LOW COST STRATEGIES FOR SHORT TERM PARKING ON INTERSTATE HIGHWAYS OF THE MVFC

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National Center for Freight & Infrastructure Research & Education
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This report documents a study of truck parking issues along the major freight corridors in the 10-state MVFC region. An online GIS instrument was developed to administer surveys and allow for continuous public participation. The study surveyed highway patrol officers, public freight planners and truckers to identify parking facilities incommensurate with truck parking needs. It proposes a method to cluster marked spots for identifying areas with the most need for additional truck parking capacity. In-person carrier interviews were also conducted to further clarify truck parking problem causes and solutions. A set of low cost strategies are finally proposed to policy makers. This study also inventories both public and private parking facilities along the region's freight corridors and provides a review of previous studies.</td></tr>
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EXECUTIVE SUMMARY

Truckers need to park for breaks and to rest in order to comply with federal Hours-of-Service (HOS) regulations for their safe and efficient operations[1]. Some parking is needed to stage loads or empties for drivers to comply with shipper or receiver appointments. However, the availability of truck parking along Interstate highways has been a concern for over a decade. This is largely due to the lack of adequate capacity at various locations of high demand. The objectives of this study are to systematically examine truck parking issues to identify locations where truck parking problems exist and to recommend low cost solutions. The study was sponsored by the Mississippi Valley Freight Coalition (MVFC) through pooled funds of the 10-state Midwest region of the American Association of State Highway and Transportation Officials (AASHTO).

The National Center for Freight and Infrastructure Research and Education (CFIRE) at the University of Wisconsin Madison performed this project along with Prime Focus Consulting. Dr. Teresa Adams was the Principal Investigator (PI) leading this research with Dr. Bruce Wang as the Co-PI.

The project began November 1, 2007 and was completed on May 30, 2009. A major theme in this research is identifying problems and solutions with stakeholders by means of survey and in-person interviews. The research team went to four truck shows to talk with truckers and conduct surveys. The four truck shows were located in Walcott IA (July 2008), Waupun WI (August 2008), Oshkosh WI (August 2008) and Peoria IL (February 2009). The participants at the truck shows, many of whom were long haul drivers, came from states across the region. In total, about 300 surveys were collected in addition to a number of surveys from remote online participants.

The project team developed a geographic information system (GIS) supported online survey instrument to invite remote participants. This made it possible for the survey to be conducted continuously throughout the study period via the Internet. This GIS tool is designed to accommodate three groups of participants: truckers/carriers, highway patrol and public freight planners. In total, 25 highway patrol officers identified 31 locations that are experiencing parking issues. Thirty-four public freight planners identified 83 spots with parking concerns, while 258 truckers/carriers identified 283 spots with parking concerns.

The team also distributed a comprehensive survey to truckers. The survey primarily dealt with locations with truck parking concerns and the frequency with which truckers experienced or observed those concerns at each location. In addition, the survey included questions about commodities that truckers ship and their origins and destinations, the hours truckers desire to drive without breaks, reasons for parking (staging, food, breaks, etc.), the availability of nearby parking capacity and their recommendations for solutions.

The research team believes truckers who have experienced problems in finding parking spots along the highway have the most valuable information for alleviating truck parking problems and for developing new parking capacities. A challenge the research team identified is that those that have experienced problems finding parking spots in an area often come from other jurisdictional regions. It is therefore difficult for public freight planners to identify problems with truckers from the same region. A survey covering a larger geographic area is therefore needed.

In general, the survey results from the three groups were consistent. Because the number of participating truckers is large and the trucker participants were more regionally-based than the highway patrol officers or public freight planners, the analysis primarily focused on data from

truckers, who are end users of parking facilities. The team developed a method for clustering for the marked locations participating truckers provided on the GIS. This clustering method determines large areas in which additional parking capacities are needed.

The in-person interviews conducted by Prime Focus identify causes of parking problems from a broader perspective, covering issues such as the logistical operations of carriers and municipal ordnances about local delivery. In this study, a set of low cost strategies are reviewed and examined. These strategies include the use of (1) in-vehicle radio, such as CB, low-power FM radio or Dedicated Short Range Communication; (2) electronic visual displays in vehicles; and (3) the Internet. Seventy three percent, 40 percent and 12 percent of participants expressed preferences for these strategies, respectively. In terms of recommendations of ways to improve truck parking, truckers showed a strong inclination to the use of variable road signs. The most desirable information about parking that truckers identified in the interviews includes (in order of importance): information on the locations of parking areas, the availability of space and amenities, and time limits on use.

The research team's major findings include the following:

- Many truck parking problems take place at the outskirts of large metro areas such as Chicago, where truckers park primarily for staging for customer appointment times.
- In most places, parking capacity shortages occur in the early evening or late at night. Truckers experiencing a problem in finding an available parking spot tend to know little about parking availability in the nearby area. This is because they either lack or are not aware of means to find this information.
- Truckers also identified design problems in public truck parking areas. For example, poor design at some locations makes entry and exit movements difficult. Also passenger cars park in some truck spots, and some vehicles take up more than one spot due to poor lane markings, which wastes available parking spaces.

This study offers the following recommendations:

- Several areas identified through this research as having the most serious shortages of parking capacity include: Joliet, IL; Bolingbrook, IL; Elmhurst, IL; Chicago, IL; Indianapolis, IN; Gary, IN; Minneapolis/St. Paul, MN; Davenport, IA; Janesville, WI; Rockford, IL; Milwaukee, WI; Kansas City, MO/KS; Louisville, KY; Detroit, MI; Toledo and St. Louis, MO.
- Advance parking information posted in real-time, upstream of each parking area, would be useful for truckers searching for available spots. Variable road signs are recommended, as many drivers have described them as a desirable resource.
- Other possible strategies include making public-private partnership investments, developing and using ITS and web-based solutions, converting weigh stations near parking facilities into additional parking, and allowing overnight parking at malls or large retail chains, and improving communication regarding state truck parking policies.

The research team believes that continuous public participation, possibly through IT technologies such as the online GIS system developed through this study, would help enhance the dialogue between the public and private sectors in identifying truck parking issues and developing practical solutions. In addition, this research has inventoried the public and private parking facilities along the major corridors in the MVFC region, which could potentially be used for more analysis of the supply of and demand for truck parking in the region.

Chapter 1. INTRODUCTION

1.1 The Need for a Systematic Study of Truck Parking

Truck parking has been a national issue for policy makers, regulators, planners and truckers starting in the 1990s. Because trucking freight has and will continue to grow, especially along the major freight corridors in the Upper Midwest region, truck parking problems have become increasingly significant to freight mobility in the region. Dry van carriers as well as refrigerated and oversize truck companies note that even in rural areas, finding a place to park for basic restroom breaks can be a problem.

This project was approved by the Mississippi Valley Freight Coalition (MVFC) Executive Committee on April 10, 2007 during the Mississippi Valley Conference Board of Directors meeting in Minneapolis, MN. It focuses on the major freight corridors on the Interstate highways in the 10-state MVFC region. The primary purposes of the project are to understand and analyze trends in truck parking and to identify 1) where new or expanded facilities are needed, 2) operational issues causing the need for parking, and 3) low-cost solutions to the truck parking problem in the MV region. Furthermore, this research makes spatial information available about parking needs along the major freight routes in the region.

The study builds upon the U.S. Federal Highway Administration's (FHWA) *Study of Adequacy of Commercial Truck Parking Facilities*[2], completed in 2002, which outlines the lack of adequate parking facilities for truckers and describes the mismatch between available facilities and trucker needs with regard to location, amenities, and functional characteristics. The urgency of this issue is a result of the increasing volume of commercial traffic on the Interstate Highway system, new Hours-of-service (HOS) regulations implemented by the FHWA in 2005, growing incidents of truck parking on ramps, and increasing awareness of the connection between driver fatigue and traffic accidents.

Truck parking is an essential component of trucking operations, especially for long hauls. Truckers driving long distances have to rest periodically to alleviate fatigue and to be in compliance with federal regulations (e.g. drivers' Hours of Service [HOS]). HOS rules specify that truckers can only be on duty for a maximum of fourteen hours, during which a maximum of eleven hours of driving is allowed. This rule implies that typically truckers are mandated to make an overnight stay while being en route for longer than a day. Complicating the matter is the fact that drivers are often under pressure to cover the greatest possible distance during each shift, causing them to drive until they have reached their legal limit and, in some cases, to park illegally on ramps or shoulders when legal parking in their immediate vicinity is unavailable. When truckers are fatigued or have reached their allowable driving time and have nowhere to park, they are forced to choose between continuing to drive and parking illegally, both of which raise serious safety concerns.

As early as 1989, truck parking became a recognized safety issue. While writing for the National Cooperative Highway Research Program (NCHRP), G.F. King,[3] reported that while trucks accounted for only 30 percent of the vehicles in Interstate traffic, they made up 44 percent of total rest area occupancy and that the truck parking capacity at public rest areas was exceeded nearly 50 percent of the time during nighttime hours. While the supply of truck parking spaces

seems, at a national level, to be adequate according to FHWA's 2002 study[4], there are regions in which available truck parking spaces are exceedingly scarce. This is probably due to the uneven distribution of truck parking demand over both space and time.

The Federal Motor Carrier Safety Administration (FMCSA) has estimated that driver fatigue is either a primary or secondary factor in 15 percent of crashes involving large trucks. Fatigued drivers searching for suitable places to rest are having an increasingly difficult time finding them, and the demand for spaces throughout the United States is projected to continue increasing in the foreseeable future. While the FHWA study mentioned above indicates a 2.7 percent annual growth in truck traffic, according to the FMSCA, this is less than the historically observed trend.[5] Another factor contributing to the national truck parking shortage is growth in the truckload (TL) sector of the commercial vehicle freight industry, which has been faster than growth than the less-than-truckload (LTL) sector. Because the truckload sector of the industry tends to require drivers to be far from home and to take long rest breaks in order to comply with hours-of-service (HOS) restrictions, the need for expanded parking facilities and ways to more efficiently utilize existing spaces is growing faster than estimates based on the growth of the industry as a whole.

One may be curious about the underlying reasons for these truck parking problems. In fact, this truck parking need may be a direct result of the logistics and operational strategies that dictate delivery schedules. The growing importance of "just-in-time" delivery and reservations is contributing to the need for truck parking in and around urban areas. Another study[6], found that while a great deal of illegal truck parking in the public right of way is a result of insufficient parking space at public rest areas and private truck stops (due to high demand and/or poor design), a significant percentage of truck drivers park in such areas in order to get away from disturbances. These can include enforcement of parking time limits at rest areas and solicitation from drug dealers and prostitutes at private truck stops. These findings were consistent across a number of recent truck parking studies.

The MVFC executive committee requested that this study include a discussion of issues dealing with assigning responsibility for providing expanded parking facilities. There is disagreement within the industry about the need for more truck parking across the country. While the American Trucking Association believes that there is a truck parking shortage[7], the National Association of Truck Stop Operators (NATSO) claims there is no shortage and that truckers park illegally for the sake of convenience rather than the inability to find safe legal parking. NATSO opposes the use of public funds to provide truck parking facilities because it would result in decreased demand for parking at private facilities. In addition NATSO believes the trucking industry's need for parking facilities is a business expense that should not be borne by the public.

Although there is disagreement regarding where the responsibility for providing truck parking lies, it is clear that the need will only increase in coming years. Trucking represents the largest component of our nation's freight transportation system. According to the 2002 Commodity Flow Survey, trucks carry almost 70 percent of the total freight in the US by value and nearly 35 percent of total ton-miles[8]. The nation's freight tonnage is projected to increase nearly 70 percent between 2006 and 2020, which necessitates planning for ways to accommodate the additional trucks that will be on the nation's highways. The freight corridors in the Mississippi Valley region will carry a great deal of this freight and must be ready to accommodate a large increase in truck traffic in the coming years.

1.2 Study Objectives and Scope

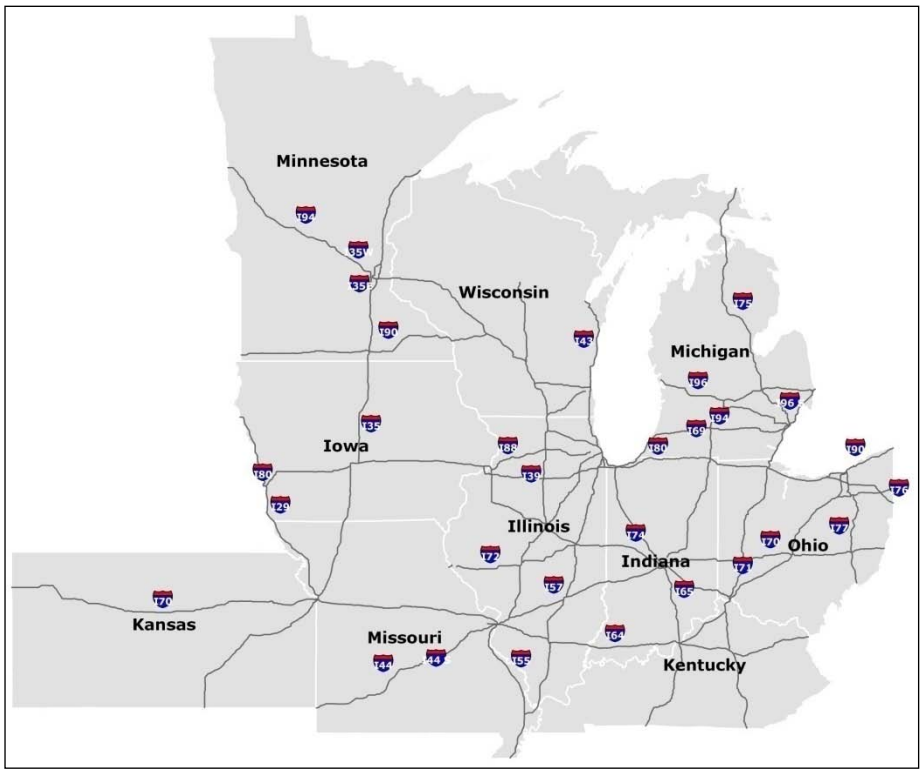


Figure 1: 10-state Mississippi Valley Region

The objectives of this study are to provide a detailed description of the status of truck parking along the Interstate highways of the Mississippi Valley region and to identify relevant truck parking issues and low cost strategies to address identified truck parking problems. The study focuses on the major freight corridors along the interstate highways in the 10-state MV region (see Figure 1), which includes Illinois, Iowa, Indiana, Kansas, Kentucky, Michigan, Minnesota, Missouri, Ohio and Wisconsin.

The goals of this research are to understand and analyze the trends in truck parking and to identify 1) where new or expanded facilities are needed, 2) operational issues driving the need for parking, and 3) low-cost solutions to the truck parking problem in the MV region. Furthermore, this research makes parking information available to freight professionals, provides spatial information necessary for the states to consider increasing short term truck parking availability in key locations along the Interstate highways in the region, and highlights the most important characteristics of new facilities. One of the other potential benefits resulting from this study is that the results may help truckers schedule breaks and rest and thereby make it easier for them to comply with Hours-of-Service regulations.

1.3 Study Methodology

Information about truck parking issues was collected from several stakeholder groups: freight carriers, truck drivers, metropolitan planning organization (MPO) representatives, state freight planners and state patrols. The research team's method for data collection combined techniques that included online and paper based surveys and in-person and telephone interviews. The team used e-mail, telephone, and personal contact to solicit responses to the web-based survey. Surveys and interviews were conducted between June 2008 and February 2009.

Web-based and Paper Surveys

MPOs, highway patrols, and state freight planners from each state were contacted via e-mail and telephone about the web-survey and its online link. The departments of transportation (DOTs) of all 10 states were sent an e-mail stating the objectives, scope and URL of the survey. Two follow-up reminders were sent two and five weeks after the initial e-mail. There was an observed increase in responses with the e-mail reminders. First time users spent six or more minutes completing the web-based survey depending on the number of locations they marked on the map.

It was easier to get responses from freight planners and highway patrol officers than from truck drivers in all states. A few local freight carriers were interviewed and the state trucking associations for each state were also contacted. However, e-mail and telephone contacts were not effective for collecting data from truck drivers. There are many possible reasons for this. First, it is difficult to get truckers' e-mail or telephone contact information, and even if they are sent e-mail notifications, the response rate is very low. Truckers are not likely to use computers as much as the other target audience groups. Truck drivers also spend long hours and much of their time driving, which limits the time they have to learn about computers. Therefore, they have a different level of computer proficiency than the other groups and may need some assistance in completing surveys.

To address these issues, ensure a large response from truckers, and account for the complexity of the truck parking decision process and all potential variables, the research team attended trucking trade show events (e.g. Jamborees and other appreciation programs) and conducted surveys with drivers. The survey findings are meant to illustrate the driver's perceptions and the comments in this report reflect the attitudes and the opinions of the drivers. It is important to note that each state is responsible for managing and maintaining rest areas and weigh stations, and practices across the survey region vary from state to state. Attitudes and perceptions are important to document, because in some cases, they do not represent the current standards, protocols or business practices. When perceptions diverge from specific practice, communication opportunities may in fact be the lowest cost solutions.

Table 1: Data Collection at Local Trucking Conventions

Location	Date	Surveys participants	Data samples	Mode of data collection
Walcott, IA	July 2008	90	130	Online & Paper
Waupun, WI	August 2008	74	72	Paper
Oshkosh, WI	August 2008	19	19	Paper
Peoria, IL	February 2009	68	78	Online & Paper

In total, the team attended four events - one in Iowa, two in Wisconsin, and one in Illinois - and surveyed the participants as listed in Table 1. The Iowa 80 Truck Stop hosts a truckers' jamboree every summer. This truck stop is located at exit 284 on Interstate 80 in Walcott, IA[9]. This event attracts many truckers and includes exhibits of products for truckers, carnival games, and a truck beauty contest. The research team's booth at this event was equipped with Internet access and laptop computers. Truckers were invited to the booth for the web-survey, and the team assisted truckers in completing the survey, if required. Ninety participants provided 130 data points during the event. Many other drivers were surveyed about their parking preferences but some did not want to fill out the survey on the computer.

The Waupun Truck-N-Show, a similar but smaller scale event, is organized every year in Waupun, WI[10]. The third event was an on-the-fly music concert organized for truck drivers in Oshkosh, WI. This program was hosted at the truck stop across from the EAA AirVenture Convention grounds. The team did not have Internet access at either of these events, thus they conducted paper-based surveys.

The truck show in Peoria, IL was organized by the Mid-West Truckers Association. This association has over 2700 members who represent trucking companies and companies that operate trucks as part of their business. The research team conducted online surveys using laptop computers and the Internet connection at the booth. A total of 68 survey participants provided 78 data points via the survey. General and location-specific questionnaires were printed out on paper and were given to truckers to fill out at the events. In order to pinpoint the locations of parking facilities, truckers were asked to mark locations on a paper travel atlas. Data from each participant was later entered into the web-based survey system. Parking facilities marked on the atlas were located on the Google Maps interface and saved into the database through the web survey.

The team's challenge at each event was to attract truckers to the booth to complete the survey. The team gave away incentive gifts, which were extremely important for attracting participants to invest their time to complete the survey. Truck drivers at the events were most comfortable filling out paper surveys. Some found the computer intimidating, though most were happy to talk about their experiences. Many truckers needed assistance in completing the mapping portion, especially with using the Google Maps interface. As this problem was more related to the truckers' expertise with computers, revising the tool's interface was not a promising solution. Thus, in cases where truckers struggled, the team members assisted them with technical difficulties and walked them through the survey.

Table 2: Distribution of Survey Responses

Group	Participants	Validated Samples
State Patrol	25	30 (97%)
Freight Planners	34	80 (96%)
Truck Drivers	258	250 (88%)
Total	**317**	**360 (91%)**

In total, 317 respondents from three groups identified parking issues at 397 locations across the region. The distribution of responses is shown in Table 2. During the data cleaning process, some survey responses were found to be incomplete and a few respondents marked locations clearly not designated or suitable for truck parking, which had to be discarded. It is evident that most of the voided entries are from truck drivers. This may be due in part to their level of proficiency with interactive maps and computers.

In the general population, there are far more truck drivers than freight planners and state patrol officers. As such, is the team expected that there would be more responses from truck drivers in comparison to the other groups. Figure 2 shows the distribution of survey respondents.

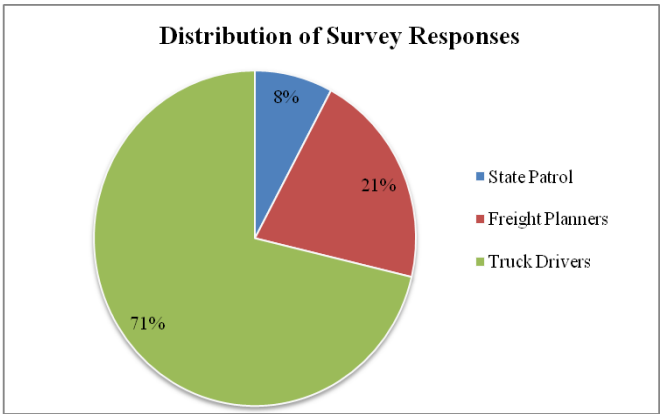


Figure 2: Distribution of Respondents among Survey Participant Groups

Interview Strategies

Representatives from both public and private sector organizations were contacted and interviewed to better understand their perspectives on truck parking issues and solutions for the MV region. Of public sector organizations, staff of the various partner departments of transportation were interviewed, along with several weigh station operators and state patrol Officers. Select representatives from the region's Departments of Tourism and Department of Commerce and staff at public and subscription radio stations were also contacted. Technical representatives at firms which support personal navigation devices and parking management systems were also interviewed.

In addition to the above-mentioned organizations, motor carriers and trucking associations in the region were interviewed to identify what role dispatchers and associations could play in communicating information about parking availability. Interviews with carriers were confidential. Ten large irregular route trucking companies and brokerage firms were contacted, many with headquarters in MVFC states, to identify truck parking opportunities and issues for their drivers. Some large companies in this region have operating centers for their trucks, while others have fueling agreements with truck stop companies, which allow drivers to purchase fuel with a credit card. Some cards provide discounts on fuel, some are billed back to the trucking company on a direct basis, and others offer other frequent fueling program discounts and benefits. Many of the truck stop vendors have truck parking available for fuel purchasers, but there are no guarantees of parking availability.

The responses from the motor carrier executives provided insight on drivers' parking location preferences. Safety is one factor, as many truck accidents happen at rest areas and truck stops. This is primarily driven by the fact that many of these locations are crowded; when the number of spaces is maximized, there is little room to maneuver.

Drivers also prefer level locations where they are not disturbed. While weigh stations are available, truckers have reported that they are concerned that they will be asked to move when station personnel arrive for duty. It is possible that other factors may play a role in truckers' decisions to park at weigh stations though these were not mentioned by truckers participating in this study. Many at WisDOT feel that truckers do not park at weigh stations because they are concerned about being inspected, which might result in delays or a ticket. Also, at some highly populated areas and at popular truck stops, vandalism and prostitution have been problems. To escape these risks of theft and minimize intrusion, many carriers move to ramp or roadside parking.

Truck parking choices are also influenced by the fact that truckers who travel regular routes are often able to predict choke points or congestion delays, and many of these drivers plan their trip with a stop after they have cleared the anticipated bottleneck location. This leads to bunching of truck parking demand on the outer edge of many urban areas. Trucking associations indicate that many drivers who travel familiar regions have less difficulty predicting where to stop for rest or breaks. They also reported that carriers with special load restrictions - such as those carrying high, wide or dimensional loads, placarded loads or hazardous waste - can run into problems finding suitable locations to rest.

Geospatial Analysis

This research aims to determine specific locations in the MVFC region with parking issues and prioritize them based on the severity and frequency that truckers experience problems at those

locations. To accomplish this, all the location-specific data collected through the survey was first cleaned for spatial errors and then exported to ArcGIS Desktop so that the team can perform spatial analyses. Other data required for spatial analysis, such as geospatial information for transportation modal networks and intermodal terminals and related attribute information, was taken from the National Transportation Atlas Database (NTAD) 2006.

