	20	0.2857	2	0.0286
Excargo Servcies Inc	27	7	0.2593	0	0
Frontier Logistics Llc	8	8	1.0000	2	0.2500
Gulf States Intermodal	18	4	0.2222	0	0
Gulf Winds International Inc	104	46	0.4423	6	0.0577
Horizon Freight System Incorporated	12	3	0.2500	0	0
Maritime Services Inc	63	20	0.3175	4	0.0635
Overland Express Company	8	2	0.2500	0	0
Overland Express Company Inc	39	16	0.4103	2	0.0513
Palletized Trucking Inc	122	40	0.3279	2	0.0164
Pinch Transportation Inc	23	13	0.5652	0	0
Powers Transportation Systems Inc	42	31	0.7381	0	0
Southern Carriers Inc	10	6	0.6000	1	0.1000
Southwest Freight Inc	20	9	0.4500	1	0.0500
Sunburst Truck Lines Inc	73	29	0.3973	1	0.0137
Team Transport Inc	24	3	0.1250	0	0
Terrier Transportation Inc	20	7	0.3500	2	0.1000
Texan Transporter	24	8	0.3333	0	0
Texas National Transport Inc	15	5	0.3333	0	0
The Transporter Inc	53	15	0.2830	0	0
Trans Gulf Transportation Inc	71	20	0.2817	2	0.0282
Transmar Distribution Services Inc	14	4	0.2857	1	0.0714
Tri Star Freight Systems Inc	16	5	0.3125	1	0.0625
Txn Logistics (Txn Management Inc)	13	5	0.3846	0	0
Unlimited Trucking Inc	17	10	0.5882	0	0
W W Rowland Trucking Co Inc	40	17	0.4250	0	0

Table E.4: 2006 Drayage Company Inspection Data

Drayage Company	Inspections	Vehicle Out-of-Service	Vehicle Out-of-Service Rate	Driver Out-of-Service	Driver Out-of-Service Rate
Ace Transportation Inc	76	36	0.4737	4	0.0526
Best Transportation Services Inc	32	5	0.1563	2	0.0625
Bridge Terminal Transport Inc	41	11	0.2683	1	0.0244
Bryan Logistics Company Llc	14	2	0.1429	0	0
C Truck (Cp Ships Trucking Limited)	12	4	0.3333	0	0
Canal Cartage Company	69	26	0.3768	1	0.0145
Cbsl Transportation Services Inc	26	9	0.3462	0	0
Century Transportation Inc	8	3	0.3750	0	0
Clark Freight Lines Inc	61	19	0.3115	3	0.0492
Container Transportation Inc (C T I)	12	2	0.1667	0	0
Core Trucking Of Texas	10	2	0.2000	0	0
Cowan Systems Llc	6	3	0.5000	0	0
Eagle Transportation Services Inc	14	1	0.0714	0	0
Empire Truck Lines Inc	30	10	0.3333	0	0
Excargo Servcies Inc	19	2	0.1053	1	0.0526
Gulf States Intermodal	49	8	0.1633	0	0
Gulf Systems Inc	1	1	1.0000	0	0
Gulf Winds International Inc	68	24	0.3529	2	0.0294
Horizon Freight System Inc	2	0	0.0000	0	0
Maritime Services Inc	35	10	0.2857	0	0
Overland Express Company	18	6	0.3333	0	0
Palletized Trucking Inc	81	11	0.1358	0	0
Pinch Transportation Inc	22	9	0.4091	1	0.0455
Powers Transportation Systems Inc	42	28	0.6667	4	0.0952
Southern Carriers Inc	4	1	0.2500	1	0.2500
Southwest Freight Inc	16	5	0.3125	0	0
Sunburst Truck Lines Inc	35	15	0.4286	1	0.0286
Team Transport Inc	15	3	0.2000	0	0
Terrier Transportation Inc	10	5	0.5000	1	0.1000
Texan Transporter	22	6	0.2727	1	0.0455
Texas National Transport Inc	8	2	0.2500	0	0
The Transporter Inc	19	6	0.3158	1	0.0526
Trans Gulf Transportation Inc	36	6	0.1667	1	0.0278
Transmar Distribution Services Inc	8	4	0.5000	0	0
Tri Star Freight Systems Incorporated	16	6	0.3750	1	0.0625
Txn Logistics (Txn Management Inc)	17	7	0.4118	0	0
Unlimited Trucking Inc	17	8	0.4706	1	0.0588
W W Rowland Trucking Co Inc	5	1	0.2000	0	0