The research team's data analyses include 1) a cluster analysis of incommensurate truck parking facilities, 2) a correlation analysis of existing truck parking facilities and parking problem spots, and 3) a determination of priority interstate corridors and cities in the region suffering from truck parking issues. The locations of parking facilities were clustered using the Nearest Neighbor Hierarchical (NNH) clustering algorithm in the software tool CrimeStat III. Analysis of responses to questions linked to locations produced results pertaining to the characteristics of services currently available at truck parking facilities, the possibility of expanding existing facilities and whether any new facilities are needed. Responses from the three participant groups differ according to their role in the transportation industry and the precision of their marked locations. The research team found that categorizing information based on these groups and carrying out group-wise statistical analyses led to better conclusions.

A visualization tool, such as the one used in this study, that is able to display comprehensive truck parking data geographically can serve as a means for distributing information to stakeholders and study participants. Furthermore, it can enhance communication between and involvement of transportation stakeholders. Such visualization provides an overall picture of the parking situation in the region, and helps major stakeholders in identifying patterns and making comparisons among various cities and states.

1.4 Organization of the Report

Chapter 2 reviews previous studies on truck parking conditions and inventories of current truck parking facilities along major Interstate corridors. Chapter 3 describes the development of the web-based GIS survey tool, including its functional and technical architecture. Chapter 4 describes major issues related to truck parking along Interstate highways in the MVFC region. Chapter 5 presents the results of the truck parking survey, analysis of the spatial data, and priority locations for investment in truck parking facilities. Chapter 6 presents recommended low cost strategies to improve truck parking in the 10-state region. Finally, Chapter 7 summarizes this study's findings and presents recommended next steps.

Chapter 2. RELATED STUDIES

Truck parking problems have likely dated back to when trucking became a major mode of freight transportation. However, this problem did not attract serious attention from policy makers, regulators, planners and truckers until the 1990s. Since then, many research projects have been dedicated to the unique need for truck parking, many of which have been supported by federal or state funding. Typical issues that have been discussed include adequacy of truck parking capacity, potential demand for truck parking along major highways, public-private partnerships for financing truck parking facility construction and operations, truck parking amenities, and alternative strategies, including the use of information technology, to promote more efficient use of existing facilities. Other related topics include the trucking industry and its operations. This section begins with a brief overview of the trucking industry, the consumers of truck parking facilities.

2.1 Trucking Industry Segments

Truck traffic on highways serves commodity flows for logistical needs. Commodity flow characteristics include commodity type, origin/destination, shipping distance, volume, and seasonality. The characteristics of commodity flows determine the characteristics of truck operations, which in turn affect truck parking needs. This suggests the importance of taking a careful look at the commodities being shipped by the trucking industry. In fact, segments of the industry are primarily defined by the trailer or the type of freight. As illustrated in Table 3, the trucking industry is as diverse as the cargo it hauls.

Table 3: Types of Commodities Shipped by Trucks

Agricultural	Heavy Specialized	Auto Hauler
Bulk	Intermodal	Waste
Dump	International	Courier
Forest	Livestock	Household Movers
GFLTL	Tank Truck	Private Fleet
GFTL	Hazardous Material	Specialized Cargo
Heavy Duty Tow	Refrigerated	Team Drivers

In addition, trucking can be classified as private or for-hire. For-hire trucking operations are further categorized into truckload and less than truckload (LTL), a classification which is used by the American Trucking Association to compile statistics. Each group has its own operational characteristics, which are described below.

Truckload – is a combination of owner operators and company fleet drivers. These drivers may operate locally, regionally, or internationally. Some drivers work in teams and some truckload carriers share tractors. Most of these drivers operate on an irregular route basis. In general, these drivers pick up freight from one owner and deliver it to a purchaser of the goods.

Less than Truckload (LTL) – is predominately regional, expedited delivery of small packages or small quantities of freight. These shipments are consolidated at terminals and loaded on a truck for regional movement. At the destination terminals, the trucks are unloaded and the packages are distributed. These drivers typically run fixed routes and have a predictable schedule. Some drivers are unionized while others are independent.

Private Trucks – are usually driven by contract drivers who run fixed routes within a network of locations typically owned by a single entity within a fixed distribution network.

Truckload is the largest segment of the trucking industry (measured by tonnage) and is expected to grow at an average of 2.5 percent per year over the next ten-year period (as shown in Table 4). The LTL segment is the fastest growing segment, although it moves the least tonnage of the

three types of trucking fleets. Private fleets have grown substantially in the past two years in response to the recent implementation of federal hours-of-service (HOS) legislation. Private fleet operations typically have the advantage of reducing variability of service.

Trucking operations can also be examined through the perspective of long haul versus local operations. The authors estimate that long haul driving involves trips of at least eight hours or five hundred miles, and primarily serves the logistical needs of shippers. As a result, truck parking facilities along major freight corridors are most important to long haul truckload trucking. Meanwhile, local operations are usually within a geographic area of daily reach. For example, drayage operations are typical local operations, as seen in the Chicago area. These companies hire independent contractors to pick up and deliver loads/empties, which arrive and depart the region by train.

Table 4: Truck Volume Forecast: For-Hire & Private Motor Carriers

	Volume - Millions of Tons			Average Annual Growth Rate (%)		
	2005	2011	2017	2006-11	2011-17	2006-17
Total	**10,693**	**12,397**	**14,027**	**2.7**	**2.2**	**2.4**
General Freight	4,903	5,745	6,665	2.9	2.7	2.8
Bulk Freight	5,790	6,652	7,362	2.5	1.8	2.1
Truckload	**5,355**	**6,221**	**7,084**	**2.7**	**2.3**	**2.5**
General Freight	2,499	2,918	3,395	2.8	2.7	2.8
Bulk Freight	2,856	3,304	3,689	2.6	1.9	2.3
LTL	**151**	**183**	**214**	**3.5**	**2.9**	**3.2**
General Freight	135	165	195	3.7	3.0	3.3
Bulk Freight	15	18	20	2.2	2.1	2.1
Private Truck	**5,188**	**5,993**	**6,729**	**2.6**	**2.0**	**2.3**
General Freight	2,269	2,662	3,076	2.9	2.6	2.7
Bulk Freight	2,919	3,331	3,653	2.4	1.6	2.0

SOURCE: American Trucking Association

The typical drayage driver is based in Chicago and performs local pickup and delivery work. These drivers are home generally every night and do not typically use public rest areas. It is estimated that 17,000 to 20,000 trips per day are the result of cross town trucking movements. Although the in-town movement of drayage operations does not generate truck parking needs related to satisfying HOS regulations, these movements may generate truck parking demand from drivers taking breaks or seeking food and rest, which would compete for the limited capacity of long haul trucker parking.

2.2 Company Facilities and Contract Provisions

In serving the logistics needs of shippers, carriers and trucking firms have developed their own operations, which are driven by market demand. Many large trucking firms - including J.B. Hunt, Schneider, and Swift - have operating centers strategically located in or close to their primary service area. One large company based in the Upper Midwest has operating centers in Indianapolis, Gary, Milwaukee, Green Bay, and Des Moines, but no center in Chicago. These operating centers provide drivers with a place to refuel, rest, take showers, and take care of minor maintenance and repairs. Laundry facilities and cafeteria services are also available to company drivers and independent contractors (ICs). Some smaller trucking companies which do

not operate on the same scale as the large carriers provide their drivers with contract services at designated rest areas or franchises. Several companies the research team interviewed had such a relationship established with Pilot Truck Stop Centers. Pilot has three different customer loyalty programs that reward drivers and/or trucking companies for repeat visits.

LTL companies typically refuel and use services at terminals where freight is picked up or delivered. Sometimes contract services are provided at nearby facilities if there is not sufficient space to support these services on site. Private fleet drivers may be employed by the large fleet owners, or might work for the contracting company directly. These drivers often have services contracted for by the private fleet owner.

Hazardous material loads and oversize/overweight loads are often subject to parking restrictions imposed by either shippers or receivers and/or by the municipality they are passing through. Independent owner operators make up the largest number of long haul over the road drivers. These drivers accept loads from brokers and logistics companies and make their own choices regarding routes and truck stop selection.

Truck drivers, and in small number of cases, the dispatchers, make decisions as to when and where to park and for how long. Understanding their decision-making is a key to alleviating truck parking problems. Federal HOS regulations stipulate that drivers cannot drive more than 11 consecutive hours when on duty. Few drivers drive this number of hours continuously before a rest. During the time they are on duty, drivers often need to stop for food, breaks, and rest. According to the research team's informal interviews with truckers at the truck shows, truckers tend to take a short break every 5 to 6 hours. When they approach the limit of 11 hours of driving, drivers must stop at a rest area, which often leads to an overnight stay and interrupts operations. Many long haul truckers complained that in the mid to late afternoon or early evening, they find it very hard to get parking at public rest areas for an overnight stay.

A great deal of truck parking outside large metro areas is also for staging. Truckers plan their trips so that their overnight stay starts in the late afternoon, especially for staging for early next day delivery at the outskirts of metro areas. This need arises because of delivery windows specified by shippers and city ordinances to reduce local traffic congestion. This study did not examine how truckers would respond to changes in delivery time windows and to the provision of truck parking by shippers at delivery locations. However, there appears to be a connection between truck parking capacity shortages along major freight corridors and the availability of truck parking provided by shippers or consignees at pickup and delivery locations.

2.3 Truck Parking Supply and Demand Studies

The public sector undertakes the primary responsibility to provide truck parking facilities using revenue from taxes on fuel, mileage and highway use. After decades of development, a vast inventory of truck parking along major freight corridors has been developed. However, the supply of parking at these facilities often does not seem to match demand from the trucking industry. Trucker preferences in terms of driving hours are important for establishing a relationship between overall truck parking supply and demand. Drivers also have preferences regarding lighting and safety, among other features, which are also of practical importance.

The National Transportation Safety Board completed a report in May 2000, which documented the results of a survey completed by the American Trucking Association (ATA) in 1999 and a second survey completed by the Owner-Operator Independent Drivers Association membership during the same year[11]. This report identified that truck drivers in both driver categories

(independent contractors and company drivers) have difficulty finding parking spaces at public rest areas at least once per week. The information presented in Table 5 was compiled by the National Transportation Safety Board (NTSB) in 2000 in an attempt to identify the current inventory of truck parking spaces on a national basis.

Table 5: Results of the National Transportation Safety Board 2000 Inventory (NTSB 2000)

Measure	Quantity
Public rest areas with full or overflowing parking at night	80 percent
Shortfall of truck parking spaces	28,400 (estimate)
Parking spaces at private truck stops	185,000 (estimate)
Number of trucks parked at private truck stops at night	167,453 (estimate)
Private truck stops that are full on any given night nationwide	53 percent
Private truck stop parking spaces to be added by the end of 2000*	20,000 to 38,000
Cost of building additional parking to meet future trucking demands	$489 to $629 million (projected)

** According to the National Association of Truck Stop Operators Vice President for Government Affairs, these additional spaces will be completed as projected.(Source: National Transportation Safety Board)*

In 2002, FHWA released a technical report titled the *Adequacy of Commercial Truck Parking Facilities*. This report included a model for estimating truck parking by state which examined the demand for various types of truck parking and estimated demand for parking at public rest areas and commercial truck stops. Table 6 shows estimated truck parking demand by facility type and by MVFC state. The last column lists the estimated annual increase in truck parking demand for each state from 2000 to 2020. These estimates correspond to projections for increases in truck volume over this period.

Table 6: Estimated Parking Spaces at Public Rest Areas and Truck Stops along Interstates and Other NHS Routes (FHWA 2002)

State	Demand			Annual Increase
	Rest Area	Truck Stop	Total	
Illinois	3,338	11,172	14,510	1.1%
Indiana	4,299	14,400	18,699	3.0%
Iowa	688	2,302	2,990	3.6%
Kansas	566	1,907	2,743	2.7%
Kentucky	2,206	7,380	9,586	2.7%
Michigan	1,275	4,262	5,537	2.2%
Minnesota	872	2,925	3,797	2.0%
Missouri	2,643	3,841	11,484	2.7%
Ohio	3,301	11,059	14,360	2.9%
Wisconsin	633	2,115	2,748	4.2%

**Information provided for routes carrying more than 1,000 trucks per day.*

Tables 7 and 8 summarize the respective parking capacity available at public and private parking facilities supply available. Table 9 lists the ratio between supply and demand in the 10-state MVFC study region.

As shown in these tables, the annual increase in demand in Wisconsin is high, which is as a result of the regional trade between Minneapolis/St. Paul, MN, Milwaukee and Chicago, IL. The following tables, which draw information from taken from the above-mentioned FHWA truck parking report, display an inventory of truck parking facilities and an estimate of the total number of parking stalls available at these locations. In some states, weigh stations have been identified for overflow parking, though few truckers take advantage of these sites. Typically there are no public restrooms available when these public stations are used for parking.

Table 7: Public Rest Facilities along Interstates Carrying More than 1,000 Trucks per Day (FHWA 2002)

State	Public Rest Area Parking Facilities	Imposed Time Limits	Parking Spaces	Overflow Parking allowed at Weigh Stations?
Illinois	54	No	1,267	No
Indiana	52	No	2,430	Yes
Iowa	38	Yes	805	No
Kansas	29	Yes	455	No
Kentucky	44	Yes	990	Yes
Michigan	75	No	1570	No
Minnesota	40	Yes	535	No
Missouri	35	No	620	No
Ohio	98	No	1405	No
Wisconsin	23	No	652	No

Table 8: Commercial Truck Stops and Travel Plazas along Interstates and Other NHS Routes Carrying More than 1,000 Trucks per Day (FHWA 2002)

State	Parking Facilities	Total Parking Spaces
Illinois	125	4,962-9,602
Indiana	120	7,972-14,529
Iowa	65	2,994-5,209
Kansas	55	2,209-4,383
Kentucky	80	3,745-7,186
Michigan	90	2,925-6,147
Minnesota	60	2,200-4,503
Missouri	140	6,468-12,272
Ohio	135	11,474
Wisconsin	80	2,863-5,971

Commercial truck stops and plazas offer a variety of goods and services, including such as fuel, food, showers, and supplies. Some sites offer minor maintenance facilities and truck scales. Offerings vary by location. These trucks stops and plazas are usually open 24/7, and commercial truck stops usually do not charge for overnight parking. Their business model focuses instead on the sale of fuel, food, and driver support services.

FHWA's *Adequacy of Commercial Truck Parking Facilities* report considers the uncertainty of truck parking demand and supply. The demand/supply (D/S) ratios are grouped into three categories, as shown in Table 9. The first category, "Surplus Spaces," (D/S < 0.9) indicates that the number of parking spaces available is likely to exceed the peak demand. The second category, "Sufficient Spaces," (0.9 < D/S < 1.1) indicates that the peak demand and the supply of parking spaces are nearly the same. The third category, "Shortage of Spaces," (D/S>1.1) indicates that overcrowding is likely.

Table 9: Truck Parking Demand/Supply Ratio along Interstates and Other NHS routes Carrying more than 1,000 Trucks per Day (FHWA 2002)

State	Public Facilities		Commercial Facilities		Total	
	D/S	Category	D/S	Category	D/S	Category
Illinois	2.63	Shortage	1.16	Shortage	1.33	Shortage
Indiana	1.77	Shortage	0.99	Sufficient	1.1	Shortage
Iowa	0.86	Surplus	0.44	Surplus	0.5	Surplus
Kansas	1.24	Shortage	0.44	Surplus	0.51	Surplus
Kentucky	2.23	Shortage	1.03	Sufficient	1.17	Shortage
Michigan	0.81	Surplus	0.69	Surplus	0.72	Surplus
Minnesota	1.63	Shortage	0.65	Surplus	0.75	Surplus
Missouri	4.28	Shortage	0.72	Surplus	0.89	Surplus
Ohio	2.35	Shortage	0.96	Sufficient	1.12	Shortage
Wisconsin	0.97	Sufficient	0.35	Surplus	0.41	Surplus

According to the inventory data from the 2002 FHWA report, demand is higher in Illinois when compared to supply than in other state in the region, which is consistent with the findings described later in this study. Indiana, Kentucky and Ohio are also facing a serious shortage of truck parking spaces. To complement previous inventories of truck parking, this study also inventories truck parking facilities (at both truck stops and public rest areas) along the major corridors in the MFVC regions using a web-based GIS system.

2.4 Issues at Public Rest Areas

"No Room at the Inn,[12] produced by the American Trucking Association, was one of the first major studies to focus attention on the issue of truck parking. This study compiled survey data from public transportation agencies and private toll road agencies regarding 1,487 public rest areas in the 48 contiguous states. The study pertained primarily to amenities, utilization, regulations, and capacity issues. Some of the study's general findings regarding the state of the nation's public rest areas include the following:

- Most provide restrooms and picnic tables.
- About half have vending machines.
- Nearly 80 percent of rest areas reported that truck parking spaces were full or overflowing at night.
- 42 percent of rest areas had some limit on truck parking, often two or four hours.
- Only 10 percent of surveyed rest areas report that time limits are strictly enforced.
- Trucks often park illegally because parking spaces in rest areas are difficult to use.
- Many state DOTs rarely enforce regulations against parking on Interstate shoulders and ramps because they do not want to force fatigued drivers to continue to drive.

The research team corroborated the findings from the survey through several extended data collection efforts. One was a direct observation survey to collect information about truck traffic and rest areas over a 200 mile segment of I-81, which connects Knoxville, TN and Radford, VA. The findings were generally consistent with those described above, except in some cases more detailed information was available. For example, the public rest areas were generally reported full between midnight and 5 a.m. on weekdays. Also, public rest area design was an issue for convenient and safe parking. Parking lot design inconvenience has also been reported in this truck parking study during interviews with truckers.

Another effort included a truck driver survey conducted along the same 200 mile portion of I-81, which generally yielded similar results. Over 90 percent of truck drivers believed there was a shortage of available truck parking. The survey drivers stated that on average, most drivers reported being unable to find parking in either a private truck stop or public rest area about four times per month. As to their preference for using private versus public truck parking areas, the survey indicated about an even split. In addition, drivers reported that their preferred use tends towards private parking areas when an overnight stay is concerned, and to public parking areas during short breaks.

A mail survey of 330 motor executives nationwide was also conducted, yielding very similar findings. Additionally, the study conducted a survey of 170 truck stop operators. The questions on the survey were generally about expansion of parking capacity. Most truck operators considered cost and availability of land as the two largest obstacles.

In addition to *No Room at the Inn*, an earlier study[13] included an inventory of state facilities and policies based on surveys sent out to the 48 contiguous states and nine toll road and thruway agencies. Key findings were more significant regarding the adequacy of parking capacity. For example, the study reported that nearly 80 percent of truck parking areas was full or overflowing onto the ramps at night. In contrast, car parking areas were reported as generally underutilized.

While these studies were completed in the late 1990s, the trucking industry has remained fundamentally the same and the problems of overcrowded facilities and illegal parking on ramps and shoulders remain.

2.5 Issues at Private Truck Stops

Truck drivers value public rest areas primarily for ease of access and convenience. Commercial truck stops and travel plaza operators provide extended-stay parking to encourage purchases of fuel, food, and other services. Truck stop operators do not generally charge for parking but rather provide parking to attract business.

Private truck stops experience many of the same truck parking issues that public truck stops do. In the study "*No Room at the Inn"*, surveys were mailed to all 987 members of the National Association of Truck Stop Operators (NATSO), with 39 percent responding. No surveys were received from New Hampshire, Vermont, Rhode Island or Delaware, and many small truck stop operators are not members of NATSO and were not included in the survey. Statistical weighting procedures were used to adjust for these deviations so that the survey results could be accurately projected to the total target population. The average distance between private truck stops and public rest areas was 13.7 miles and did not vary significantly by region. A consistent finding between public and private truck stops was capacity shortages for truck parking. In fact, the capacity shortages at private truck stops were more serious. For example, more than 50 percent said their facilities were "filled to capacity" at least 20 nights per month.

Additionally, the Federal Highway Administration's 2002 *Study of Adequacy of Commercial Truck Parking Facilities* found that there were a total of 284,601 truck parking spaces on Interstate highways in the U.S. at 3,382 commercial facilities. NATSO reported an annual increase of 6.5 percent in the number of parking spaces available at commercial truck stops and travel plazas.

Unlike public truck parking areas, private truck stops often appear to have the flexibility to expand their capacities according to growing demand. However, truck stops often face large hurdles in their efforts to provide more parking. An acre of truck parking, which can accommodate approximately 20 trucks, costs an average of $100,000 to construct and another $7,500 to $10,000 per year in maintenance and security costs. The price of constructing new parking spaces at truck stops near metropolitan areas can be much greater. On top of the price, truck stops seeking to increase their parking capacity must deal with homeowners who do not want diesel exhaust fumes, traffic, litter and noise in their neighborhoods. Often homeowner opposition leads to zoning regulations or large impact fees assessed on truck stops in exchange for infrastructure improvements to accommodate a higher volume of truck traffic on local roads. Both of these outcomes often make it impossible for truck stop owners to expand their capacity. If private truck stops are to effectively accommodate current and future truckers, they must find a way to overcome these challenges.

2.6 Substitutability between Public and Private Truck Parking Areas

While public and private parking areas provide some similar services, they function differently. Most public rest areas are located along major highways and are easily accessible to drivers on those highways. In contrast, private truck stops are often located at highway exits and are less convenient for drivers. Over 90 percent of the truck drivers who ranked accessibility as an important factor in their decisions for short-term parking prefer public rest areas for short stops.

Several other distinctions have been identified. First, drivers tend to use public rest areas for short naps and to use the telephone, while private truck stops are used for overnight rest, showers, and meals. Second, private truck stops offer a much wider range of services than public rest areas.

The Iowa State Patrol surveyed 88 percent of parking spaces in Iowa's public rest areas, (accounting for a total of 514 spaces) located along Interstate highways between 10:00pm and 5:30am during the week of October 17 to 24, 1999[14]. Many of the public rest areas were overcrowded, sometimes filled to twice their capacity. Conversely, private truck stops along Iowa's interstate highways that were surveyed during October and November of 1999 reported that they were almost never overfull and were generally filled to only 55 percent to 80percent of their capacity.

This discrepancy in usage of public and private truck parking spaces has been widely noted. The FHWA estimates that while 23 percent of total truck parking demand is for spaces at public rest areas, only 10 percent of available spaces are located in public rest areas. This substantiates the limited interchangeability of public and private parking facilities from the truck driver's perspective.

2.7 Previously Proposed Strategies for Improving Truck Parking

There have been a number of dialogues between stakeholders regarding how to improve truck parking. In 1999, FHWA hosted a Rest Area Forum[15] to identify issues and find solutions to provide adequate and safe parking for commercial drivers and their vehicles. This forum included state transportation officials, law enforcement officers, motor carrier representatives, private truck stop operators, commercial drivers and safety advocates. Five recommendations resulted from the forum:

- Improve safety and security at public rest areas.
- Encourage private enterprise to increase truck parking through the use of public-private partnerships, tax incentives and low-interest loans. Encourage shippers and receivers to provide parking in urban areas.
- Create alternate parking sites to address immediate issues.
- Improve public rest and parking areas by providing uniform spacing.
- Increase public rest area construction, modernization and expansion with support from federal, state and discretionary funds.

Thirteen national stakeholder groups were contacted to determine their views and recommended solutions to truck parking needs. Individuals from both public and private sectors were involved.

While both groups shared an interest in solving the truck parking problem, their viewpoints were decidedly different. The stakeholder group felt that the trucking industry should have the primary responsibility for ensuring that adequate parking is available for commercial vehicles. It was felt that in general, commercial truck stops provide adequate parking to meet the needs of most professional drivers. In cases where these needs are not being met, it was felt that the carrier industry should look for alternative parking options, which may include agreements with shippers and receivers and/or the development of scheduling discipline, which would improve the efficiency/throughput of current truck parking facilities.

It was also noted that the government should be responsible for providing parking spaces for commercial vehicles. Policy approaches such as increasing funding for parking spaces at public rest areas, removing parking restrictions at current rest areas and increasing truck parking designations at existing facilities were recommended. It was suggested that park-and-ride facilities, inspection and weigh stations and other facilities should be opened for truck parking. With respect to this finding, WisDOT staff report that while federal money exists for building new rest areas, funding to maintain them is difficult to come by, and a lack of resources for maintenance can lead to closure of rest areas.

The motor carrier industry most strongly supported improved communication methods to help increase awareness of existing facilities. Ideas included variable message signs, brochures, telephone messages and Internet postings. Shippers and receivers felt most strongly that the federal government should mandate the use of highway funds for the construction of public rest areas where parking needs have been identified. This group of stakeholders felt that public-private partnerships could be used to increase parking capacity and that low-interest loans and/or state-owned land should be used for the development of new facilities.

There is currently a lack of consensus about where the responsibility should rest for increasing truck parking. Transportation officials and citizen groups cite safety and crash data to justify their arguments for expanding facilities, yet the cost of land, especially in urban areas, is often prohibitive. Other private sector groups feel that government supported expansion or public-private partnerships will upset the economics of current truck support facilities and may provide unfair advantages to new entrants. Studies seem to indicate that while there may be an adequate supply of truck parking, it is often not in areas with highest demand. An effort to provide real-time information on truck parking availability seems to be the one solution which is acceptable on both sides of the debate.

Public rest areas along the Interstate highway network are funded by Interstate maintenance funds. Federal law prohibits states from allowing private enterprises to sell goods at Interstate pubic rest areas for profit. Some exceptions exist in New York and Pennsylvania, where these concessions pre-dated the designation of Interstate status to highways. This federal law was enacted to prevent unfair advantages to private companies with direct Interstate access compared to companies operating concessions at exits off of Interstate highways.

Several states have explored the commercialization of rest areas, but federal law would need to be modified in order to permit this commercialization. Moreover, the National Association of Truck Stop Owners (NATSO) asserts that private development on Interstate highways will adversely affect the businesses of its members located at the exits as well as the local economy through decreased employment, tax base and tourism[16]. Public-private partnerships have been explored on a limited basis with the Oasis concept which was approved by FHWA on October 18, 2006. The Oasis program requires that facilities be within 3 miles of the interstate system,

meet certain geometric and access specifications, and must be open 24/7. Truck parking at these new Oasis facilities will be allowed for up to 10 hours.

Congress established the Truck Parking Initiative in the 2005 highway reauthorization bill (SAFETEA-LU)[17]. The Truck Parking Initiative is a pilot program designed to increase the availability of long-term parking for commercial motor vehicles along the National Highway System and is funded through Fiscal Year 2009. The Federal Highway Administration determined that $5.385 million was available for grants in Fiscal Year 2006. In 2007, Congress authorized $24 million through 2009 for state and local governments to pay for more truck parking along major highways and interstates. States would get the money to look for 'parking solutions,' which could include the creation of new parking spaces or a system that alerts truckers to where available parking spaces are located. This legislation represents the first time that Congress has set aside money for this purpose.

Realizing new parking capacity will take a combined effort by all stakeholders. In a series of listening sessions, several short term actions were suggested[18]. State partner groups' recommendations included the following:

- Construct new public rest areas with additional truck parking spaces
- Consider truck parking only options at public rest areas
- Increase the priority of public rest area construction
- Add new truck parking spaces to existing public rest areas
- Redesign rest areas to improve vehicle circulation through the lot
- Convert parallel parking to pull-through parking for trucks
- Covert closed public rest areas into parking facilities
- Investigate the use of federal funds for rest area maintenance
- Explore alternative financing of public rest area construction
- Develop pilot projects for public rest areas
- Partner with other state agencies, such as departments of tourism
- Improve security at current sites with call boxes, cameras and enforcement
- Identify combining use of current ports-of-entry, weigh stations and police substations with truck parking facilities

Public rest areas and commercial truck stops are very different facilities. It is important to note that commercial enterprises offer many incentives and repeat purchase programs to promote brand loyalty. When given an option truckers generally prefer to park in familiar areas and frequent locations where a wide array of services are provided.

Providing information on parking availability is one way to accommodate demand in over-crowded areas. For example, to reduce congestion and truck idling, the Port of Oakland, CA implemented a reservation system for arriving trucks. This improves coordination with arriving vessels, but increases demand at parking areas nearby. Other information initiatives for the future include:

- Educating drivers on the safety benefits of rest and on related driver fatigue symptoms,
- Developing ITS systems to deploy real-time information on current parking availability,
- Publishing a "Truckers Map" to identify commercial truck parking areas,
- Distributing parking information in truck credential/licensing mailings, and
- Using improved signage to inform users of parking availability.

Policy and enforcement changes have been considered by several states, which include:

- Increased enforcement of parking rules at interchange ramps,
- Revised parking limits to permit trucks more time at public rest areas,
- Encouraging more local government and business support for the operation of commercial truck stop facilities,
- Encouraging better recognition of credit and tax incentives for terminal operators who provide 24 hour access to "truck staging areas,"
- Establishing building requirements for future warehouse and terminal facilities to incorporate truck parking and staging facilities as part of the development/building permitting process, and
- Encouraging public-private partnerships.

In summary, stakeholders agree that truck parking needs to be improved. In reality, facilities that provide truck parking differ significantly based on the funding source. Public facilities are very basic and will likely remain as they are as long as they are primarily funded from federal sources. Meanwhile, private firms have more incentive to build new facilities and/or to expand existing ones, but would greatly benefit if public policy and sentiment would be more favorable toward trucking. Related issues such as land use, zoning and delivery curfews have impacts the development of new facilities. In the interim, the common solution that all can agree on is improving communication systems to help match users with open spaces.

2.8 Previous Studies

This report provides details for developing new parking methodologies or strategies based upon reviewing earlier studies. There are four studies which are particularly relevant to this project; these are described below.

The Minnesota Truck Parking Study

One of the studies most relevant to this project, the Minnesota Interstate Truck Parking Study,[19] was completed in January 2008 in order to help the Minnesota Department of Transportation (MnDOT) gather information necessary to support decisions regarding future approaches to solving truck parking issues in Minnesota. The issues examined by the study effort included 1) what the state's role should be in the provision of truck parking; 2) what methods of providing long term truck parking will provide the greatest support to the state's economy, and 3) what actions will have the greatest impact on traffic safety while taking maximum advantage of effective technology and available federal programs.

The Minnesota Interstate Truck Parking Study examined the supply and demand of public and private commercial vehicle parking along Minnesota's three primary interstate corridors: I-90, I-35, and I-94. The study was conducted through three primary activities:

- An inventory of Minnesota's Interstate Truck Parking supply was established to be used as a basis for the collection of data regarding truck parking demand by time of day. Areas within one mile of Interstate exits were examined for parking facilities, rest areas, truck stops, vacant lots, and large parking lots at retail centers.

- Data compiled on parking facilities was then given to a field data collection team for use during facility site visits to carry out a truck parking demand analysis. Field researchers recorded truck parking supply information, including facility layout descriptions and total parking spaces, the number of available spaces, parking duration and limits and facility ownership (public or private). Once this data was summarized, the team worked with the MnDOT rest area program manager to develop a measure that would effectively identify facilities that had reached or were over capacity during the busiest hours of the day. Overall, 20 facilities were identified as having significant capacity issues during the busiest time of day. Using all the available information, the project team produced maps showing the supply and demand for parking at public rest area facilities and indicated how often public rest area parking facilities for commercial vehicles are filled to capacity during week-night hours.
- A survey of trucking company practices was then conducted. Vehicle information was turned over to researchers, who then contacted the motor carrier companies responsible for trucks observed in the study to find out more about why their drivers were parked in a particular location and the nature of their stop. An attempt was made to contact the operating motor carrier within 48 hours of vehicle observation. The interview consisted of nine survey questions sent to 433 motor carriers throughout the Midwest and Canada. Of the 433 carriers identified, 178 responded (41% response rate) to the survey by telephone, fax, US mail or email. The main purpose of the interviews was to determine the reasons for parking selection.

Currently, the project team is developing a framework for future discussions regarding the financial and safety impacts of various options, along with the impacts s upon the motor carrier industry nationally, regionally, and locally, and upon Minnesota shippers. This parking study essentially set the stage for future research on implementing solutions to solve the state's truck parking issues.

Several statewide solutions have been identified that will form the framework for future implementation studies. Upcoming phases of this study will evaluate the effectiveness of several options including, but not limited to, public private-partnerships, parking capacity additions, parking policy revisions, and information technology systems.

Minnesota's Advanced Parking Information System

While the use of information technology (IT) systems for truck parking is a relatively new phenomenon, information technology systems for passenger parking have already been developed. One notable example is Minnesota DOT's Advanced Parking Information System, which James Wright documented in a 1996[20] article. St. Paul began implementation of the system in the late 1995 and it became fully operational by November 1996. A system evaluation later studied implementation of electronic signs displaying real-time parking availability information for special events in the Civic Center/Rice Park area of downtown St. Paul. At that time, the system included ten parking facilities. Traffic data was collected during six different major events which drew visitors to the area between March 1995 and November 1996. However, because of installation delays, malfunctions and data collection issues, only the data collected at the time of the final event - the Smithsonian Exhibition on November 1 and November 8, 1996 - was used to evaluate the impact of the system.

Most of the motorists who responded to the survey (a total of 139 responses) felt that the system had value but that it's efficiency remained in question. During the study period, there were observed reductions in delay at critical intersections and reduced travel times on selected routes. However, these were difficult to directly and completely attribute to the Advanced Parking Information System. Operating and maintenance costs of the system were approximately $2,425 per month. Some of the key lessons learned from the evaluation were that: 1) participating facility staff need adequate training and communication to operate their portion of the system effectively and to deal with technical difficulties and unplanned circumstances; 2) the roles of public and private partners need to be clearly defined to ensure efficiency; 3) the prior experience of contractors in the installation of traffic control equipment is important for preventing delays; and 5) project scheduling should allow for a system validation and testing period prior to full operation and evaluation.

Milwaukee's Advance Parking Guidance System

Fornal, Rylander and Letourneau reviewed Milwaukee's Advanced Parking Guidance System (APGS), which was still in the planning stages according to the June 2006 issue of the ITE[21] Journal. The goal of Milwaukee's system is to provide real-time parking availability information for people attending summer festivals in the city, including Summerfest in particular, and to help visitors find parking, reduce congestion and promote the use of a shuttle bus through the downtown to the fairgrounds. Responsibility for the system's development and future implementation, operation, and ongoing maintenance rests with a number of agencies and organizations, which include the City of Milwaukee Department of Public Works, WisDOT, the Milwaukee County Transit System, the Milwaukee Police Department, the Milwaukee County Sheriff's Department, various public and private parking facilities, and a number of information service providers, such as local businesses and downtown organizations. The City has responsibility for all operation and maintenance expenses for infrastructure within the public right-of-way. Parking providers are responsible for on-premises system infrastructure, for attending meetings for the design and deployment of the system and for allowing access and/or making any hardware or software modifications as required for proper system operation. In addition, parking operators are required to provide the system with accurate, real-time information about the number of parking spaces available to the public.

The system model for Milwaukee's APGS consists of dynamic parking availability signs, static guide signs, parking facility equipment and a control center with communication links to parking facilities and parking availability signs. The dynamic signs display static facility names and directions to three parking areas, with a variable display next to each that shows display the number of available spaces, and whether the facility is "full," "open," or "closed." These dynamic signs are to be placed at points visible to drivers who are within the central business district and are expected to be choosing a parking facility. Static signs are to be placed at major entrance points into the downtown, points where motorists must turn as they are driving downtown, and outside entrances of participating parking facilities.

Each of the participating parking facilities has existing parking availability monitoring software. The APGS requires that these existing systems use an interface to link to the central system. Real-time updates, based on the availability information from each parking provider, will be updated on dynamic signs every one to two minutes. Communication between parking facilities, the control center and the dynamic signs will be transmitted via a wireless serial network with repeater sites to provide adequate coverage. Such a system, while focused on reducing

congestion caused by auto traffic during major events in Milwaukee, performs many of the functions that would be required of an integrated intelligent parking system for commercial motor vehicles.

Germany's TCP System

A 2006 article in ITS International detailed a new system being used in Germany to better manage and increase capacity at roadside rest areas[22]. After the opening of the Iron Curtain, truck traffic increased on many major corridors in Europe, creating truck parking issues similar to those in the US. The A3, a major corridor for traffic and trade in Germany, is one of the routes identified as the focus of the Long Distance Corridor (LDC) initiative. The goal of this initiative is to use traveler information systems to provide users with seamless accessible services along their route in order to increase safety and capacity.

Along the A3, parking capacity is often exceeded at night, and trucks park in illegal and unsafe locations. The solution to this problem—Telematics Controlled Parking (TCP)—was developed through a public-private partnership consisting of Manns Ingenieure, the members of the CENTRICO Euro-Regional project in the German region of Rheinland-Pfalz, and the road authority of Rheinland-Pfalz. TCP is a system that positions vehicles in lines according to their departure times so that trucks can be parked very close together while maintaining sufficient space to ensure that trucks due to leave can do so unhindered. Depending on the length of the vehicles and the geometry of the parking area, it is often possible to park at least three vehicles one after the other. Upon arrival at the parking area, the driver enters his/her vehicle type and departure time and is then allocated a space either behind another truck with an earlier departure time or at the front of a new line. Typically, up to 40 percent more spaces are created within existing parking areas. Another advantage of TCP is the fact that certain types of vehicles, such as police cars or trucks with abnormally sized loads, can have spaces set aside for them.

A pilot project was opened in September 2005 that doubled the amount of parking for large commercial vehicles from 42 to 84 spaces. In order to monitor capacity utilization, the system uses magnetic field sensors under each of the vehicle parking spaces. There have been some initial problems with these sensors due to the differing ferromagnetic masses of the vehicles using the spaces, but the supplier, Megatronic AG, is working through these issues. Upon seeing the TCP system's barrier for the first time, some drivers report being worried that they would have to pay for parking; however, repeat users of the system have been happy with their experience.

Study to Improve Passenger Parking

There have been numerous methodologies already implemented previously to improve parking efficiency; however, some have been for passenger parking. Garber et al (2004)[23] proposed a methodology for implementing a truck parking information system with the goals and objectives listed in Table 10. They suggest that such a system should be centralized and include parking data collection equipment, a parking information management center, telecommunication networks, an information displays and dissemination devices. Specific technologies they believe will hold particular promise for such a system include the following:

- Use of in-pavement inductive loop detectors as primary data collection components, based on their performance-cost ratio
- Video image processing as a backup technology

- Variable and static message signs in order to get parking information to drivers on the road
- Internet websites to inform drivers during their pre-trip planning process

Table 10: Goals and Objectives for Truck Parking Systems

Goal	Objectives
Convenience and comfort	Provide real-time truck parking information. Reduce truck driver parking search difficulties.
Safety	Reducing truck driver fatigue driving and truck related incidents. Reduce illegal on-ramp or on-shoulder parking and smooth highway traffic.
Efficiency	Increase overall utilization of parking facilities. Balance and increase utilization of different truck parking facilities.

SOURCE: Garber et al 2004

I-5 Parking Carma

Parking Carma was launched in 2001 with patented innovative "Smart parking" technology. This application has been rolled out for passenger vehicles in over 70 cities and holds significant promise for truck carriers. The technology allows drivers to determine the real-time availability of parking spaces from their cars, homes or offices. The network uses wireless sensors and other technologies to gather, organize, analyze and process parking information from off-street parking facilities. Available parking spot information is then distributed to drivers, trucking companies, local organizations and dispatchers in a convenient, easily accessible manner.

Caltrans is sponsoring a project with Parking Carma and U.C. Berkeley to test several sensor devices along the I-5 corridor in order to expand this offering to more commercial freight transportation companies. This project will be expanded to commercial trucking applications in 2009 and will be a multi-year program focused on specific California corridors, asset owners and carriers.

The program, as envisioned, will allow parking lot owners, truck stop operators and other parking vendors to provide real time parking availability data with Parking Carma. Parking Carma will populate their database with this information. Users will be able to access Parking Carma and view space availability by location or via an automated trip plan calculator which will estimate real-time travel times based on user specified origin and destination points. Consumers will establish an account with Parking Carma and will be assigned an access code. Information about the consumer's vehicle will be saved and users will be able to make parking reservations by hour, day or month. This reservation system can be accessed via the Internet or by cell phone. Reservations can be made or modified electronically and reservation fees can be charged to credit cards or cell phone bills.

Parking Carma's central database optimizes parking solutions based on various parameters specified by parking asset managers. Usage and reservation fees are dynamic and can be modified on a real-time basis.

Benefits of Parking Carma (for passenger vehicles) are estimated to include:

- Increased availability of parking in dense urban retail and residential communities,
- Real-time parking information by location, allowing users to see available resources,

- Increased utilization of existing parking resources and the potential of space sharing based on real-time spot location reservations and up to the minute reporting,
- Cashless billing via phone or credit card billing systems, and
- Increased revenue and parking utilization, which will benefit parking asset owners.

Also, cities and public agencies estimate that data from this application could reduce the need for new infrastructure, reduce traffic congestion at peak hours of demand, increase parking revenue via 24 hour monitoring, and could provide data for improved land use and planning.

2.9 Private-Public Relationships

Truck parking ensures safe driving for efficient delivery, and serves both the private and public interests directly. Therefore public and private institutions have a legitimate common ground for establishing partnerships. Such partnerships could involve jointly managing or influencing truck parking demand and supply using several guidelines that have been identified in the National Transportation Safety Board Report (2000)[24]. These include the following:

- Shippers and brokers' delivery schedules should be an integral part of any solution to truck parking problems.
- Commercial Motor Vehicle (CMV) operators shall make informed and wise decisions about parking to avoid ramp or shoulder parking.
- Fleet dispatchers in the private sector shall be provided with good sources of parking availability information from the public sector so that they can make well-informed advance decisions.
- State governments shall investigate the feasibility of developing privately-owned rest area facilities.

A note about the first item is worthwhile. According to the survey conducted as part of this study, truck parking at the outskirts of major cities is largely due to staging for early next day delivery. This relates to shippers' delivery requirements. For instance, large department stores have their most convenient delivery windows in the early morning. Also, one participant in this study made a suggestion regarding the feasibility of requiring shippers to provide truck parking spaces. Shippers' provision of parking spaces is probably particularly relevant to densely populated business areas.

If public planners know where there are shortages in parking capacity and also where there is high potential to improve safety and private-sector operational efficiency, it would be easier for them to make the right planning decisions. Demand information could be supplied by the private sector to meet this goal. A by-product of this study is a Google Maps-based online GIS tool that collects information from the private sector about the timing and locations of shortages of parking capacity. This online tool, which is described in the following section, is accessible to the public 24/7.

Chapter 3. WEB GIS SURVEY TOOL

Truck parking planning and operations take place in space as well as in time. Interactions between planners, operations managers and users of transportation systems are operate in this time-space network; therefore, the communication of both location and time-related information is often essential to their decision making. As a result, applications of GIS- and now web-based GIS- have become essential in transportation planning and operations. This specific project involves an online GIS-based survey of freight carriers, state patrol officers, and freight planners about the location and attributes of truck parking areas on the transportation network. This chapter describes the research team's use of GIS technologies to gather location-based information on truck parking needs on Interstate highways in the MVFC region.

3.1 Web System Analysis

System Description and Usage

The survey tool can be accessed from the CFIRE website (http://www.wistrans.org/cfire/Research/ MVFC/MVFC04/04.htm). The tool functions best in the Microsoft Internet Explorer web-browser.

Figure 3 shows the functional design of the survey tool interface on the client side. This design allows the user to create a login and password and then use them to access the survey. After logging in, participants are required to choose the category to which he or she belongs: highway patrol, freight planner or truck driver. Depending on this choice, the survey prompts general questions about truck parking problems. Next is an overview of the purpose and scope of the map survey tool, followed by a brief tutorial on the basic functionalities of Google Maps.

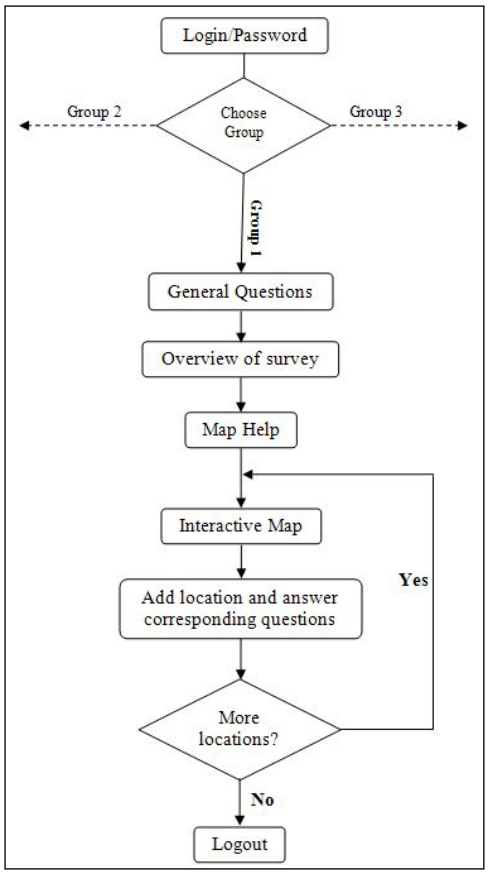


Figure 3: Functional Design of the Client Side Interface

The user then reaches the interactive survey map where she/he can pinpoint location(s) with truck parking problems. Because the survey requested that users precisely locate a parking facility, the online map feature was required to have excellent user interactivity and geocoding services as well as tools for marking specific parking locations. Thus, the research team made use of Google Maps API. To help users find locations, the tool provides three search methods: search by address, search by highway number, and search by landmark. In addition, users can zoom and pan to truck parking locations. The user can then place a marker at the location and complete a location specific questionnaire by clicking on the marker. Location specific questions vary depending upon the user group. By answering

these questions, users contribute to a database of locations with truck parking issues. The tool allows users to mark more than one location before logging out. The user can return again to add more parking locations.

Functional Requirements

To gather information about problematic truck parking locations in the MVFC region, an online survey of transportation stakeholders was conducted. The widely-dispersed freight networks and stakeholders in the 10-state region made it desirable to have an Internet-based geographic-information supported study tool so that stakeholders could identify problematic truck parking locations. However, there were several major challenges in accomplishing the desired functionality of this tool. A detailed description of each of these challenges is provided below.

Participants in the survey were expected to provide information about general problems in truck parking as well as problems concerning specific parking facilities. The information participants can provide is dependent upon their role in the transportation industry. The research team came up with three major groups of transportation stakeholders: highway patrol officers, freight planners, and truck drivers. People from these three groups are most likely to provide insight on nature, causes and solutions of truck parking problems. Highway patrols have experiences with truck parking conditions because they enforce parking regulations. They are most likely to know about ramp parking problems. Meanwhile, freight planners are expected to be aware of locations and conditions of rest areas in their state. The largest and most important target audience members are truck drivers, who are the end users of truck parking and have had parking experiences at a variety of locations within the region. Drivers are possibly the best people to communicate information about parking facility conditions and adequacy.

The survey was designed to make users aware of the objectives of the survey and the geographic scope and to guide users through completion. The survey required participants to input information about locations with parking problems only along the Interstate highways in the 10-state region. Also, prior to directing users to Google Maps, the tool's interactive features and functionalities had to be briefly illustrated to assist users who are not familiar with Google Maps. The survey design included guided steps and explanations.

In order to collect comprehensive information on truck parking in context of this research, the survey included two types of questionnaires. One posed questions about general characteristics and issues in parking and another asked questions about specific parking facilities. The first questionnaire, being independent of locations, is not related to the interactive map. However, the second questionnaire requires a map. These questionnaires also needed to be different for each target audience and relevant to their role in the transportation industry.

Pilot Testing of Tool and Interface Design

One of the study team's major challenges was to keep the survey interface simple for users because the targeted respondents have different levels of computer proficiency. Several rounds of pilot testing were done to ensure a user friendly interface. In addition to in-house tests (by peer graduate students, staff and faculty), three motor carrier representatives and two public freight planners participated in testing. Feedback and suggestions about the user interface and questionnaires were incorporated into subsequent revisions of the survey tool before the survey was finally deployed.