Because these firms perform a significant percentage of the total drayage operations at the ports, they are categorized as “dray carriers.” It should be noted that some if not most of these firms will also perform operations that are not categorized as dray operations; however, given that the database does not indicate precisely where the DOOS or VOOS incidents occurred, the database can most correctly be referred to as a record of out-of-service rates connected to dray carriers rather than a comprehensive inventory of dray out-of-service rates. The researchers assumed that out-of-service rates are similar across companies that provide multiple services. The nondrayage category consisted of all other motor carriers that were not found to provide dray service to BCT. The Texas DPS commercial vehicle inspection data is from 2003 to 2006.

Out-of-Service Rate Comparisons

The methodology utilizes statistical tools to compare out-of-service rates for drayage fleets versus non-drayage fleets. The goal is to discover whether the drayage out-of-service rates are significantly different than non drayage out of service rates. The hypothesis is that drayage fleets are less safe when compared to other fleet types. Therefore, if out-of-service rates for drayage vehicles are shown to be statistically higher than the non-drayage out-of-service rates, the hypothesis will be supported. Out-of-service rates are calculated for both the driver and the vehicle. Table E.5 lists the carriers and the container counts for the top thirty carriers in 2005.

Table E.5: Company Transaction Totals at Barbours Cut Terminal in 2005

Carrier	April	October	Carrier	April	October
Gulf Winds International Inc	2,056	3,808	Transmar Distribution	451	525
Canal Cartage Company	1,437	1,671	Core Trucking Company	418	525
Empire Truck Lines	1,206	1,086	CBSL Transportation Services	417	593
Clark Freight Lines	1,184	1,481	Southern Carriers Inc.	414	364
Trans Gulf Transportation Inc	1,128	1,208	ACE Transportation Inc.	411	423
Maritime Services LTD	1,060	700	Eagle Transportation Service Co.	410	199
Gulf States Intermodal	962	1,304	Team Transportation, Inc.	403	431
Palletized Trucking Company	924	949	Southwest Freight Inc	348	269
Container Transportation	771	809	Cowan Systems	328	416
Best Transportation	613	565	Texas National Transport Inc.	324	203
Overland Express	593	385	Terrier Transportation	322	320
Tri Star Freight Systems	486	749	Texan Transporter	306	277
TXN Logistics Transportation	476	729	Horizon Freight Systems	292	214
Bridge Terminal Transport	471	822	Unlimited Trucking Inc	291	211
Frontier	460	382	Pinch Transport	273	230

The annual drayage and nondrayage commercial vehicle inspections totals for Harris County and Chambers County are in Table E.6. The 2006 inspections total is considerably lower than other years, and one potential reason for this difference is the inspection figures for that year are preliminary data. The Texas DPS MCB was still finalizing 2006 totals when the data was requested.