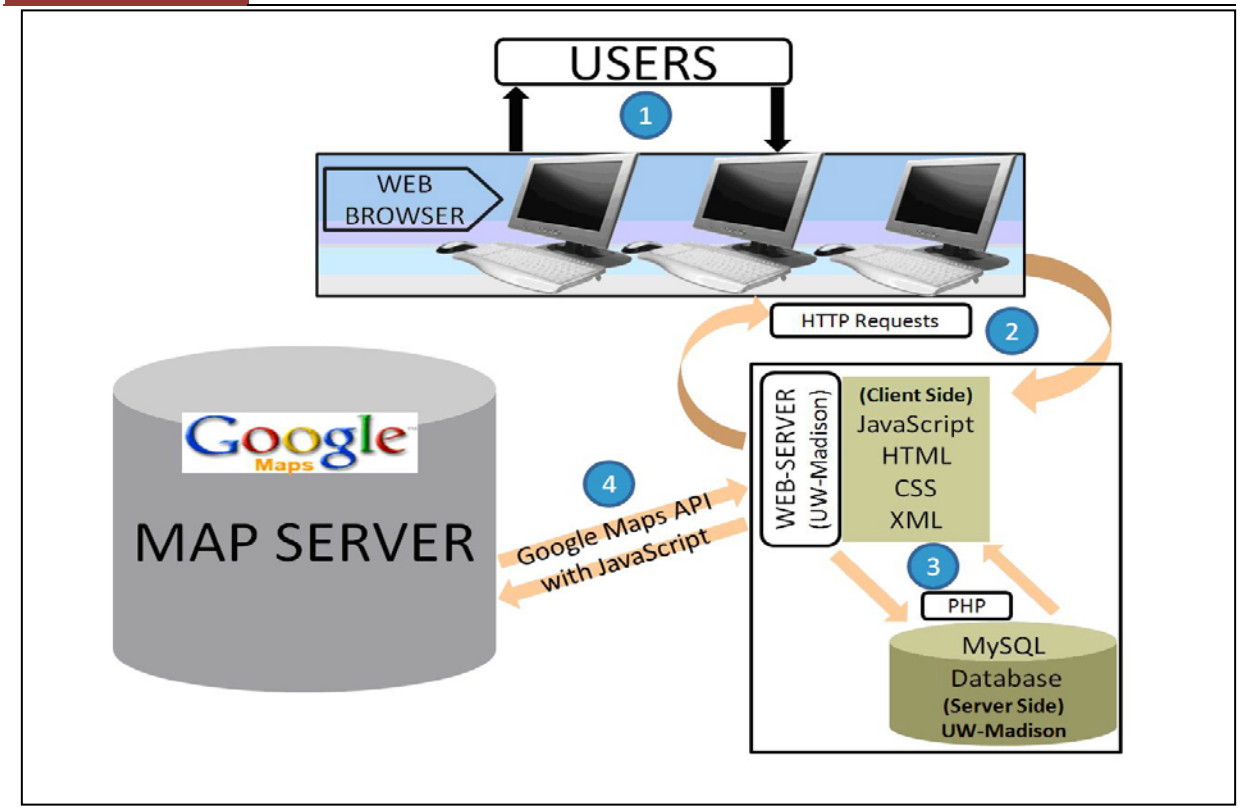
3.2 Technical Architecture

The web-map survey follows the two-tiered client-server architecture shown in Figure 4. The client makes a service request and the server fulfills the request. In this case, the client side (e.g. internet users) is enabled with a web-browser. The server side is composed of a MySQL database and a virtual host on a web-server.

The client side is implemented in Hyper Text Markup Language (HTML), Cascading Style Sheets (CSS) and JavaScript. HTML code prepares content for the survey respondent's web-browser. CSS are used for formatting and layout of the pages. JavaScript is used to implement the routines for supporting user interactions on the web interface. A major part of the JavaScript entails importing classes from the Google Maps API to incorporate Google Maps features and embed them in the web-interface.

The server side of the map-based survey tool involves Hypertext Preprocessor (PHP) code and database tables. PHP code interacts with the database in two ways. First, it queries the records based on user-defined criteria. User-defined criteria are actually the values entered into the web-interface. HTML is used to read and then send user input values to PHP files. The code written in PHP files prepares and executes database queries and then sends results back to the client side. JavaScript on the client side and PHP on the server side cannot interact with each other directly for data transfers. Thus, values retrieved from the database cannot be directly sent to the JavaScript. In order to transport data retrieved from the database, the research team used Extensible Markup Language (XML). PHP outputs XML, which is read by the JavaScript and displays queried records on the client's interface[25]. The second way PHP interacts with the database is to insert data. PHP is used to take the values from the interface using the JavaScript and HTML and insert them into the database. This does not require writing XML code because HTML can be used to send the values to PHP and in turn to the database, but HTML cannot be used to receive the data from PHP[26].

The database plays an important role in collecting and storing the information obtained from the survey. The user operates through a web browser session running on the client's computer, and without the database, all information would be lost when the session was closed. To store the session information, users are authenticated with a login and password, which connects the client's browser session to the database. During a session, the user's information is passed to the web-server through PHP and is saved to the database. The database saves the spatial locations of truck parking problems and answers to related questions about problem locations, frequency and severity in database tables. These tables were later exported for analysis.



1. Users interact with the survey tool at the web-browser interface.
2. Hypertext Transfer Protocol (HTTP) requests are sent to the web server at UW-Madison to load the page which uses HTML, CSS and Google Maps API with JavaScript (i.e. the login password form followed by general questions, instructions and map page and interactive features).
3. The Web server interacts with the MySQL Database using PHP to send login password information and save answers to questions.
4. The Web server simultaneously interacts with the Google Maps server to retrieve the map and its interactive features.

Figure 4: Functional Design of the Client Side Interface

In order to provide access only to people relevant to freight operations, the survey interface had to be secured using login password authentication. The task required users to be able to create their own login password and then use the same during the survey session. This also facilitates users to complete the survey in multiple accesses. They can access the survey using their login password already created, see their responses from previous sessions and continue the survey from that stage. This also prevents biased responses since participants see only their own data and not data entered by others.

3.3 Inventory of Parking Facilities on Interstate Highways of the MVFC Region

One of the goals of this research is to identify parking locations where new or expanded facilities are needed, along with the operational issues causing those needs. This requires developing an inventory of truck parking facilities in the ten states for comparison with data obtained from the survey. This inventory includes the following data elements:

- Major privately owned truck stops and public rest areas located along the Interstate highways in the 10-state region, and
- Site location data, including city, state, zip code, route number, travel direction and milepost number,
- Physical characteristics of the facilities, such as the number of truck parking spaces, and
- Facility amenities such as food service, showers, restrooms, scales, and repair facilities.

The development of the inventory also required information about public rest areas, commercial truck stops and travel plazas with overnight parking. The primary data sources used to obtain this information include:

- State DOT websites, which were complemented with a telephone survey to quantify locations, facilities and the number of public rest areas
- The online Dieselboss Truck Stop Locator Directory[27] along with the Truckers' Guide[28] 2007, to get information about commercial truck stops and travel plazas
- Google Maps satellite imagery, and
- Microsoft (MS) Live Search Maps satellite images and bird's eye view images.[29]

One challenge in developing the inventory was recording spatial information about parking areas. This was accomplished using the Google Maps online digitizer tool[30]. This tool can be used to find a location on a map and generate the associated latitude and longitude coordinates. Using information from the abovementioned data sources, a parking facility can be approximately located with the Google Maps online digitizer tool and then accurately located using the interactive map features, satellite images and MS Live Maps bird's eye view images. A parking location can then be stored in the database along with its spatial information and attributes, such as the amenities available at that location. All the parking locations were entered into the MySQL database using the above procedure.

This inventory contains 7,323 parking spaces at 271 rest areas along the interstate highways and 46,648 parking spaces at 471 privately owned truck stops in the 10-state region. All public rest areas were included, even those with no truck parking spaces, and private truck stops with as few as ten spaces were included. The highest number of spaces at a single public rest facility was 226 spaces at a public rest area in Kentucky, while there were as many as 375 spaces at private facilities in Indiana and Ohio. The numbers of facilities and spaces for each state are summarized in Table 11 and Table 12. The "Rest Areas" column lists the number of public rest areas identified in each state, and the "Parking Spaces" column lists the total number of parking spaces at those facilities. These numbers do not match the values reported in FHWA's *Study of Adequacy of Parking Facilities*, which was completed in 2002[31]. The total number of rest areas in the 2008 inventory is 56 percent of the number reported in the 2002 FHWA report. A possible

reason for this difference could be that some rest areas have closed due to a lack of funds for maintenance. Also, available data sources do not always precisely express the number of parking spaces available at truck stops, and this information is not available in the Truckers' Guide, which lists a range for parking spaces at each facility (i.e. small means 0-10 spaces, medium means 20-50 spaces, and large means 50 or more spaces).

Table 11: Inventory of Public Truck Parking Facilities on Interstate Highways in the MVFC

	Public Rest Areas			
	FHWA 2002		CFIRE 2008	
	Facilities	Parking Spaces	Facilities	Parking Spaces
IA	54	1267	23	644
IL	52	2430	22	760
IN	38	805	25	767
KS	29	455	19	348
KY	44	990	27	998
MI	75	1570	49	1074
MN	40	535	30	477
MO	35	620	19	645
OH	98	1405	46	1159
WI	23	652	11	451
Total	**488**	**10729**	**271**	**7323**

Table 12: Inventory of Private Truck Parking Facilities on Interstate Highways in the MVFC

	Privately Owned Truck Stops			
	FHWA 2002		CFIRE 2008	
	Facilities	Parking Spaces	Facilities	Parking Spaces
IA	125	4,962-9,602	38	3,395
IL	120	7,972-14,529	52	5,870
IN	65	2,994-5,209	71	7,575
KS	55	2,209-4,383	24	1,880
KY	80	3,745-7,186	43	4,210
MI	90	2,925-6,147	34	3,325
MN	60	2,200-4,503	27	2,145
MO	140	6,468-12,272	75	7,120
OH	135	11474	64	7,145
WI	80	2,863-5,971	43	3,983
Total	**950**	**47812-81273**	**471**	**46,648**

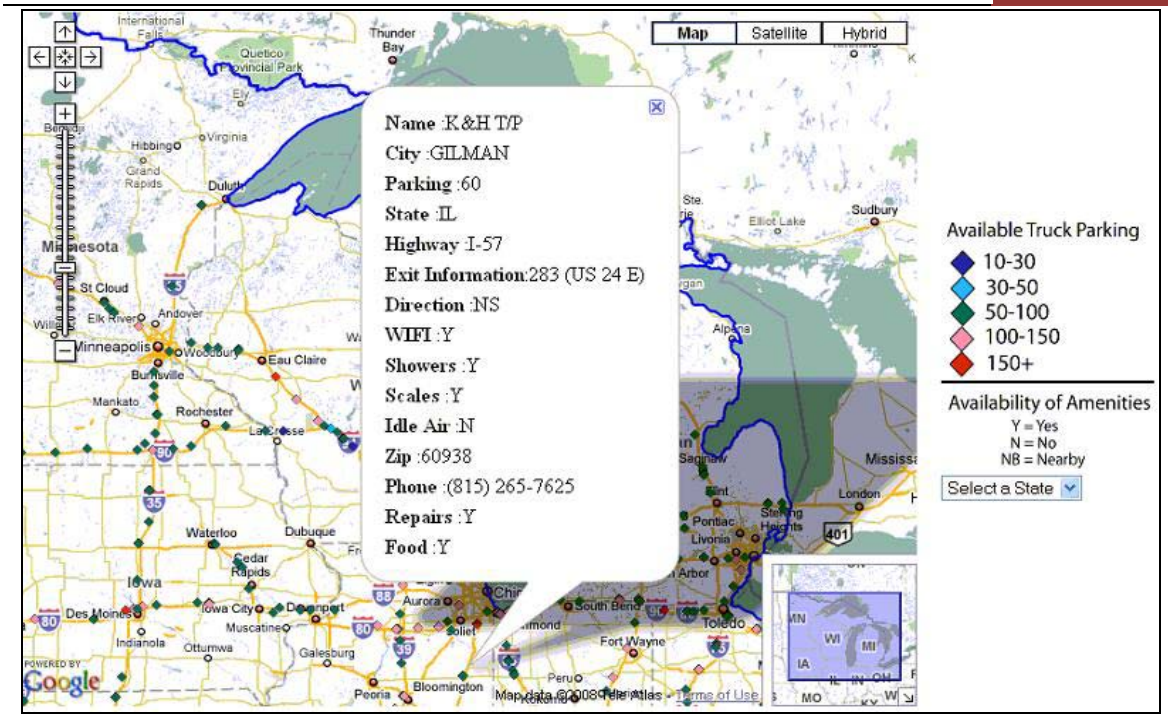


Figure 5: Screenshot of Private Truck Parking Facilities Visualization Tool

In an effort to visualize the major private parking facilities in the 10-state region, a Google Maps-based tool was developed. Figure 5 shows a screenshot of this tool.

Chapter 4. SPATIAL ANALYSIS OF TRUCK PARKING NEEDS

4.1 Objectives of the Analysis

The goals of this research are to understand and analyze trends in truck parking and to identify 1) where new or expanded facilities are needed, 2) what operational issues are causing the need for parking, and 3) low-cost solutions to truck parking problems in the MVFC region. Furthermore, this research makes parking information available to freight professionals, and provides spatial information necessary for states to consider increasing short term truck parking availability in priority locations and identify the most important characteristics needed at new facilities.

All of the location specific data collected through the survey was first cleaned and edited for spatial errors, and then exported to ArcGIS Desktop for spatial analysis. The survey instrument has technical limitations due to the web-based GIS, which introduces errors due to the resolution of the gathered spatial information. Imprecise placement of markers by survey participants also introduces error. These errors needed to be corrected before the locations of the parking facilities could be accurately determined. The inventory of existing truck parking facilities that was developed facilitated the cleaning process, as the research team was able to match the marked facilities with existing ones. Other data required for the spatial analysis, such as geospatial information for transportation modal networks and intermodal terminals and related attribute information, was taken from the National Transportation Atlas Database (NTAD) 2006.

The spatial analysis portion of the study aimed to determine specific locations in the MVFC region experiencing parking issues and prioritize these locations based on the frequency and severity with which parking issues are experienced. The spatial analyses included 1) a cluster analysis of incommensurate truck parking facilities, 2) a correlation analysis of existing truck parking facilities and parking problem spots, and 3) a determination of priority interstate corridors and locations in the region that are experiencing truck parking issues. The locations of parking facilities were clustered using a Nearest Neighbor Hierarchical (NNH) clustering algorithm in the software tool 'CrimeStat III'[32].

The spatial results indicate that Interstate corridors, cities and their outskirts, and suburban areas are suffering from truck parking issues. The comprehensive geographic results of these analyses were disseminated over the Internet via another Google Maps visualization tool. The visualization tool can enhance the communication and involvement of transportation stakeholders by providing an overall picture of the parking situation in the region, which can be used to identify patterns and compare various cities and states.

Analysis of responses to questions that are location-specific produces results regarding the characteristics of existing facilities, the possibility of expanding these facilities, and whether any new facilities are needed. Responses from the three participant groups differ according to their role in the transportation industry and the precision of their marked locations. The research team found that categorizing information based on these groups and carrying out group-wise statistical analysis led to better conclusions.

A few surveys were found incomplete, as the participants quit after answering general questions on truck parking. These partial responses have useful information on general characteristics of truck parking in the region and were used in the analysis along with the complete survey responses.

4.2 Data Cleaning

Cleaning the data from the survey served two purposes. First, the data was subject to errors in terms of the spatial location of markers. Because respondents recall the locations of truck parking facilities based on highways, exit numbers or landmarks, there is always a possibility that the markers will not exactly correspond to actual truck parking facilities. Therefore, it was necessary to verify and correct each marked location. Second, the research team converted each marker's location into a linear reference along the highway so that the data can be overlaid with other linearly referenced highway attributes. Data collected through Google Maps contains latitude and longitude information for each marker, so it was necessary to attribute each marker with state, highway, and exit number or milepost information.

The truck parking inventory, Google Maps and Microsoft (MS) Live Maps satellite view and "bird's eye view" images were used to find a linear reference for each marker. Each marker was matched with the closest parking facility in the inventory. The locations of the markers were further corrected by using satellite images and bird's eye views, which made it possible to locate a truck parking facility possible up to a scale of 1.5 inch = 40 yards. An approximate geometric center of each truck parking facility was assumed to represent the latitude and longitude of that facility, with was generated using the Google Maps digitizer tool. Each marker was "snapped," or attached, to a truck parking facility.

During the process of snapping markers to existing truck parking facilities, linear referencing attributes for each marker were determined and recorded. Brief details for these attributes are mentioned in Table 13. The sketch in Figure 6 illustrates these attributes graphically.

Table 13: Linear Referencing Attributes Recorded for Each Corrected Marker

Attribute	Description
Highway	Interstate highway along which the truck parking facility is located.
State	Two letter state name abbreviation for the state in which the truck parking facility is located
Identifier 1	Access point for the truck parking facility in the cardinal travel direction. The possible values are exit, milepost or interchange
Number 1	Number of exit or milepost or interchange in identifier 1
Direction 1	Access direction for the truck stop in the cardinal direction. Possible values are N or E.
Identifier 2	Access point for the truck stop in the non-cardinal direction. The possible values are exit, milepost or interchange.
Number 2	Number for exit or milepost or interchange in identifier 2
Direction 2	Access direction for the truck stop in the non-cardinal direction. Possible values are S or W.

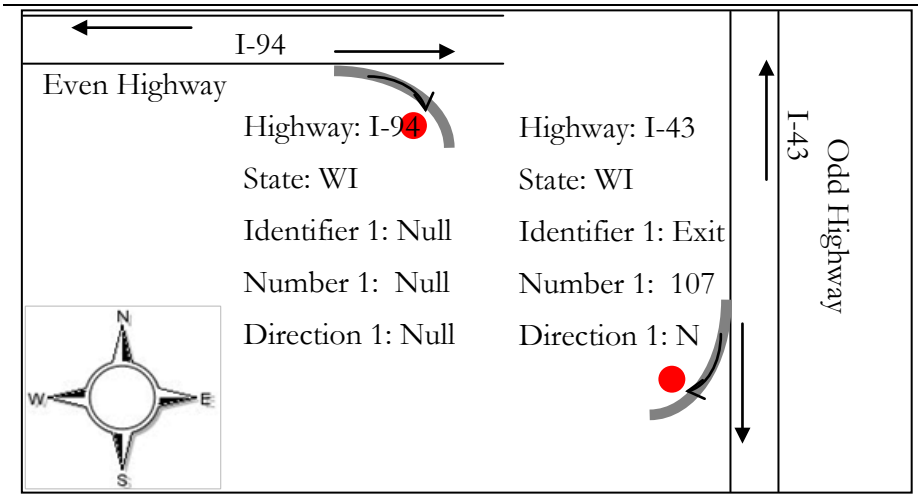


Figure 6: Sketch Illustrating the Recorded Linear Referencing System Attributes

Corrected and original latitudes and longitudes, along with the linear referencing system attributes, for each marker were stored separately for each group in database tables named *Locations_HP_Corrected*, *Locations_FP_Corrected,* and *Locations_TD_Corrected*, respectively.

4.3 Data Quality

Data collected in the survey potentially contain two kinds of spatial errors. The sources for these errors are resolution limits in Google Maps and imprecise locations of markers on the interactive map tool. Both of these errors were addressed before spatial analyses were performed.

Resolution

While placing a marker on a map, there could be two possible locations for markers due to resolution limits. These are related to the fact that markers are added to map pixels. The smallest possible distance between two probable locations of a marker would be equal to the resolution of the map at that zoom level. As mentioned previously in Chapter 3, the customized tool to add a marker is enabled at or above the 13th zoom level. This is to make sure that all the participants are presented with similar and higher scale maps while marking a location. However, depending on scale of the map at a particular zoom level, errors can be introduced in marking a location, so it is safe to assume that the lowest resolution corresponding to zoom level 13 is the maximum error. For a 19 inch monitor with monitor resolution of 1400 by 900 pixels, the scale for zoom level 13 is approximately 1:20,000.

The size of each pixel at 96 pixels per inch is 1/96 inches. The maximum error introduced due to the resolution limit equals 1*20,000 divided by 96 inches, which equals approximately 5.3 meters. Depending on the resolution and pixels-per-inch settings of the computer display, these errors might vary slightly.

Imprecise Location of Markers

After the data cleaning process was completed, the database tables *Locations_HP_Corrected*, *Locations_FP_Corrected* and *Locations_TD_Corrected* contained the locations of the actual truck parking facilities and the original spatial locations input by the survey participants. The location error for each marker was then calculated using the Haversine formula[33] which gives the distance between two points on the earth's sphere.

The average error calculated for all the valid markers is 1.13 miles. It can be observed that the error due to the resolution limits is negligible (5 meters << 1.13 miles) when compared to the error introduced by imprecise placement of the markers. The research team's spatial analysis process accounts for the latter error.

4.4 Visualization and Distribution of Survey Data

This section discusses how the results are organized and displayed in the system, both internal to the system manager and external to the relevant stakeholders. The web-based survey tool is being used to collect and store locations with truck parking problems in the MV Region. In the tool's design, the research team purposely kept survey participants from knowing the input from others. In this way, each entry is not influenced or biased by entries from others. To meet part of the study objectives, this research makes the parking information available to freight professionals and provides spatial information necessary for the states to consider increasing short term truck parking availability at priority locations. Thus, the team measured the level of parking problems at each location after summarizing all survey results and disseminating the geographic results over the Internet via another Google Maps visualization tool. This tool can be accessed at http://mvfcpraveen.cae.wisc.edu/visualizer (see Figure 7).

Figure 7 shows 360 validated markers identifying locations with parking needs. This reflects responses collected during visits to four trucking conventions and by contacting planners and highway patrol officers via e-mail and telephone. Clicking on a specific marker reveals associated parking information.

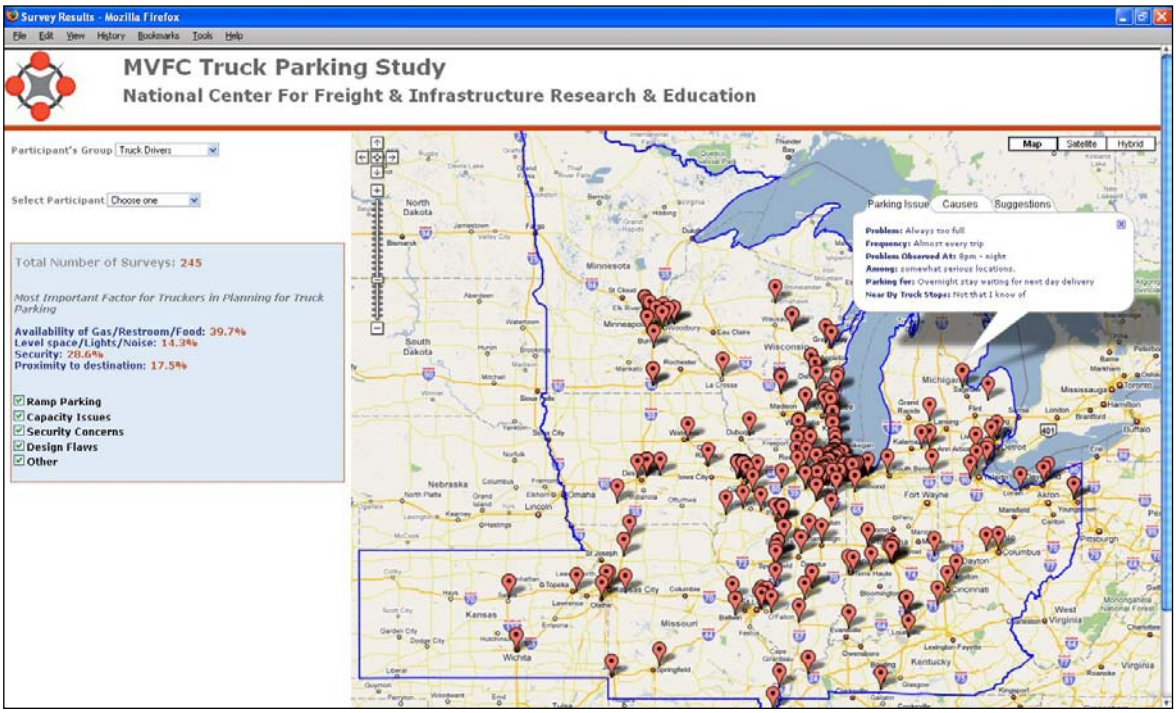


Figure 7: Screenshot of the Data Visualization Tool Interface

The key features of the analysis and visualization tool include:

- Visualization of all problematic truck parking locations collectively;
- Categorization of locations based on participant group (i.e. highway patrols, freight planners and truck drivers, each being from a particular jurisdictional area);
- The ability to filter locations by participant (i.e. choosing a particular user name and seeing that user's information, the answers to general questions and all the locations marked by that user only);
- The ability to show derived results from answers to general questions for each participant group (e.g. the priority factors for truck drivers when looking for a truck parking facility);
- Sorting locations for a specific participant group based on parking problem type (e.g. show all the locations of ramp parking marked by highway patrol officers); and
- Showing parking issues, causes and suggested solutions identified by participants in pop up windows on markers.