Table E.6: Harris County and Chambers County Inspection Counts

Fleet Type	2003	2004	2005	2006
Nondrayage	22,069	22,454	21,668	17,544
Drayage	1,500	1,482	1,617	991
Total	23,569	23,936	23,285	18,535

The analysis relies on being able to separate drayage carriers and nondrayage carriers. Carrier DOT numbers and the name of the company were used to populate the two categories. Then, the number of inspections that resulted in an out-of-service violation was divided by the total number of inspections to calculate an out-of-service rate, and variances were also calculated. Hypothesis testing and the t-test are the main tools used to compare whether the differences between the out-of-service ratios are significant. Before conducting the t-test, the F-test is used to determine whether the difference between the variances for the drayage and nondrayage vehicle and driver out-of-service rates is significantly different. This test is needed to identify whether the t-test that assumes unequal or equal variances should be used. The tests are conducted for both the driver and vehicle. One test compares drayage driver out-of-services rates versus nondrayage driver out-of-service rates, while another test compares drayage vehicle out-of-service rates versus nondrayage vehicle out-of-service rates. Two t-tests are performed per year, and 4 years of data are available.

Results

A priori the researchers did not know whether the population variances between drayage and nondrayage fleets could be assumed to be equal. The statistical t-test varies depending on whether the sample variances can be assumed to be equal or unequal. The F-test was used to determine the equality of the variances. Most F-tests results indicated that the variances were significantly different at an alpha value of .05. The 2005 vehicle variances were the only case in which the variances were assumed to be equal, and the appropriate t-test was used in that case. For all other cases, the t-test where variances are assumed to be unequal was used.

The findings for these experiments do not support the hypothesis that drayage fleets are less safe than nondrayage commercial vehicles. Drayage out-of-service rates were significantly different from nondrayage fleets, but the drayage out-of-service rates were lower than nondrayage vehicle and driver out-of-service rates. The two-tailed t-test was used with an alpha value of .05 and a critical t-value of 1.96. Only in 2005 for the vehicle inspections were drayage vehicle out-of-services rates not significantly lower than nondrayage. All other years were significant with t-statistics as high as 5.35 in 2003. The significant difference between drayage and nondrayage driver out-of-service rates was even more prominent than for vehicle inspections. Drayage driver out-of-service rates were significantly lower than nondrayage out-of-services rates for all 4 years. The t-statistics ranged from 7.57 in 2006 to 12.36 in 2004. Table E.7 and Table E.8 present the results for the vehicle and driver statistical analysis.

Table E.7: Drayage versus Nondrayage Vehicle Inspection OOSR Comparison

		2003	2004	2005	2006
Mean	**Drayage**	0.2995	0.2928	0.3618	0.3189
	Nondrayage	0.3652	0.3589	0.3508	0.3684
Variance	**Drayage**	0.2099	0.2072	0.2310	0.2174
	Nondrayage	0.2318	0.2301	0.2278	0.2327
Degrees of Freedom		1730	1705	1862	18533
t-statistic		5.35071	5.39271	-0.8834	3.15304

Table E.8 : Drayage versus Nondrayage Driver Inspection OOSR Comparison

		2003	2004	2005	2006
Mean	**Drayage**	0.028	0.02564	0.02907	0.02725
	Nondrayage	0.08256	0.08119	0.0636	0.06903
Variance	**Drayage**	0.02723	0.025	0.02824	0.02653
	Nondrayage	0.07575	0.0746	0.05955	0.06427
Degrees of Freedom		2114	2116	2161	1278
t-statistic		11.74	12.36	7.68	7.57

Concluding Remarks

The Texas DPS inspection data is a viable data source to describe the safety fitness of drayage operations in any context. Other data sources are available including crash data and moving violation data, but crash data is often considered to be less accurate. The FMCSA does not use crash data in its SafeStat analysis because of accuracy and completion problems in many states. Texas does have more acceptable crash data than other states, but the inspection data is more readily available from the Texas DPS than their crash data.

The demonstration described was performed for drayage operations in the Port of Houston. Inspection data is beneficial because it can be used to compare drayage fleets against other carrier types and help validate or refute assumptions. The results from this analysis on drayage in the Port of Houston indicate that drayage trucks and drivers are not less safe than non-drayage vehicles.