4.5 Spatial Distribution of Data Collection Locations

Google Inc. offers a free service called Google Analytics[34] that generates detailed statistics about who visits a website. This requires adding the Google Analytics Tracking Code (GATC) as a snippet of JavaScript code in the website's first page. This technology is able to provide approximate estimates on web statistics, though it does have some limitations[35]. Some statistics on the use of the survey are discussed below.

The map in Figure 8 shows the spatial distribution of the visitors to the survey website. This distribution should not be confused with the spatial distribution of locations marked in the survey.

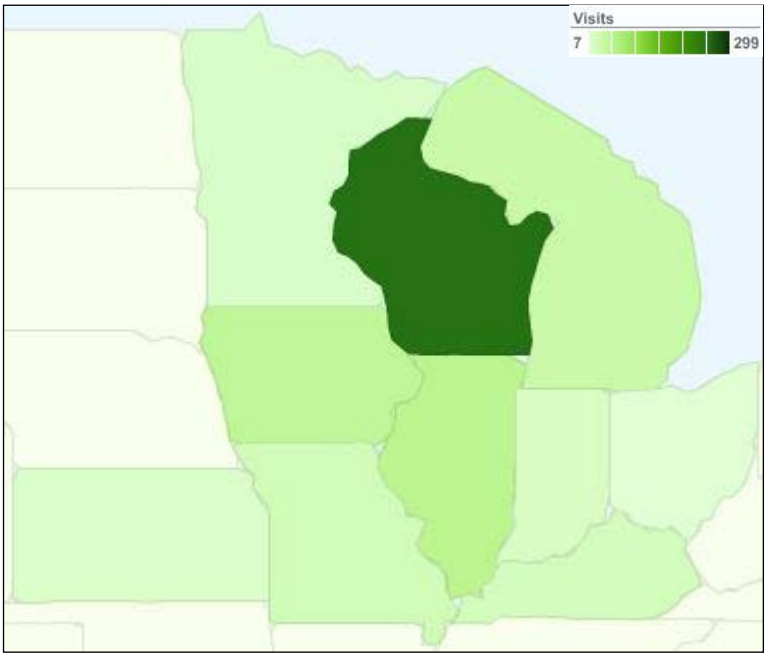


Figure 8: Spatial Distribution of Survey Access Locations

The survey was sent to stakeholders in the 10-state region, but it can be accessed anywhere. In addition, people can find the survey link through Google searches; however, the map in Figure 8 is refined for the –ten MVFC states. Most visits to the website are intentional, though some are random. Most visits are from Wisconsin, followed by Illinois and Iowa. The high number of visits reflects visits from CFIRE research staff in

Madison who were developing and testing the website and from the data collection efforts at the Peoria, Illinois and Walcott, Iowa truckers' events. The significant, though non-uniform, visits from other states in the region likely represent the responses from state planners, DOTs and state patrols.

4.6 Geospatial Analysis

Distribution of Parking Problems over the Region

Based on the responses to the survey questions, the truck parking issues that were reported have been classified in the following categories:

- Capacity issues, meaning that parking facilities are always too full to meet the demand for truck parking
- Not enough parking facilities around, meaning that the area in vicinity of these locations does not have enough parking facilities
- Ramp parking, which can occur under several circumstances:
    - There are not enough parking facilities around,
    - The parking facility always too full,
    - The parking facility is still available, or
    - Other reasons, such as the design of parking areas. For example, the characteristics of the industrial park in Kentucky at exit 29 on I-265 cause trucks to park and wait on ramps, while the food court area at the facility is too small and causes congestion.
- Closed facility, meaning that the facility is out of business
- Design issues, such as when parking spaces at a facility are too small for long trucks and or when bad design causes problems for trucks as they enter and exit
- Safety issues, which can include drug dealers and prostitutes
- Other issues, which can include bad maintenance, issues related to lighting and noise, and unused car parking areas at the facility

The map in Figure 9 shows the distribution and concentration of locations with the abovementioned parking issues across the region. It can be observed that truck parking facilities with insufficient capacity are spread over all the 10 states; however, their concentration tends to increase around Interstate interchanges and in and around major urban areas in the region.

Locations with ramp parking issues can be found close to incommensurate truck facilities and rest areas. Truckers tend to avoid the hassles at congested parking facilities by parking on nearby ramps. In some cases, however, truckers park on ramps for convenience. Occurrences of ramp parking when a parking lot is available demonstrate this behavior. On the other hand, in some cases, truckers are found parking on ramps because they have reached their legal driving limit (under HOS rules) and are unable to find available parking facilities nearby. Many such occurrences are observed in Kentucky along I-64 and the Western Kentucky Parkway and between Chicago, IL and Milwaukee, WI along the I-94/I-43 corridor.

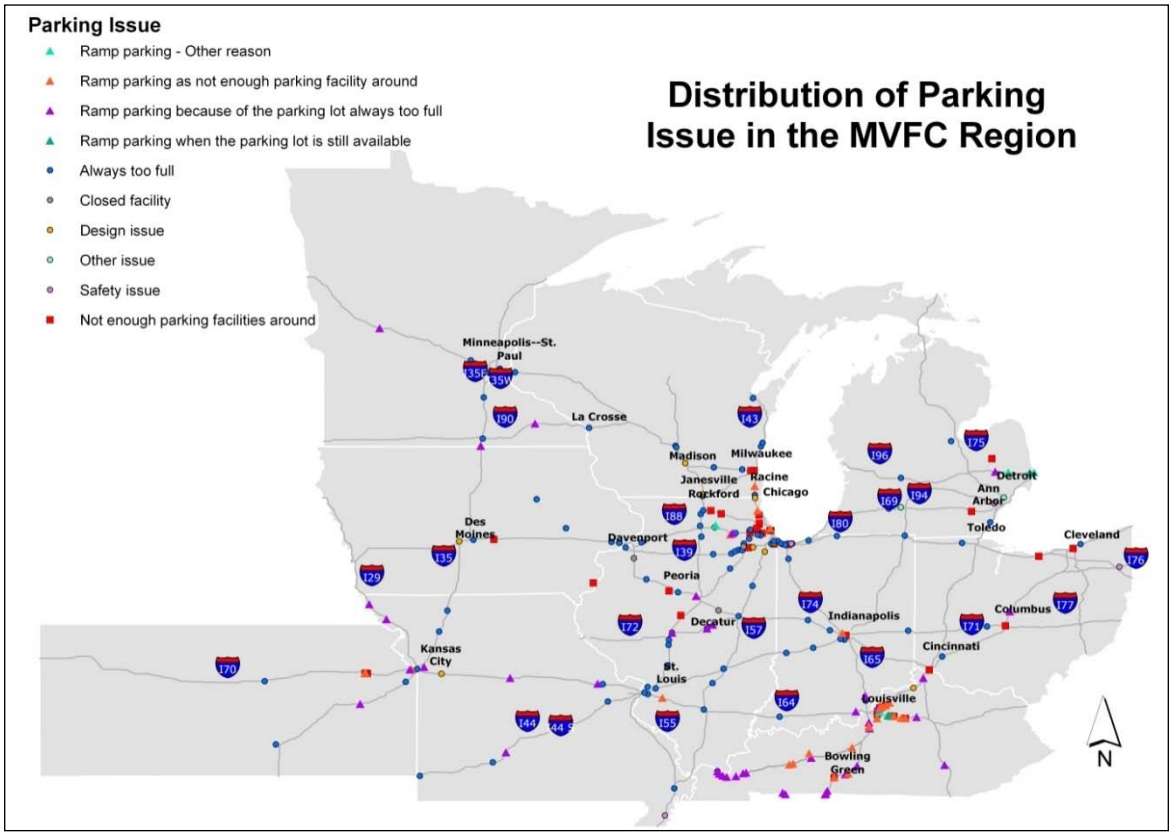


Figure 9: Distribution of Parking Issues in the MVFC Region

Far fewer parking facilities are observed as having safety and design issues. Safety issues tend to occur in and around cities. Truckers consider suburbs or rural areas to be safer. Narrow parking, not enough parking for longer trucks, and turning constraints are some of the reported design flaws. One trucker illustrated a design flaw at the parking facility in Minooka, IL (Milepost 122/I-80) in Figure 10. In this location, the path for trucks exiting after refueling goes between the parked trucks, which makes exiting both dangerous and difficult for drivers.

Several respondents did not tell us about problems at specific parking facilities. However, they were more concerned about the locations where they were unable to find any truck parking facilities nearby. A total of 45 such points were found in the survey. Such points are important when determining where to add additional parking facilities. Participants identified some closed rest area facilities in Illinois as contributors to the increased shortage of truck parking around the Chicago area.

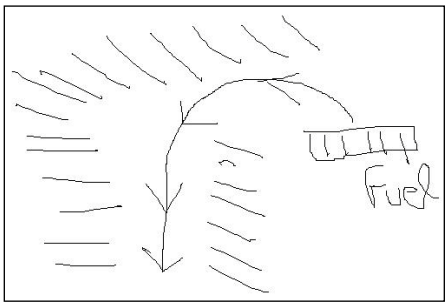


Figure 10: Design Flaw at a Truck Stop as Described by a Trucker

Several comments from truckers bring up issues such as bad maintenance, expensive food, poor lighting, excessive noise at some facilities and frustration about underused car parking at other facilities. Regarding underused car parking, it is important

to note that designated car parking areas at rest areas are not designed to accommodate the weight of trucks.

Clustering of Incommensurate Truck Parking Facilities

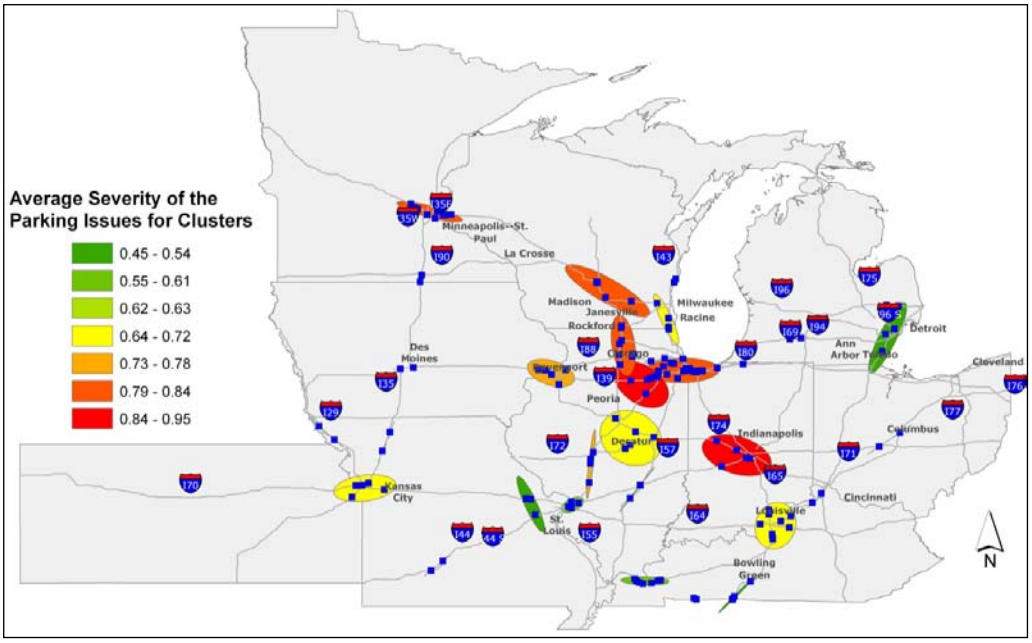
The purpose of this analysis is to determine priority locations with truck parking problems in the region. This analysis was carried out using the data points which had been matched to an existing facility and represented capacity issues at truck parking facilities.

Moran's I test was run in ArcGIS for all such points and the results indicated the dispersion of such points as 'clustered'. In order to create the clusters, the research team used the software tool 'CrimeStat 3.1'. CrimeStat is a spatial statistics program used to analyze crime incident locations and to provide supplemental statistical tools to aid law enforcement agencies and criminal justice researchers in their crime mapping efforts. The program is Windows-based and interfaces with most desktop GIS programs.

The Nearest Neighbor Hierarchical (NNH) clustering algorithm was used for the purpose of creating clusters. This algorithm tends to generate elongated clusters[36]. As this research aims to determine which Interstate corridors are experiencing truck parking issues, elongated clusters were more useful as they could be aligned with Interstate highways. A shortcoming of this method is that two clusters with quite different properties may be connected due to the existence of noise. However, if the clusters are separated far from each other, the NNH clustering algorithm works well. The research team expected the clusters to be found around the outskirts of various metro areas in the 10-state region, which are located far apart.

The clusters were mapped along with the parking facilities within the cluster area. Each parking facility was assigned a severity value based on participant data collected. The facilities that were identified by more than one participant were assigned an average severity value. In this way it was possible to calculate the average severity for each cluster and to classify them based on severity values. The map in Figure 11 shows this representation.

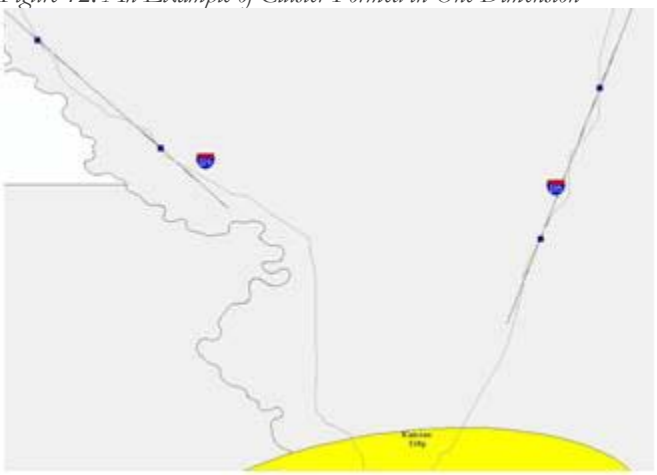
Figure 11: Clusters of Incommensurate Truck Parking Facilities in the MVFC Region



Locations in and around major urban areas were found to have the most severe parking shortages, which is understandable as urban areas are the zones with intensive trucking operations and with the most pickup and delivery operations. Clusters with high densities and severity values can be seen near Chicago and its suburban areas, which is intuitive as Chicago is the largest intermodal freight hub in the U.S. and the biggest hub in the Midwest region with intensive freight operations. Several Interstate highways, such as I-90, I-94, I-80, I-88, I-55 and I-57, converge and intersect in this zone, causing heavy inflow/outflow of truck traffic and in turn truck parking issues. Minneapolis-St. Paul, MN and its outskirts have also been observed as having serious parking shortages. Milwaukee, WI, Decatur, IL, Peoria, IL, Kansas City, KS/MO and Louisville, MO experience similar severity in terms of capacity issues at truck parking facilities. These cities are followed by other urban areas, including Detroit, MI, Des Moines, IA, St. Louis, MO and Columbus, OH.

Many of the cluster ellipses lie along the interstate and are not visible in Figure 11. For example the clusters along I-29 and I-35 near Kansas City can be seen at a higher scale in Figure 12.

Figure 12: An Example of Cluster Formed in One Dimension



Locations with Insufficient Parking

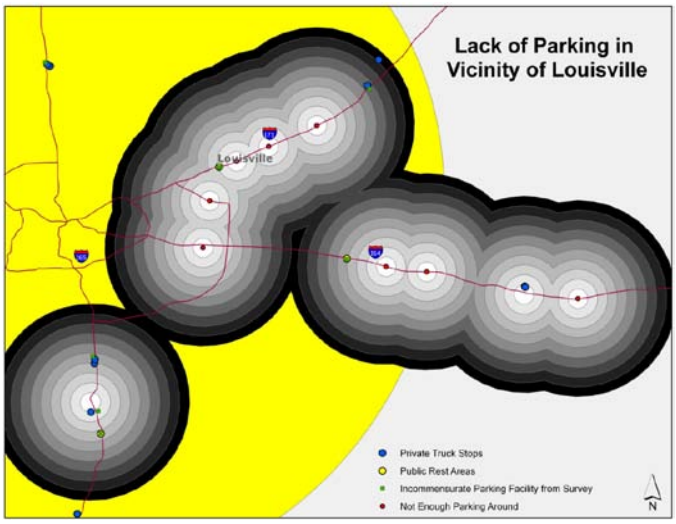
Table 14: Public Rest Areas and Private Truck Stops within Buffers of Locations where Parking Is Needed

Buffer Mile	Public Rest Areas	Private Truck Stops
1	0	0
2	1	2
3	2	3
4	2	6
5	**4**	**8**
6	5	13
7	5	17
8	5	23
9	5	23
10	**8**	**25**

Several respondents told us about locations without truck parking nearby. A total of 45 such locations were identified in the survey and are shown in Figure 9. Buffers that incrementally increase by one mile were drawn around each location. The combined total number of public rest areas and private truck stops lying in the buffer zones are listed in Table 14. It is evident from this analysis that there are few truck stops at some locations across the 10-state region. Adding new truck parking facilities at such locations may significantly resolve truck parking issues.

Figures 13, 14 and 15 show the buffer zones for locations with insufficient parking in the vicinities of Louisville, KY, Chicago, IL, and Indianapolis, IN.

Figure 13: Locations in the Vicinity of Louisville with Insufficient Truck Parking



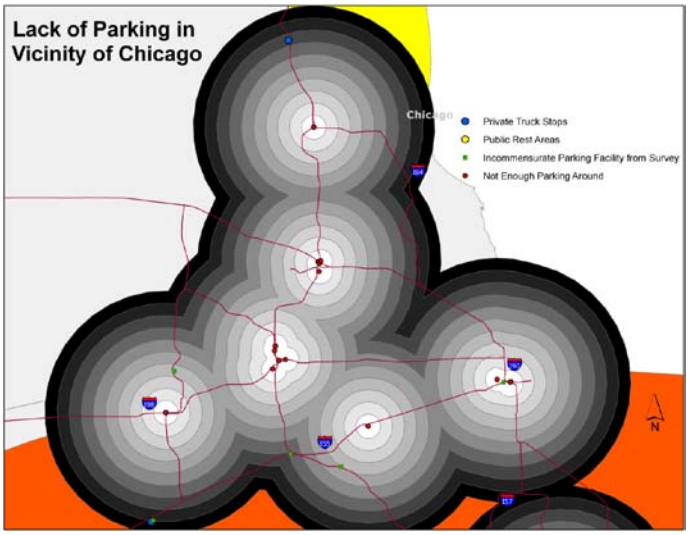
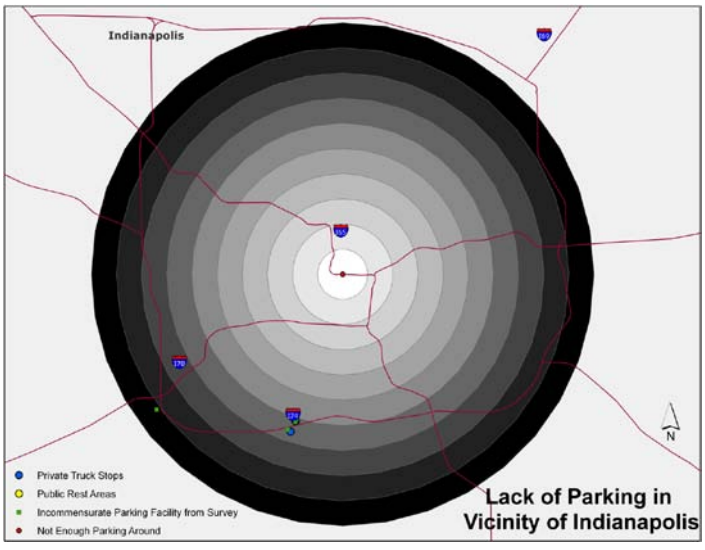


Figure 14: Locations in the Vicinity of Chicago with Insufficient Truck Parking

Figure 15: Locations in the Vicinity of Indianapolis with Insufficient Truck Parking



Interstate Corridors with Parking Issues

This analysis determines the Interstate corridors suffering from truck parking issues in the 10-state region. The map in Figure 16 highlights sections of Interstates with various truck parking problems. The color coding represents the severity of the issue for that section. Severity is determined using the density of markers along Interstate highways.

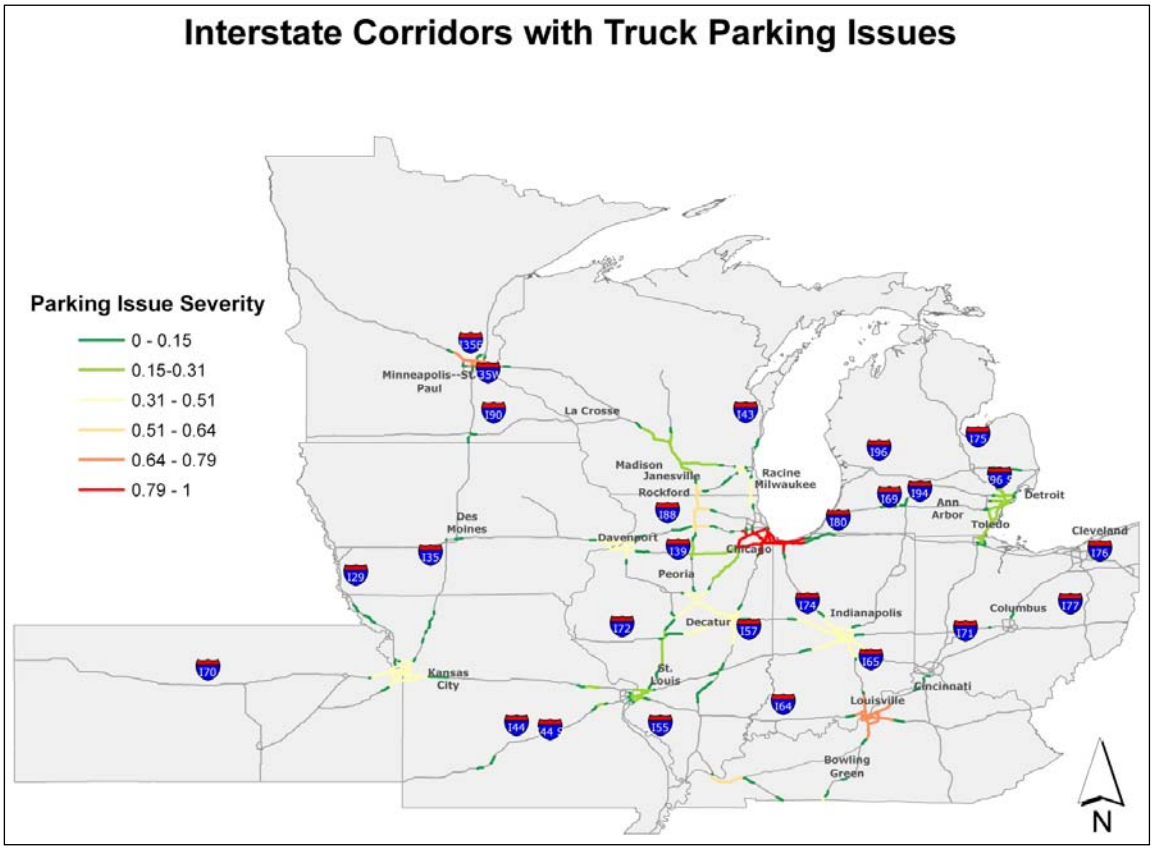


Figure 16: Interstate Corridors with Truck Parking Issues in the MVFC Region

The map shows that the I-94 corridor that connects Minneapolis/St. Paul to other cities, I-90 and I-43 in Wisconsin, and I-94 to Milwaukee, WI has several problematic parking locations. This makes sense as I-94 supports heavy truck flows between Minneapolis/St. Paul, MN and Chicago, IL and Detroit, MI because of the manufacturing and agricultural economic activities in those states. I-96, I-75 and I-94 near Detroit, I-71 near Columbus and Cincinnati, OH, and I-90 near Cleveland, OH are minor trouble corridors. I-65 and I-70 are vital north/south arteries, and so the segments of I-70 near St. Louis, MO and I-65 and I-70 near Indianapolis, IN, along with I-80 and I-94 in Indiana near Chicago, have parking issues. In Illinois, interstate corridors to Chicago have serious parking problems. I-35 near Kansas City, KS/MO and I-80 near Des Moines and Davenport, IA in also have parking problems. I-80 serves as a vital east-west link across the U.S. and is expected to have heavy truck traffic[37].

The Upper Midwest region is much more dependent upon manufacturing and by extension, freight mobility, than the nation as a whole. In the years between 1992 and 1997, the Midwest's percent growth in manufacturing employment outpaced every other region in the nation[38]. The upper Midwest region is also largely dependent upon agriculture. Every state in the region is ranked as one of the top ten corn producing states in the nation, while five are ranked as one of the top ten soybean producers. Thus, Interstate maps show a high concentration of east-west truck traffic across northern Illinois, Indiana, and southern Wisconsin. Very heavy north-south flows extend across Indiana and Ohio. Chicago, IL and Detroit, MI serve as hubs for these flows.

4.7 A Few Examples of State Level Analysis

This analysis gives a detailed picture of the geographic spread of locations with parking issues in each of the 10 states. It provides these states with important information about truck parking facilities which should be considered when resolving existing issues and planning for additional facilities.

Minnesota

Three interstates - I-35, I-90 and I-94 - traverse Minnesota. I-94 and I-35 come together at the outskirts of Minneapolis/St-Paul, which has the most parking issues in this state. The primary issue is related to the capacities at Minneapolis/St Paul-area truck parking facilities. I-94 has heavy truck flows between Minneapolis/St. Paul and Chicago because of manufacturing and agricultural activity in Minnesota and Illinois. Truck flows between Minneapolis/St. Paul and Des Moines, IA, on I-35 aggravate the problem at the outskirts of Minneapolis/St. Paul. Overnight ramp parking occurs near rest areas that are overfull. The map in Figure 17 shows these results.

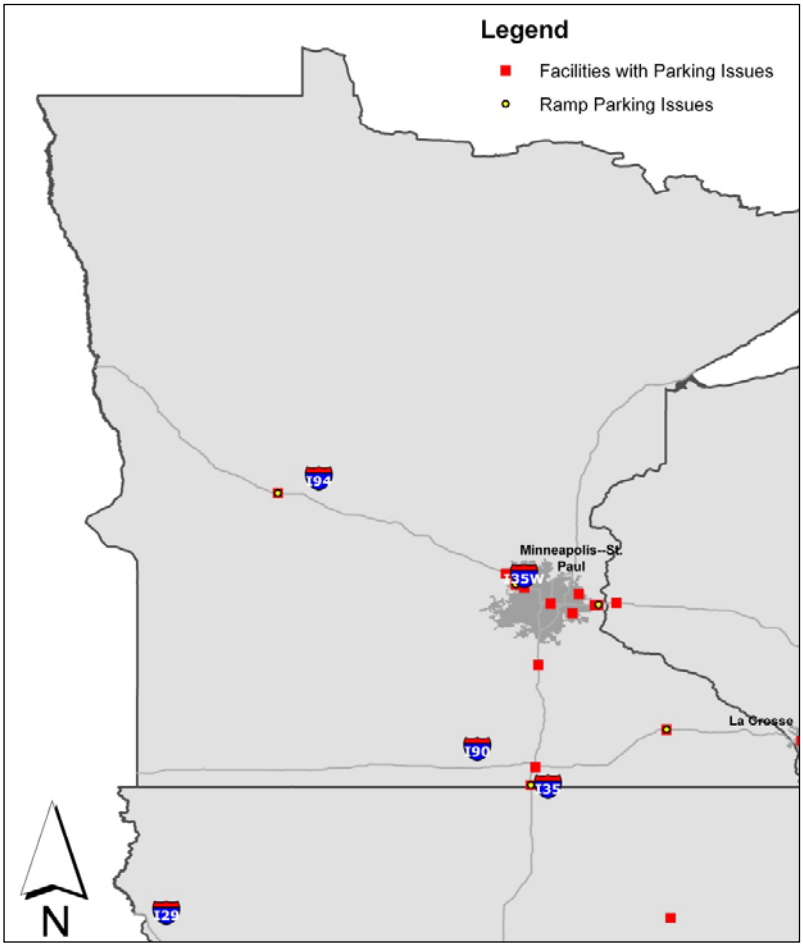


Figure 17: Parking Issues in Minnesota

The survey results were compared with results of an interstate truck parking study conducted by Mn/DOT (see Section 2.5 of this report). Both studies give similar results.

The Mn/DOT study ranked truck parking facilities based on the number of times facilities went over their capacity. Most of the severe facilities determined in this way are the locations that exceed their capacity at least 50 percent of the time. They are found at MP 222/I-90, MP 105/I-94, MP 215/I-94, MP 256/I-94 and MP 1/I-35. The Mn/DOT study identified occurrences of ramp parking because parking facilities were full and drivers needed to park per the HOS rule.

Kentucky

Kentucky is served by five major Interstate routes, which are I-24, I-64, I-65, I-71 and I-75. These routes connect Kentucky to the rest of the nation and most of the major cities within Kentucky with each other. I-75 and I-65 are the state's busiest highways; they connect Kentucky to the Great Lakes region and to the southern states. I-64 connects Kentucky to points east and points west. I-71 connects Kentucky to the Northeast, and I-24 connects far western Kentucky to the St. Louis, MO area to the northwest and Nashville, TN to the southeast[39]. The map in Figure 18 is truncated to highlight specific areas and thus only shows three Interstates.

The survey results in Kentucky showed that there were many locations with insufficient parking facilities. The map shown in Figure 18 focuses on occurrences of ramp parking issues close to such facilities. Some of these ramp parking issues are the result of overflow at the rest areas. However, the majority of them are caused by truckers being unable to find any parking facilities while driving on the Interstate. This map shows potential locations in Kentucky where additional parking facilities can be added to reduce parking shortages.

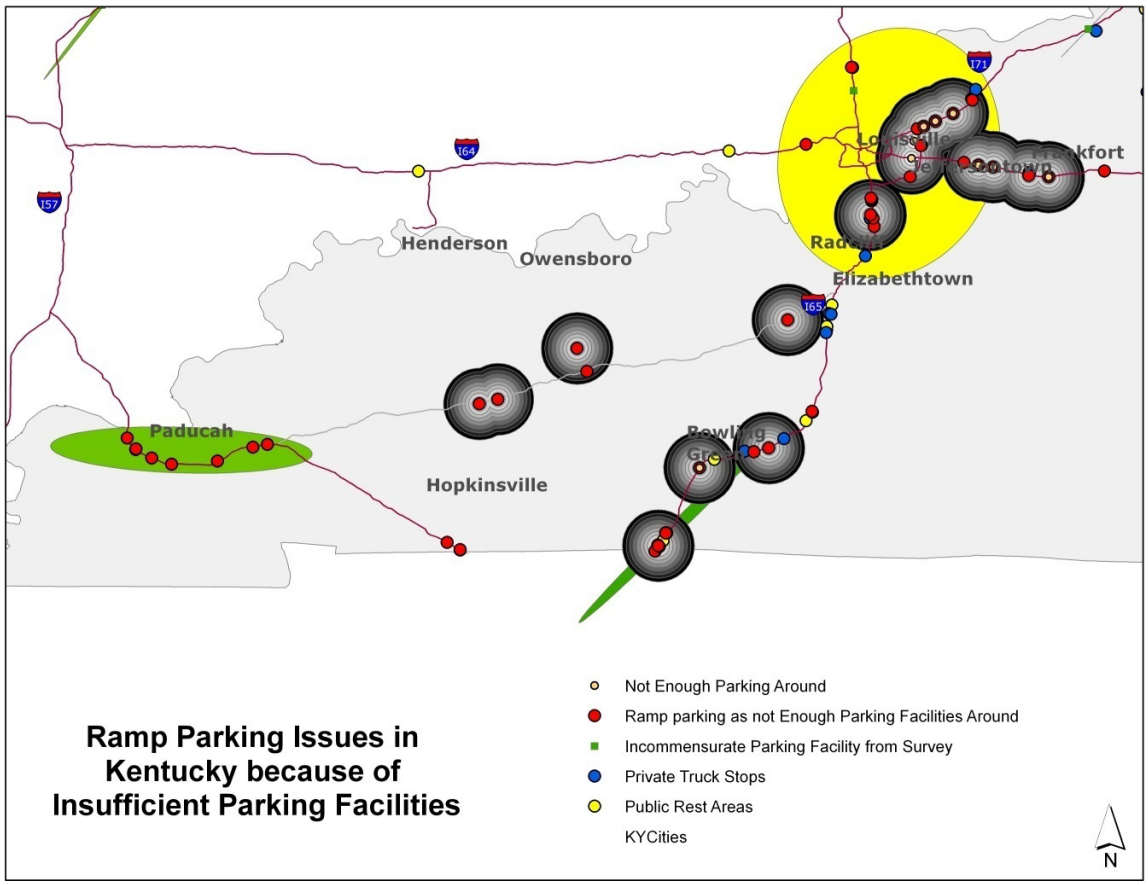


Figure 18: Parking Issues in Kentucky

4.8 Characteristics of Problems at Incommensurate Parking Facilities

The chart in Figure 19 shows the distribution of parking problems among respondent groups. The majority of respondents find parking lots 'always too full'. About 50 percent of respondents from the state patrol and freight planners groups indicate ramp parking problems in the region. However, this data may be biased, as most of the ramps parking issues were reported by highway patrol officers and freight planners; whereas the distribution of participants is inclined towards truck drivers. Locations that do not have enough parking facilities around are reported by the truckers and freight planners groups only. These responses can be used to determine the locations where additional facilities can be added in order to resolve the capacity issues frequently reported in the survey. Truckers, being the end users of truck parking facilities, knew best about issues such as design flaws in parking lots, security concerns, insufficient space for long trailers, maintenance of lots and problems of drugs and prostitution.

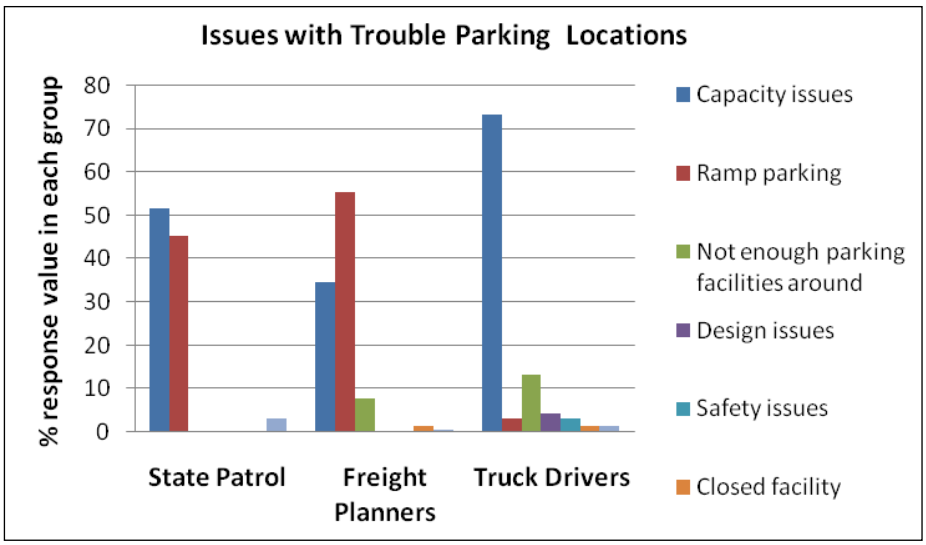


Figure 19: Issue Types at Incommensurate Parking Facilities

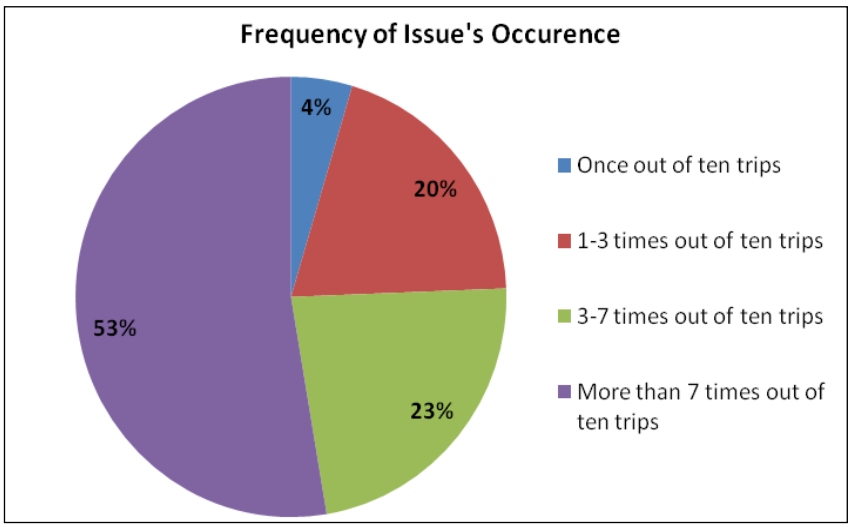


Figure 20: Frequency of Problems at Incommensurate Parking Facilities

The frequency of occurrences of problems at incommensurate locations was collected from truck drivers, as they are regular users of parking facilities. Their responses show that 53 percent of drivers experience problems in more than 70 percent of their visits to that location (see Figure 20). This implies the problems are persistent.

Along with the frequency of problem occurrences, truckers were asked to mention the time of day during which they experience these problems. As shown in Figure 21, the responses to this question clearly show that parking facilities are most crowded between 9 pm and 5 am. This happens because most of the truckers are resting/sleeping at night, which causes huge increases in demand for truck parking spaces at night. The trend line shows problems decreasing in the morning after 9 am and then increasing again in the afternoon and through the night. Most truckers leave truck parking facilities early in the morning; therefore a greater number of problems are seen before 9 am. The problems increasing after 12 noon and in the evening may be due to truckers coming into the parking facilities for lunch and dinner, respectively.

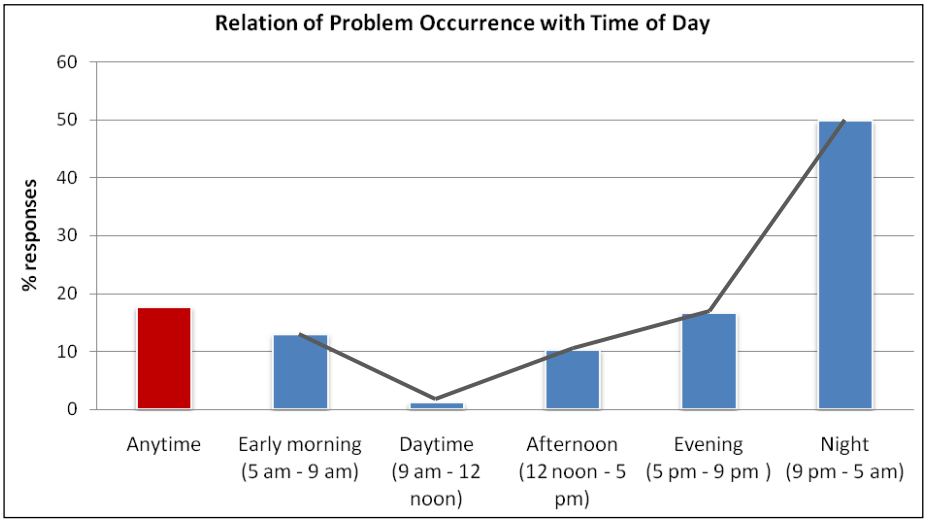


Figure 21: Relation of Problem Occurrence to Time of Day

One survey question asked why truckers park at problematic stops. This question allows participants to choose more than one reason. It is evident from the responses that truckers need to stop after reaching the maximum hours-of-service (HOS) limit. The lack of good facilities at truck stops affects truckers' long stays. A considerable number of respondents commented that daytime stays at truck stops while waiting for a delivery window is another important factor forcing them to stop at such spots. The distribution of these reasons is shown in Figure 22. Other reasons include needs for restrooms, food in transit, showers, truck cleaning, and fuel.

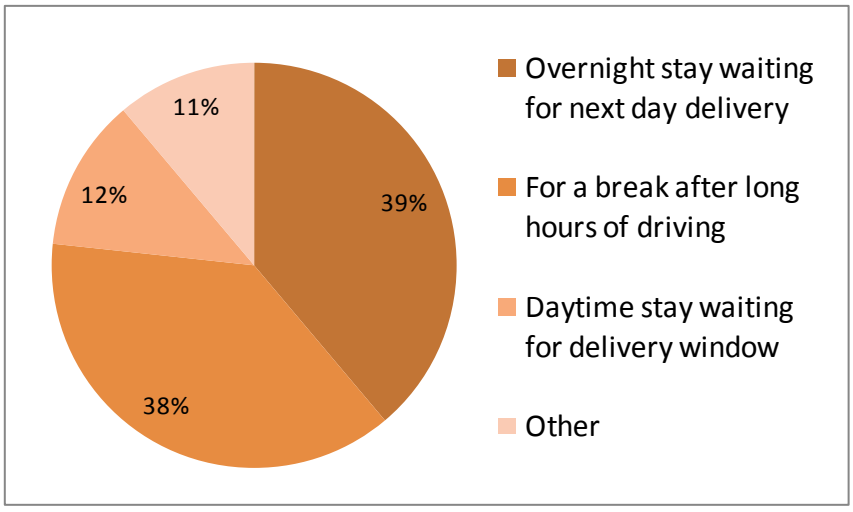
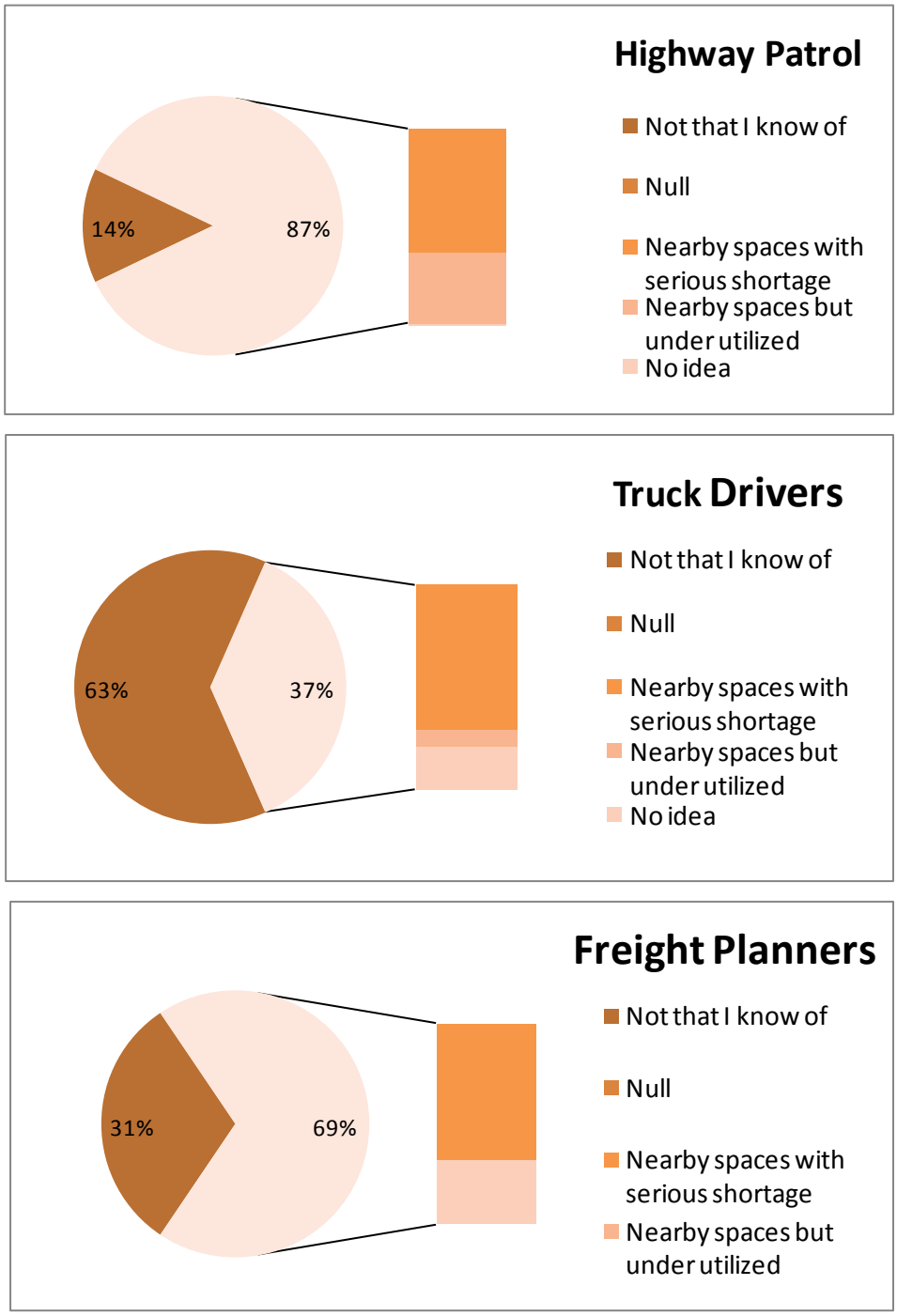


Figure 22: Reasons Forcing Truckers to Park at Incommensurate Facilities

The next question investigates the alternatives available to truckers for avoiding certain facilities. The results show that most of the truckers either do not know about nearby truck stops or the nearby truck stops have

a serious shortage of parking spaces. However, the responses from truckers to this question are significantly different the responses from the highway patrol and freight planner groups. The charts in Figure 23 compare these distributions. The comparison indicates that there is a possible lack of information for truckers about available truck parking facilities. If truckers are made aware of available nearby spaces, they can avoid parking at an already full stop and reduce further congestion there.

Figure 23: Awareness of Nearby Truck Stops for Each Participant Group

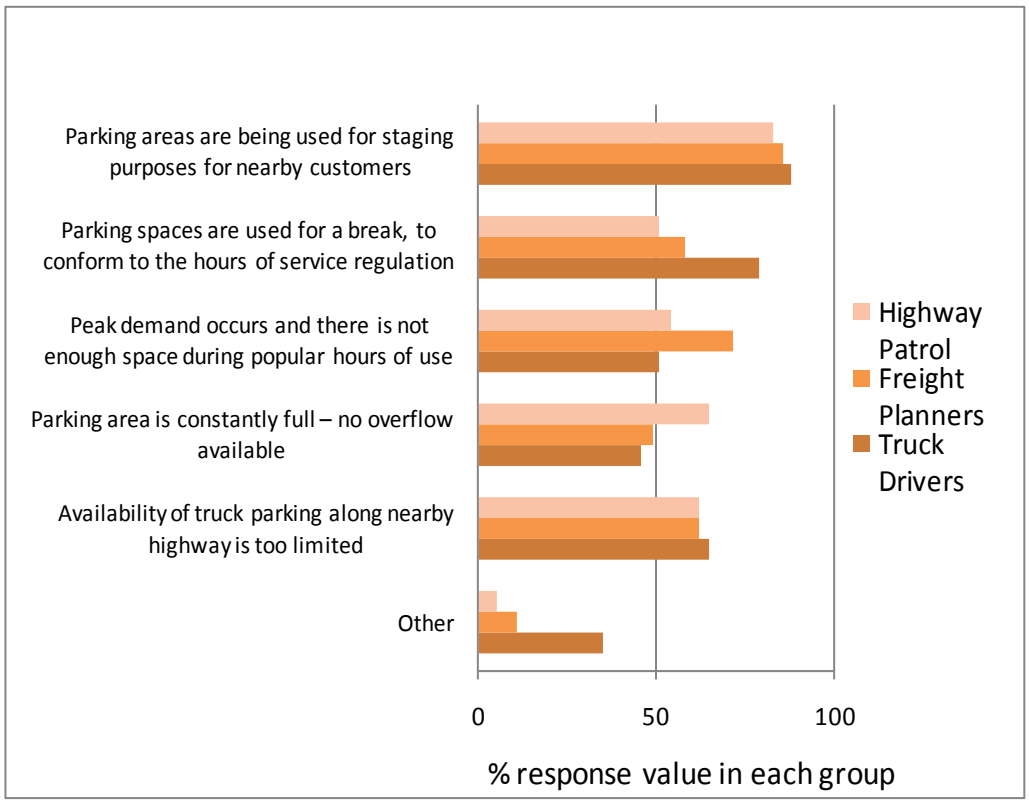


A subsequent question gathered information about the factors causing parking problems at locations marked by various participants. Users were allowed to choose more than one option to answer this question. The responses are shown in Figure 24. Other reasons mentioned in this context are 'security concerns', 'unable to handle traffic', 'bad maintenance' and 'bad stripes design'.