Appendix F: The Port of Los Angeles/Long Beach Clean Air Action Plan

In 2006, the San Pedro Bay ports put forward a multifaceted plan to improve the emissions impact of all port-related activity through the adoption of best available technologies. If fully implemented, this plan is expected to fundamentally alter the structure of the largest port drayage fleet in the country. Many other ports, particularly those located in non-attainment areas, are monitoring the implementation plan and are trying to anticipate whether similar plans will be mandated nationwide. The potential impact of the Clean Air Action Plan (CAAP) on the drayage sector has focused attention on port drayage in a way that is uncustomary to its history. While historically perceived as a lightly regulated, highly informal sector of the port's activity, port drayage would become one of the most tightly regulated types of trucking in the United States, should the CAAP be fully implemented.

In the past year, organizations representing drayage operators in the Greater Los Angeles area have organized in response to the plan. Reaction from truckers themselves has been mixed. Under the plan the traditional owner-operator model would be replaced by a new model in which trucking companies interested in serving the port would apply for franchises. To be approved for a franchise, the drayage firm would prove that it uses only 2007 or later model-year trucks and pays all of its employees (drivers) the prevailing wage. An industry-sponsored study completed in 2007 found that 15 percent of owner operators preferred to be paid an hourly wage, while 80 percent would prefer to remain owner-operators[32]. Current data shows that the drivers who are paid hourly, on average, make more than the owner-operators.[33] However, because hourly drivers make up such a small percentage of the total population of dray drivers, it is uncertain whether this would hold true if extended to the entire population of dray drivers.

The Port of Los Angeles / Port of Long Beach Clean Trucks Plan—part of the Clean Air Action plan—is scheduled to begin on January 1, 2008. The 5-year plan seeks to replace 16,000 port drayage trucks with 2007 or later model-year trucks (Table F.1).

The first group of trucks to be banned would be any truck manufactured prior to 1989. By 2012, all trucks operating would be model year 2007 or later or would be retrofitted to achieve equivalent levels of emissions. The initial 2008 ban is estimated to impact 14 percent of the trucks that are then in operation.

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[32] A survey of dray haulers at the Ports of Los Angeles and Long Beach found that drivers work an average of 11.2 hours per day for an average annual income of $29,903 (Monico and Grobar, 2004).

[33] http://www.harbortruckersfsf.org/trucleair/Facts.htm

Table F.1: Ports of Los Angeles and Long Beach Clean Trucks Program[34]

Implementation Date			
	Truck MYs	Total No. Of Trucks Affected	Percentage of Trucks Affected
January 1, 2008	MY Pre-1988	2267	14%
January 1, 2009	MY 1988-1993	5337	33%
January 1, 2010	MY 1994-1998	7112	43%
January 1, 2011	MY 1999-2003	1422	9%
January 1, 2012	MY 2004-2006	248	2%
	TOTAL	**16386**	**100%**

Source: http://www.portoflosangeles.org/News/news_041207ctp_pres.pdf

The program offers sizeable grants to acquire and scrap older trucks. The plan is, in effect, an extension of the Gateway Cities program—a truck retirement program that is expected to have retired 500 trucks by 2008. Grant amounts would be determined by the extent of NOx and diesel particulate emissions reductions and cannot exceed 80 percent of the cost of the replacement vehicle.

From an air quality perspective, Texas faces similar concerns as California, given that many of the major centers of dray activity, such as Houston and Dallas, have problems with air quality. Houston is classified as severe nonattainment for ozone. While Dallas is also in nonattainment status, a far greater share of the Dallas pollution is tied directly to on-road emissions.

Before the Port of Los Angeles and the Port of Long Beach could develop the Clean Truck Plan, the ports had to understand how drayage affected the region and its transportation system. TxDOT is currently conducting similar analysis and research to help determine what action is needed in Texas concerning drayage.

[34] http://www.portoflosangeles.org/News/news_041207ctp_pres.pdf