At the end, the survey sought suggestions from respondents for solving truck parking problems. Users were allowed to choose more than one of the predefined responses shown in Figure 25. Suggestions include:

- Encouraging private investment and expansion of truck stops,
- Using GPS with truck parking information,
- Using 511 services,
- Improving safety,
- Allowing more flexibility in hours of service,
- Reopening closed rest areas,
- Establishing new truck parking in the area,
- Designating short term parking nearby, and
- Adding signs to tell about nearby parking locations.

Figure 24: Potential Reasons Causing Parking Issues



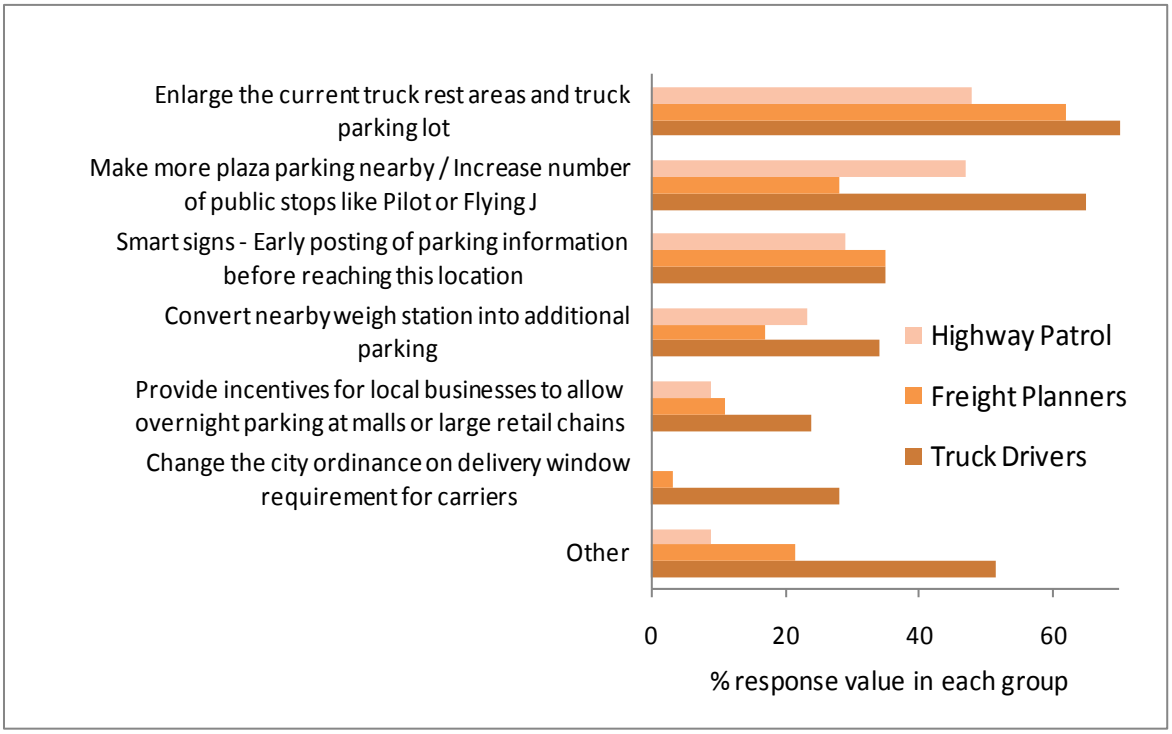


Figure 25: Low cost Solutions Suggested by Survey Participants

In response to the question regarding how parking problems were brought to the attention of freight planner groups, the majority of reports come from state patrols, DOT inspection or surveys, and personal observations. In fewer cases, they are reported either by private agencies or the general public. The chart in Figure 26 shows this distribution.

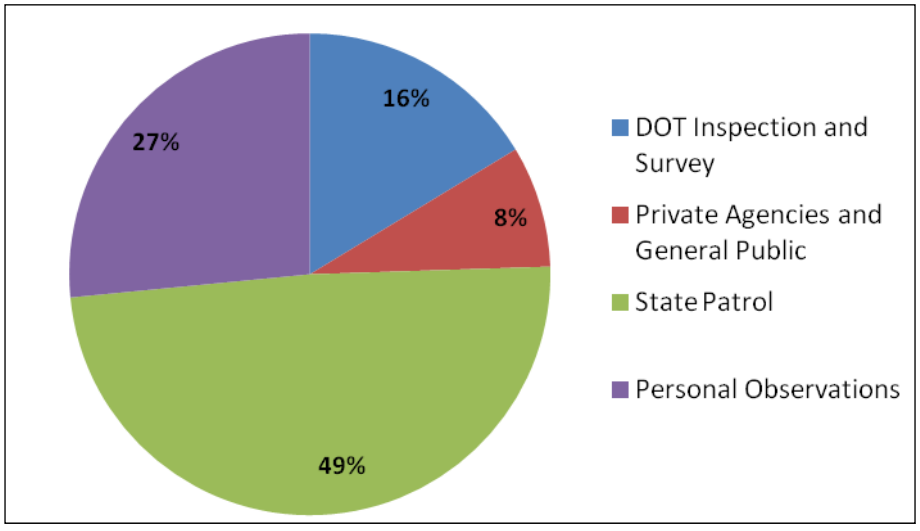


Figure 26: Sources of Parking Problem Notification for Planners

Several other observations from the analysis of the responses to questions on truck parking include the following:

- About 14 percent of highway patrol officers give tickets if they see ramp parking or illegal parking. The remaining 86 percent issue a warning or overlook ramp parking.
- The Majority of DOTs mention having insufficient funds to meet parking demand in their states.
- Approximately 54 percent of truckers need to park every 10 or 11 hours.
- Fifty-eight percent of all truckers like to park at locations at the outskirts of large cities.
- The most common method to get information about truck stop locations is to use truck stop guides, followed by CB radio, word of mouth, and their past experiences.
- CB radio, Sirius, XM, Satellite radios and past experiences are the sources to get information about traffic congestion.
- On average, truckers check these sources about 2.86 hours in advance to plan their parking.
- The most important factors for truckers in planning their truck parking are the availability of fuel/restrooms/food, followed by security and proximity to their destination.

Chapter 5. ISSUES IN TRUCK PARKING

5.1 Interviews at Truck Shows

The research team talked with truckers at several truck shows in the 10-state region. Each of the truck shows the research team visited represented some subtle variations between trucker populations. This finding is important because it illustrates the great variation in the types of truckers and the locations within which they operate.

The survey findings presented in this study are meant to illustrate the drivers' perceptions, and the comments in this report reflect the attitudes and the opinions of the drivers. It is important to note that each state is responsible for managing and maintaining rest areas and weigh stations and that practices across the survey region vary from state to state. Attitudes and perceptions are important to document, because in some cases, they do not represent the current standards, protocols or business practices. When perceptions diverge from specific practice, communication opportunities may in fact be the lowest cost solutions.

Walcott, IA

This show occurred in early July 2008 and was located just off I-80 on a primary east –west long haul truck corridor. The carriers who filled out surveys were by and large dry van, irregular route carriers who are often dispatched to areas or geographic regions unfamiliar to them. This event had the highest attendance and also represented the broadest geographic dispersion of truck parking problems and congestion issues. Issues from East and West Coast states were identified. Theft, vandalism and safety were more important to this group of "random" irregular route drivers.

Waupun, WI

This show was attended by many more regional drivers who were often home at night. These drivers were familiar with navigating the known choke points and were very savvy about seeking alternatives in and around areas where less familiar drivers may have discovered no parking options. Several drivers identified "secret" places (many were vacant lots or abandoned fuel or hotel parking lots) and used these locations as a backup. Several company fleet drivers attended this show and explained how their vehicles are equipped with GPS devices and engine monitors. These devices track how many hours the vehicle is running and how fast the vehicle travels. Drivers of vehicles equipped with these devices can lose compensation or bonus pay if they speed or exceed run time without specified breaks. One crisis story was shared where a driver had three minutes left on his clock and was circling a rest area hoping that someone would leave so that he could park legally. While the episode he described had a happy ending, many times a lack of parking spaces at the right place can have impacts on pay or bonus money.

Truckers at this show described other aspects of truck parking experiences. One driver for a large retailer mentioned that many times central dispatchers route drivers through areas where there is known parking availability (usually in more rural areas). Meanwhile, stores are making space for delivering drivers to rest, provided no trash, noise, or other nuisances are created. Truckers who regularly haul dimensional loads indicated that they often have to map out routes

well in advance of their departure and can only operate during certain conditions and daylight hours. These loads often require more than one space, so finding a suitable spot to park for these shipments can be difficult.

Peoria, IL

This truck show was dominated by local truckers mostly involved in agriculture or construction. Many of these drivers complained about traveling in rural areas where no services were available near off ramps or highway exits. Some drivers who handled hazardous loads reported that some hotels would not let them park in their facilities due to the nature of their cargo. Others identified that in rural areas, finding a place to park and find a restroom can present a problem.

5.2 Regional Issues

This section presents collections of comments gathered from discussions with truckers, which are grouped by topic The overarching issues mentioned by truckers are a lack of parking capacity and concerns for the loss of operating efficiency. Truckers also made comments about how they make use of technology.

Lack of Capacity

- There is no parking between Knoxville, IL and Burlington, IA.
- Several drivers commented that Indiana and Iowa were among the best states to stop in the 10-state region. They also noted that Illinois is one of the worst states for truck parking.
- Parking in Wisconsin and Minnesota is good, while in Cleveland, OH parking is really bad after 3 pm, particularly on toll roads.
- Some drivers reported that many retailers in larger markets have discontinued truck parking in their customer parking areas. According to a few Illinois drivers, "McDonald's is about the only place left which will accept truck parking." However, even this capacity may be insufficient. For example, the McDonald's in Monmouth, IL has limited parking for 15 semi trucks; however, the demand there is for at least 30 trucks.
- There are many occurrences of ramp parking along I-94 in Michigan and in Wisconsin, especially at night. In particular, trucks park on outbound ramps of Chicago. Apparently, carriers have traveled through the choke points and then stage themselves to continue reliably on their next shift. This pattern suggests more truck parking locations are needed. One driver recommended accepting the problem and suggested installation of portable bathrooms at these high use areas.
- Most carriers agreed that there were not enough truck stops in general and wonder why many of the rest areas are closing down.

Loss of Efficiency

- One driver shared this rule of thumb: "Open [the] door once and you will lose about ½ an hour" and said he wanted to see more easy in-and-out, short term parking at rest areas.
- A driver hauling dimensional loads preferred to stop at rest areas because of the time savings. This driver noted that a restroom break may take 10 minutes if he stops at a rest

area, but if he has to leave the highway and find a truck stop it can take up to 30 minutes.

- Several drivers suggested that parking should be available in vacant business lots when rest areas are full.
- A number of drivers noted that parking by fast food restaurants was often difficult and it is sometimes dangerous for them to leave their vehicle idling by the highway.

Comments related to Technology

- Some of the truckers are using GPS in order to locate delivery points, though few mentioned using this strategy. Many do not have GPS units.
- Because of uncertainty of regional congestion, one carrier noted the need to allow a one-to-two hour travel time cushion in order to reliably meet delivery appointments. Then, because there is no place to park near the shipper, the carrier is forced to continue driving around until the delivery appointment time.
- Some truck parking facilities were designed to accommodate more cars than trucks. These facilities were designed before the explosion of truck traffic. One suggestion is that 75 percent of the available parking area should be designated for trucks. One example is in Battle Creek, MI, off I-94, where trucks are directed to form a single line along the back side of the facility, which barely accommodates more than five or six trucks.
- Some truckers assert that idling laws need revision and that there is a need for trucks installed with generators.
- For some drivers who choose to turn off their engines during breaks, it can cost $10 to $12 for midnight plugs in Mitchell, IL and Effingham, IL to keep the driver's cab air conditioned or heated. These costs are typically not reimbursed.

Other Comments

- Truckers carrying fuel tanks sometimes stays at hotels or motels, where they are asked to remove their fuel tanks.
- Rest areas generally do not have concession stands. Truckers report that the vending machines are expensive and the product quality is poor (coffee machines vend weak coffee). Candy bars are really expensive at commercial truck stops such as Pilot. Truckers assert that the stops double or triple the prices to take advantage of truckers.
- Some truck stops charge what truckers describe as a lot for parking, such as off I-75 in Michigan, where they charge about $5. If a price could be in the range of $2-$3, this may assist truckers.
- Some drivers go to a nearby Wal-Mart when truck stops are full. Many are open 24 hours and have bathrooms.

"Coffee and candy bars are really expensive at commercial truck stops such as Pilot. They double or triple the prices to take advantage of truckers. Some truck stops charge a lot for parking such as off I-75 in Michigan, [where] they charge about $5."

Survey respondent's comment

- Safety issues in cities, such as vandalism and crashes in parking lots due to overcrowding, result in drivers moving to ramp parking in rural areas.

Chapter 6. LOW COST STRATEGIES FOR TRUCK PARKING IMPROVEMENT

Truck parking has historically been provided by states along the Interstate network at rest areas. Many truck stop operators provide truck parking as a means to attract potential customers. Yet because of the anticipated growth of freight and the implementation of the Hours-of-Service (HOS) legislation, providing truck parking at sites that have the highest demand has been difficult for a variety of reasons. Many truckers want to get past congested urban areas or to a point where there is a highly reliable and predictable travel time between where they stop and their final destination. These locations are often in areas where real estate costs are high and little remaining open land exists to develop truck parking facilities.

The research team explored several potential low cost solutions as a result of discussions with public and private parking providers, software experts and drivers. Responses collected through the survey also provide ideas for low-cost solutions to truck parking problems in the Midwest region. These are briefly discussed below.

In developing strategies to deal with truck parking problems, it is important to know drivers' preferences for parking in terms of location and timing. The Federal Highway Administration published a report, *Commercial Vehicle Driver Survey: Assessment of Parking Needs and Preferences*, in 2002[40] that details driver preferences regarding the type of information that they would find helpful as well as their preferred methods of receiving this information. The top information items that drivers reported they would find helpful, (along with the percentage of drivers that mentioned each item), are listed below:

- Location of parking facilities along the road being traveled (84%)
- Amenities available at parking facilities (77%)
- Number of parking spaces available at upcoming parking facilities (68%)
- Length of time limits on upcoming truck parking spaces (46%)

Drivers completing the survey were also asked how they would like to receive real-time parking information. Their most preferred methods (and the percentage of drivers indicating each method) were:

- In-vehicle radio, such as CB, low-power FM radio or Dedicated Short Range Communication (73%)
- Electronic visual displays in vehicles (40%)
- Internet (12%)

However, while the survey did not list variable message signs along the roadway as a possible way to convey real-time information to drivers, on another portion of the survey drivers were asked to indicate their top five recommendations for improving truck parking. Twenty eight percent reported that signs and roadway information were important. This suggests that variable message signs may be a viable option for transmitting real-time parking information.

6.1 Private Truck Stops and the Privatization of Rest Areas

Among the most commonly cited truck parking problems are the shortage of parking capacity at public rest areas and, in some cases, the closures of public rest areas. Lack of funding for operation and upkeep for these areas may be one cause, but there are other reasons spaces are lost, such as road widening efforts. (U.S. Highway 41 in Wisconsin between Appleton and Green Bay is an example.)

One suggestion to overcome the shortage is to privatize these facilities. However, federal regulations (US Code Title 23, Chapter 1, Section 111) prohibits privatization of rest areas on federally funded highways. Toll roads that receive no federal aid have promoted privately financed rest areas, which do not exist on the Interstate system unless they were in operation prior to 1960.

Public-private partnerships with private truck stops which already have restaurant, diesel, and shower facilities [are the way to go]. Maine DOT partnered with Irving Oil Company on just such a project near I-95 in Kittery, Maine.

Survey respondent's comment

During the last 20 years, there has been much interest in public-private partnerships for the maintenance and operation of rest areas, which would enable state transportation agencies to reduce costs. However, these efforts have been met with stiff opposition from the National Association of Truck Stop Operators (NATSO), the McDonald's Corporation, and local businesses. NATSO, which represents over 900 private truck stops nationwide, and McDonald's are concerned that an increase in the size and services at current public rest areas would lead to reduced demand at restaurants and truck stops located at highway exits.

While the National Transportation Safety Board (NTSB) recommended in 2000 that the Congressional ban on privatization of rest areas be repealed, NATSO argues that lifting the ban would damage existing businesses located near commercialized rest areas and would result in a decrease in available parking spaces because nearby truck stops would go out of business. A NATSO funded study conducted by the University of Maryland in 2002 found that interchange exits located near commercialized public rest areas built before 1960 experienced significantly lower sales than average stops at interchange exits. Specifically, they sold 56 percent less food, 51 percent less gasoline, and had 46 percent lower sales at truck service facilities.

With over 90 percent of truck stop parking free, NATSO has maintained in the past that if demand grows large enough, truck stop owners will begin charging parking fees to truckers to cover the costs of providing additional parking. One example from Indiana illustrates the challenges posed by these expenses. Indiana DOT (INDOT) contacted a private truck stop owner plans to expand an off ramp along the new I-465 extension. There was available land next to the existing truck stop. IN DOT contacted the truck stop to see if they had considered acquiring additional property for truck parking. Representatives of the truck stop replied that the cost of the land, pavement, lighting, maintenance and increased property taxes could not be justified since these anticipated costs would be far greater than any incremental increase in fuel

or grocery purchases at the existing location. A similar analysis in Milwaukee revealed that and the price of land in proximity to the interstate was prohibitively expensive and out of reach for most truck stop operators.

While it may be politically difficult to privatize rest areas, one possible alternative is to create incentives for truck stops to provide free parking and the services of public rest areas. For example, Vermont closed a small run-down rest area and designated a nearby truck stop as a "Vermont Interstate Center." In exchange for this designation, the truck stop agreed to meet certain criteria, such as providing prominent tourist information, 24-hour access to pay phones, parking and restrooms. Utah has tried a similar program. NATSO supports directing motorists to private facilities as a substitute for public rest areas, but the organization believes that the federal government should set standards to increase openness and transparency in the process of designating such facilities to ensure fairness. It also supports standardizing the name and signage of these facilities across the country as well; it suggests the name "Interstate Oasis."

Other arrangements with private partners are possible. On I-94, at the Lake Forest Oasis, the Illinois Tollway has worked with the local community and major employers to ease congestion during re-construction of I-94 and the Ill. Rte 60 interchange by allowing temporary tolled access to Northbound I-94 through the Oasis truck parking lot. In exchange for this, property adjacent to the truck parking lot was given to the Tollway for truck parking expansion at the Oasis. The Tollway is currently designing this expansion so as to add over 30 tractor trailer spaces to this lot.

6.2 Parking Management Systems

The next series of recommendations involve the use of real-time information, the first among these being parking management systems. While real-time tools that inform drivers about current space availability are useful to those considering an immediate stop, these systems can also be useful for drivers who have preplanned stops, especially for drivers to confirm that anticipated spaces exist before they exist the highway. Many drivers indicate that many of their usual stopping points are becoming unavailable as the volume of freight and number of trucks increases. Such an information system would also be useful when drivers find themselves at the end of their hours-of-service limit with no legal place to stop and rest.

Smith, et al. (2005)[41] performed a comprehensive evaluation of ITS technologies related to truck parking for the Federal Motor Carrier Safety Administration. The report mentions two possible methods of correcting this problem. One was to use historical data to calculate daily and seasonal patterns of parking space usage and provide drivers an estimate of when all spaces are likely to be filled. Another strategy is to allow drivers to reserve a parking space with a parking management system, which would then include these reservations when providing parking availability information to drivers. However, the added communication tasks required in order to process reservation requests and update parking availability information might make this approach impractical. Reservation processes can be further complicated by rest areas where parking spot designation is unclear and when passenger vehicles and recreation vehicles park in areas designated for trucks. Also, many drivers complain about others who park on the lines or take up two spaces.

Two recommendations for enhancing the ability of drivers to plan their stops more effectively involve the use of information technologies. First, historical occupancy data (for a time period of

at least one year) could be provided online so that drivers can better estimate the likelihood of finding a space at a given time and date. Second, parking availability information could be integrated into the decision support software sometimes used by drivers and carriers to select refueling stops. Planning where to refuel is important to carriers because fuel is a carrier's second largest cost item. Many truck stops publish how many spaces are available at their location but have not implemented a reservation system. Rest locations are often at or near refueling areas, so integrating information about these locations into a single online format would make the trip planning process more efficient.

All ITS deployments - which include parking management systems - made with highway trust funds must conform to the National ITS Architecture and Standards[42]. Parking management functions, as defined in the National ITS Architecture, include space availability monitoring, the provision of information about parking availability and cost, electronic fee collection, and violation enforcement. Parking availability information is to be provided to: drivers in the immediate vicinity of parking areas through the use of variable message signs, information service providers through fixed-point to fixed-point communication, and other parking facilities. Parking information service providers could include 1) large trucking firms performing this function for their fleet or industry groups, 2) truck stop operators or 3) public highway agencies performing this function for specific parking locations or geographical areas. Work continues in this area to determine the best way to inform drivers of parking availability.

6.3 Real-Time Counts of Available Parking Spaces

The effectiveness of real-time tools to aid drivers in planning where to stop is dependent on 1) having a sufficient number of total parking spaces on the road segment, 2) the ability to accurately detect the number of trucks parked in an area, and 3) being able to translate this information into a usable format for approaching drivers. ITS solutions can aid in matching supply and demand to better utilize spaces.

Measuring the number of available spaces can be done using either vehicle detection at each parking space or a "count in, count out" method that would keep a running total of available spaces by detecting trucks entering and leaving the parking area. Vehicle detection at each space tends to be more accurate but much more costly to implement. Meanwhile, at some parking facilities, there is a single entryway for both automobiles and commercial motor vehicles, which necessitates that any "count in, count out" system be able to distinguish between cars and trucks. Effective "count in, count out" technologies include pole-mounted break beams and weigh-in-motion (WIM) technologies. Although the cost of WIM equipment tends to be much higher than pole-mounted break beams, parking areas co-located with weigh stations might save costs by making existing WIM equipment dual-use. The "count in, count out" approach also requires that entries and exits from parking areas be well organized to ensure that all vehicles are detected as they enter and exit the facility. The system also needs to be able to allow an operator to manually adjust the count on a daily or weekly basis so that counting errors do not accumulate and reduce the accuracy. This often requires on-site reconciliation or the means to monitor these areas via remote cameras for visual verification.

6.4 Sign Boards to Communicate Parking Availability

Communicating parking availability information to drivers can help effectively use parking facilities by matching drivers with available parking spaces. Solutions such as smart signs, which display real-time information on available parking spaces at truck stops before truckers reach them, can help truckers plan for parking in advance of their stop. Also, signs posted showing the distance to the next truck stop from the prior one can enhance planning on the driver's part regarding how far and where they are going. A potential low-cost solution would be putting signs at truck stops to give information about nearby locations. Variable message signs are the simplest, most effective method of delivering information to drivers. The signs located near parking areas could be hard-wired, while those located further away could be equipped with a radio-frequency or cellular telephone interface. ITS solutions of this sort are less likely to meet resistance from local residents and are far less capital intensive than infrastructure solutions to increase the supply of spaces.

6.5 Web-based Information Systems

There are currently several online resources available to aid truckers in planning for their next stopping place. NATSO operates an online guide with very basic information about 1,100 truck stops in the United States[43]. *Trucker's Friend* is a paid website sponsored by TR Information Publishers, which includes information on facilities and the number of parking spaces at several thousand truck stops[44]. The state of Maryland also publishes a truck map and motor carrier handbook which is available online and lists private truck stops, park and ride lots, and weigh stations with overnight parking within the state. However, none of these sites provides a nationwide all-inclusive list of legal parking areas for trucks. One of the future potential extensions of the survey data visualization tool and online inventory of truck parking for the Midwest region produced through this study could be a comprehensive GIS-based truck parking information system.

The study team contacted several navigation systems providers to explore ways of communicating truck parking locations via satellite navigation systems. In much the same way passenger cars can program favorite destinations into their navigation systems, truckers could potentially program a truck parking directory into their navigation systems. After several interviews, a process was suggested whereby information about all the truck parking locations in a given state could be compiled into a universal file format. As the cell phone technology improves and the use of personal navigation systems expands, there is an opportunity for state DOTs to compile and collect truck parking data for their state. At "Welcome Portals" located near state boundaries, many states have WIFI hot spots which could be used by carriers and/or the public to download parking asset locations. These locations could be coded with intercept data, so that as the motor carrier or the passenger vehicle approaches a rest area or parking facility, the driver could be alerted to the resource. Today DOTs could collect and format the location data for all parking resources in the state and this data could be downloaded in comma separated value ("csv") files for use in any personal navigation system.

There are some limitations to using web applications to transmit parking information to truckers. From a practical standpoint, the driver wants to know if there is a parking spot at the desired location before they pull off the highway. Many drivers report that they find searching

the web for a parking spot to be a waste of time, particularly on applications without real-time features. It is also impractical for drivers to access a computerized screen while driving.

6.6 Radio Broadcast Solutions

Radio broadcasts may also be a viable means of getting parking information to drivers. Many drivers listen to satellite radio broadcasts. One provider indicated that many of the "Trucker Buddy" programs are prerecorded, but a mechanism could be designed to incorporate truck parking information on the weather and travel channels, provided there is a way to make sure the information is up to date and accurate. This solution may be helpful in larger urban areas, but there are many areas which are not covered by these satellite stations where queuing and parking issues exist. Broadcasting regular parking space availability messages using a synthesized voice on traveler information radio (on AM frequencies set aside by the Federal Communications Commission) would be an economical option as well. However, converting the raw parking data into a suitable format for broadcast would require some effort. CB radio, which is very popular with truck drivers, is another possible medium for transmitting the information of parking space availability, although it is not typically used to broadcast information. For any of these mechanisms to be effective, a real time inventory of available spaces left or alerts signifying areas where no space is available must be first established.

6.7 Cellular Phone Based Solutions

The majority of truckers carry cellular telephones with them, and those that do not can use phones at stopping places. It is feasible to communicate information to drivers through either a dedicated parking availability information system or an additional truck-specific menu on the existing 511 traveler information system. On-board computers, which are widely used by carriers to communicate with drivers, could also be used to transmit parking information.

The 511 system was designed by the Federal Communications Commission (FCC) as a nationwide three-digit telephone number for traveler information. This system was established in 1999 to support the provision of traffic delay, weather, transit and tourism information. Actual functionality varies by the telecom provider and the state DOT or the local transportation and transit agencies that support the system.

The deployment status map in Figure 27 indicates that nearly 70 percent of the U.S. population has access to the system[45]. The dark green states have operational systems and the light green states began implementation in 2008. Seven of the 10 states of the MVFC are deploying or have deployed 511 systems. In 2008, over 30 million 511 calls were made nationally.

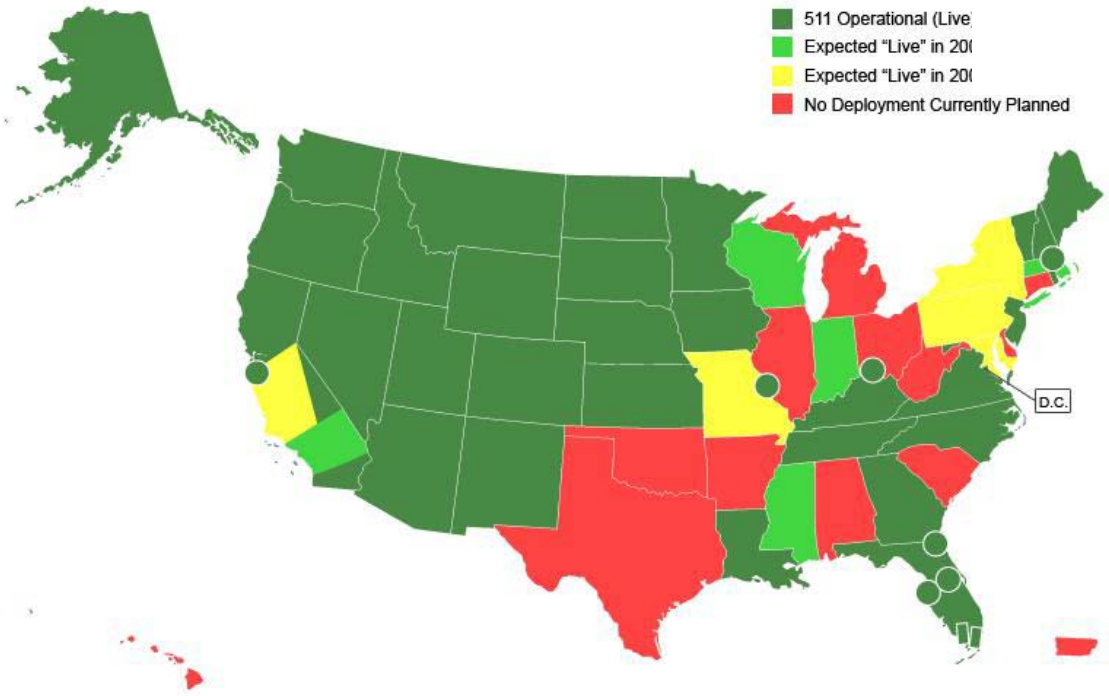


Figure 27: 511 Deployment Status as of Feb. 21, 2009

Truck parking availability data is the missing piece of information in the current system. Placing vehicle counting devices at truck stops and rest areas constitute two solutions to this problem. These counters may not always be accurate if users park using more than one spot. Cameras could be mounted at popular parking locations and instant visuals of parking areas could be transmitted via cell phone displays. Setting up a truck-specific menu on the 511 programs across the multi-state region would improve adoption of the system. The issues of interoperability in the MVFC area are being addressed by the MVFC Clearinghouse Project.

While truck parking availability information is important, safety concerns are an important factor in determining how to transmit this information. Information presented via variable message signs and on-board computers can distract drivers so messages must be short enough to be read at a glance. Cellular phones present a similar safety issue and their use by drivers is prohibited in many parts of the country.

6.8 Other Possible Solutions

In the comments sections of the survey, respondents provided addition recommendations for improving truck parking. For example, most truckers prefer to park near final delivery locations or on the outskirts of the cities where they have to deliver next day. Given these circumstances, one potential option is providing incentives for local businesses, retail malls and large retail chains, including mall anchor tenants, to allow truck parking. Yet in some areas, truckers who have

"Compensate shopping centers or big box retailers to allow large trucks to use their lots. And ask shippers and receivers to allow more overnight parking."
Survey respondent's comment

not disposed of trash in an appropriate way have strained relationships with retailers, and some have banned parking. Moreover, mall parking lots have not been designed or built to support the weight of large loaded trucks. Some retail establishments have expressed concern over the potential maintenance costs they will incur if overnight parking is allowed.

"Open abandoned lots for truck parking, charge a small fee to use lots - make truckers take some ownership in keeping them clean."

Survey respondent's comment

Reopening abandoned truck stops and converting nearby weigh stations and commuter lots into additional parking places can also reduce congestion at incommensurate truck parking locations. From a driver's perspective, if they park at a weigh station, they anticipate they will be asked to move within a few hours of arrival to accommodate the needs of the weigh station. This can cause them to explicitly violate Hours-of-service (HOS) rules and regulations. While policies regarding truck parking at weigh stations may vary from state to state, this perception no doubt affects truckers' parking choices.

Many carriers have contacted their shippers and freight receivers to see if truck parking can be accommodated. While there have been some success stories, some have objected due to the lack of physical space available to accommodate a parked truck while others have had concerns about insurance and security. It is often difficult to expand existing parking facilities in manufacturing areas where no open land surrounds the facility.

Finally, improved communication between states and truckers with clear information about each state's truck parking policies would be beneficial. For example, some truckers seeking to park in public facilities in Wisconsin operate under the assumption that overnight parking at public rest areas and weigh stations in unlawful. However, WisDOT staff, including officers in the Wisconsin state patrol, say overnight parking is allowed. New or improved efforts to disseminate parking policy information, particularly regarding the variations across states, can be implemented by both public and private stakeholders and may be a low cost way to help truckers to find safe parking alternatives. Furthermore, overnight truck parking at park-and-ride facilities may be an option during off hours.

Chapter 7. SUMMMARY OF FINDINGS AND RECOMMENDATIONS

Truck parking demand is likely to continue increasing, and it is important that trucks be accommodated in a safe and efficient manner. This analysis presents different representations of truck parking issues in the 10-state MVFC region. It displays the spatial concentration of markers representing parking problems, and identifies 1) the priority cities with truck parking problems in individual states and across the 10-state region and 2) the parking issues along Interstates in the region. This research led to the following results regarding truck parking issues:

- The shortages of parking occur in the late afternoon or early evening at most places.
- Truckers experiencing problems in finding an available parking spot tend to know little about other parking availability in the nearby area, and do not have or are not aware of means of finding that information.
- Truckers identified design problems in the public truck parking areas. For example, poor design makes entry and exit movements difficult and therefore wastes valuable parking space.
- Locations with truck parking problems are usually in and around major urban areas, which is understandable because urban areas - such as Chicago, IL, Detroit, MI Louisville, KY, Milwaukee, WI Minneapolis/St. Paul, MN, Kansas City, MO and Indianapolis, IN- are likely to have the most intensive freight operations.
- About 14 percent of the locations of parking problems identified through the survey are in the Chicago area, indicating a critical parking shortage in that area. Elmhurst and Rosemont are identified as the most problematic locations in Chicago's suburban, areas followed by Joliet, Lansing and Hillside.
- Minneapolis, MN and Louisville, KY and their outlying areas are also experiencing serious truck parking needs. They are followed by Indianapolis, IN; Davenport, IA; Kansas City, KS/MO; and Milwaukee, WI. St. Louis, MO; Decatur, IL; Cincinnati, OH; Detroit, MI; Madison, WI; La Crosse, WI; Rockford, IL; Janesville, WI; Columbus, OH; and Cincinnati, OH have moderate parking shortages. Bowling Green, KY; Ann Arbor, MI; Cleveland, OH; Des Moines, IA; and Toledo, OH also need some improvements in terms of truck parking.
- Interstate corridors to Chicago, such as I-90, I-94, I-55, I-57 and I-80, have the highest density of incommensurate parking facilities.
- Louisville, KY has a high density of locations with truck parking issues. I-39, I-90 and I-43 near Rockford, IL and I-24 near Paducah, KY also have several truck parking problems. These are followed by I-74 and I-80 near Davenport, IA; I-43 and I-94 near Milwaukee; I-70, I-35 and I-29 on the outskirts of Kansas City, KS/MO; I-65, I-69, I-70 and I-74 near Indianapolis, IN;, I-72 between Decatur, IL, and Springfield, IL; I-74

between Decatur, IL and Peoria, IL; and I-55 between Peoria, IL and Springfield, IL. The most common parking problem is related to capacity. Parking facilities are 'always too full,' meaning that parking capacity does not meet demand. Other issues associated with parking locations, such as 'security concerns', 'unable to handle traffic', 'bad maintenance' and 'bad stripes design' were also mentioned in the survey.

Table 14 gives a summary of locations and highways in the 10-state region having truck parking issues. It also indicates that our sample size in the survey covers all the major interstate corridors in the 10-state region.

Table 15: Summary of Locations and Highways with Truck Parking Issues in the 10-state Region

State	Cities with truck parking issues	Interstate corridors	Section of Interstate
Illinois	Chicago, St. Louis, Rockford, Decatur	I-90, I-94, I-55, I-57, I-80, and I-74	Corridors near Chicago, and Corridors connecting Moline with Peoria and Springfield to St. Louis.
Indiana	Indianapolis	I-65, I-69, I-70, I-80, I-90, I-94 and I-74	I-65, I-69, I-70 and I-74 near Indianapolis and I-80, I-90, I-94 near Gary
Iowa	Davenport, Des Moines	I-80	I-80 corridors near Davenport and Des Moines
Kansas	Kansas City and Topeka	I-35, I-70	Corridors between Kansas City and Topeka
Kentucky	Louisville, Bowling Green and Paducah	I-64, I-65, I-71 and I-24	I-64, I-65 and I-71 corridors near Louisville and I-24 near Bowling Green
Michigan	Detroit and Toledo	I-75, I-94, I-96	I-75 corridor between Toledo and Detroit, and I-94 and I-96 on outskirts of Detroit
Minnesota	Minneapolis – St. Paul and Albert Lea	I-94, I-35	I-94 on east and west outskirts of Minneapolis –St. Paul and I-35 in Southern Minnesota
Missouri	St. Louis, Springfield and Eureka	I-44, I-70	I-44 between Springfield and St. Louis and I-70 between Columbia and St. Louis
Ohio	Columbus and Cincinnati	I-71	I-71 between and close to Columbus and Cleveland
Wisconsin	Milwaukee, Madison, Beloit, Racine	I-43, I-90, I-94	I-43 corridor connecting Chicago and Milwaukee, I-90 and I-94 connecting Chicago, Madison and Minneapolis

Major truck parking problems are caused by parking areas being used for staging purposes and for breaks to conform to hours-of-service (HOS) regulations. Thus, there are not enough parking spaces to meet peak demand during popular hours of use. Also, there is a lack of communication systems informing truckers about available parking spaces nearby.

Solutions to truck parking problems should be considered in the context of freight logistics and operations. For example, within urban areas, large distribution centers should consider providing truck parking spaces that are most convenient to truckers. Truck parking capacity should be added at the outskirts of large urban areas, such as Chicago, IL, Minneapolis/St. Paul, MN and Louisville, KY for trucks staging for next day delivery. One of the major reasons that trucks stage for early next day delivery is due to the inability to deliver at night or due to the peak hour

traffic the next morning. City ordinances may need to change to make the delivery window wider for truckers.

Suggestions from the survey participants about how to address the truck parking issues and improve utilization of currently available parking capacity will require technology investments by both the public and private sectors. Variable message boards can be used to provide advance parking information and help en route truckers make early and informed decisions. Upstream truck parking lots can display capacity availability for downstream lots. Solutions for improving communication mechanisms to inform on-road truckers about available truck parking include web-based, radio and cellular phone based systems.

Advancements in web-based technologies and open source tools make it possible to enhance the involvement of stakeholders in truck parking planning and operations. This report presents a web-based GIS for collecting and disseminating geospatial information relating to truck parking on the Interstate Highway system. The web-based survey tool described in this report offers a platform for data collection, and subsequently, a mechanism to support the visualization and analysis of truck parking hot spots. Such an Internet-based GIS system could be used to create an online forum where public and private stakeholders can communicate with each other about location-specific information.

Among the many suggested remedies to the truck parking shortage in the Midwest, there are several solutions that may hold particular promise. The first of these is the privatization of rest areas and public support of private truck stops in the form of tax credits or incentives. This solution is more cost-effective for the public sector than constructing or expanding rest areas and is supported by private truck stops as well. A second solution is the use of ITS technologies to inform drivers on the road of available truck parking locations on a real-time basis. Even simple signage indicating nearby parking areas can help truckers find suitable rest areas, which helps reduce illegal parking and driver fatigue. This solution has the advantage of being relatively low-cost and would be unlikely to attract great opposition from neighboring land owners.

Other solutions are to reconfigure existing rest areas to accommodate more trucks, use weigh stations and park-and –ride facilities for truck parking during off hours, and to improve communication about state parking policies, such as those regarding weigh station parking. All of these solutions would help alleviate the truck parking shortage or perceived shortage and reduce the number of illegally parked trucks on the ramps and shoulders of highways, and would help fatigued truck drivers find safe places to rest.

Appendix A: Online Survey to State Patrol Officers, Freight Planners and Truckers

1. Please rate the following truck parking problems in your state.* [1 = not an issue; 5 = very serious issue]

	1	2	3	4	5
Truck parking space shortage overall					
Truck parking space sufficient overall, but in shortage at critical points					
No Communication mechanism to inform drivers of available spaces					
Parking on ramp or in not designated wayside when spaces are available at the nearby parking lot					

Other truck parking problems _____

2. Please rate the following factors to alleviate truck parking problems in your state.* [1 = not recommended; 5 = highly recommended]

	1	2	3	4	5
Parking reservation system at critical parking spots					
Advances truck parking signs					
Cell phone notification system					
Reduced delivery curfews					
Adjunct to 511 system					
Incent businesses to accept deliveries 24/7					

3. What are the constraints/major obstacles (in ranking order) to solve the truck parking problems in your state?* (Check all that apply)

☐ Current regulations
☐ Lack of parking available
☐ Lack of funds to meet parking demand
☐ A breakdown in private sector which is not providing truck parking spaces to meet demand
☐ Lack of available land to build parking spaces
☐ Lack of public acceptance to allow parking in their neighborhoods
☐ Other _____

4. What solutions have you found to be successful?* (You are welcome to convey any general comments here.)

_____

QUESTIONS ABOUT SPECIFIC TROUBLE LOCATIONS (To Highway Patrol)

(* indicates mandatory questions/fields)

1. What is the truck parking problem at this location?*
   - o Ramp parking
   - o Always too full
   - o Other_____

2. How would you rank this parking location in terms of space shortage in your state?
   - o Among the top 3 in most shortage of space
   - o Among the top 5 in most shortage of space
   - o Among the top 10 in most shortage of space
   - o Somewhat serious, but not in the top of list

   General comments on ranking_____

3. How do you address this parking problem?*
   - o Issuing tickets (___tickets per day on average)
   - o Warning/reminding the drivers
   - o Letting it go
   - o Other_____

4. Are there nearby truck stops or other rest areas available?*
   - o Yes
   - o Those additional spaces are under utilized
   - o Those additional spaces are in serious shortage
   - o No idea
   - o Not that I know of

5. What causes the truck parking problem at this location?* (Check all that apply)
   - ☐ Peak demand occurs and there is not enough space during popular hours of use
   - ☐ Parking area is constantly full – no overflow available
   - ☐ Parking areas are being used for staging purposes for nearby customers
   - ☐ Parking spaces are used for a break, to conform to the hours of service regulation
   - ☐ Availability of truck parking along nearby highway is too limited
   - ☐ Other _____

6. What low cost solution(s) do you suggest to solve the parking problem at this location?* (Check all that apply)
   - ☐ Convert nearby weigh station into additional parking
   - ☐ Enlarge the current truck rest areas and truck parking lot
   - ☐ Make more plaza parking nearby
   - ☐ Change the city ordinance on delivery window requirement for carriers
   - ☐ Smart signs - Early posting of parking information before reaching this location
   - ☐ Allow overnight parking at malls or large retail chains such as Wal-Mart and Target
   - ☐ Increase number of public truck stops like Pilot or Flying J
   - ☐ Other _____

7. General comments about this location. You are welcome to recommend any contact (name/tel/email) to know more about the problems.

_____

QUESTIONS ABOUT SPECIFIC TROUBLE LOCATIONS (To Freight Planners)

(* indicates mandatory questions/fields)

1. What is the truck parking problem at this location?*
   - o Ramp parking because of the parking lot always too full
   - o Ramp parking when the parking is still available
   - o Other_____

2. How was this truck parking problem brought to your attention?
   - o Meeting with carriers
   - o State highway patrol reports
   - o Personal observations
   - o Public complaints
   - o Other_____

3. How would you rank space availability at this parking location?* (1= space always available; 5 = always in shortage)

   ☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5

   Time period of the day when this location has parking problems_____ *(Ex: 8 am – 10 am)*

4. Are there nearby truck stops or other rest areas available?*
   - o Yes
   - o Those additional spaces are under utilized
   - o Those additional spaces are in serious shortage
   - o No idea
   - o Not that I know of

5. What causes the truck parking problem at this location?* (Check all that apply)
   - ☐ Peak demand occurs and there is not enough space during popular hours of use
   - ☐ Parking area is constantly full – no overflow available
   - ☐ Parking areas are being used for staging purposes for nearby customers
   - ☐ Parking spaces are used for a break, to conform to the hours of service regulation
   - ☐ Availability of truck parking along nearby highway is too limited
   - ☐ Other _____

6. What low cost solution(s) do you suggest to solve the parking problem at this location?* (Check all that apply)
   - ☐ Convert nearby weigh station into additional parking
   - ☐ Enlarge the current truck parking lot
   - ☐ Increase number of public truck stops like Pilot or Flying J
   - ☐ Allow overnight parking at malls or large retail chains such as Wal-Mart and Target
   - ☐ Change the city ordinance on delivery window for carriers

☐ Smart signs - Early posting of parking information before reaching this location
☐ Other _____

7. General comments about this location. You are welcome to recommend any contact (name/tel/email) to know more about the problems.
_____

QUESTIONS ABOUT SPECIFIC TROUBLE LOCATIONS (To Truck Drivers)

(* indicates mandatory questions/fields)

1. What is the truck parking problem at this location?*
   o Ramp parking
   o Always too full
   o Other_____

2. How frequently do you observe/experience parking problem at this location?*
   o Once or less out of ten trips
   o Three times out of ten trips
   o Seven times out of ten trips
   o Almost every trip

   Time period of the day when this location has parking problems_____ *(Ex: 8 am – 10 am)*

3. What is your route when you observe the problem at this location?*

	(state)	(state)	(commodity type)
from	_____	to_____	_____
from	_____	to_____	_____
from	_____	to_____	_____

4. How would you rank this parking problem?* This location is among the top 10/20/30/somewhat serious locations.*

5. If you are a driver, why do you park at this location?
   ☐ For a break after long hours of driving
   ☐ Overnight stay waiting for next day delivery
   ☐ Daytime stay waiting for delivery window
   ☐ Other occasional needs (e.g. restroom, food etc.) _____
   ☐ I am not a driver

6. Are there nearby truck stops or other rest areas available?*
   o Yes
   o Those additional spaces are under utilized
   o Those additional spaces are in serious shortage
   o No idea
   o Not that I know of

7. What low cost solution(s) do you suggest to solve the parking problem at this location?* (Check all that apply)
   - ☐ Convert nearby weigh station into additional parking
   - ☐ Enlarge the current truck rest areas and truck parking lot
   - ☐ Make more plaza parking nearby
   - ☐ Encourage private investment and expansion of truck stops
   - ☐ Incent local business to allow truck parking at their sites
   - ☐ Change the city ordinance on delivery window requirement for carriers
   - ☐ Smart signs - Early posting of parking information before reaching this location
   - ☐ Other _____

8. General comments about this location.
   _____

Appendix B: Paper Survey to Truckers

PERSONAL INFORMATION

Name_____

Phone Number_____

E-Mail_____

Affiliation/Organization_____

State of Registration_____

GENERAL QUESTIONS

1. Please choose your criteria for parking: (Check all that apply)

☐ I need to park every ___ hours.

☐ I like to park at locations at the outskirt of large cities.

2. Please rank the following factors in your planning for parking places.

Factor	Priority
availability of gas/restroom/food	
level space/lights/noise	
security	
proximity to destination	

3. In general, where do you get information for:

- Truck Parking? _____
- Traffic Congestion? _____

I check these parking information sources ____ hours in advance.

SPECIFIC TROUBLE SPOTS

The following questions involve your input of parking trouble spots. Using the atlas, please give us a detailed location (city, exit number, state, etc) that has poor parking and answer the following questions.

Location:
_____

What is the truck parking problem at this location? (Ex. Ramp parking, Lot too full)
_____

How frequently do you observe/experience this problem?
_____ times out of every ten trips

Time of day when the problem is observed _____ (Ex: 8:00 A.M- 10:00 A.M)

What is your route when you observe the problem?
From (state) _____ to (state) _____ Commodity Type _____

This location is among the top (10 20 30 100) most serious locations. (Circle One)

Why do you park at this location? Circle one or fill in the blank

For a break after long hours of driving	Overnight stay waiting for next day delivery	Daytime stay waiting for delivery window	

What causes the truck parking problem at this location? (Check all that apply)
- — Peak demand occurs and there is not enough space during popular hours of use
- — Parking area is constantly full – no overflow available
- — Parking areas are being used for staging purposed for nearby customers
- — Parking spaces are used for a break, to conform to the hours of service regulation
- — Availability of truck parking along nearby highway is too limited
- — Other: _____

What do you suggest to solve the parking problem at this location? (Check all that apply)
- — Convert nearby weigh station into additional parking
- — Enlarge the current truck parking lot
- — Make more plaza parking nearby
- — Encourage private investment and expansion of truck stops
- — Incent local businesses to allow truck parking at there sites
- — Change the city ordinance on delivery window for carriers
- — Smart signs - Early posting of parking information before reaching this location
- — Other: _____

Please name three low cost solutions to truck parking problems?

1. _____
2. _____
3. _____

Are there nearby truck stops or other rest areas available nearby? If yes, how far away are they and why don't you park there?

General comments about this location:

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