Project Title:
Autonomous Vehicles and Freight Transportation Analysis

Funding Agency:
The North Central Texas Council of Governments (NCTCOG)

NCTCOG Project Manager:
Jeff Hathcock

UTA Principal Investigator:
Mohsen Shahandashti, Ph.D., P.E.

Student:
Binaya Pudasaini, Ph.D. Student
It is not clear how the advent of emerging automated truck technologies would impact the Dallas-Fort Worth’s (DFW) truck industry or the infrastructure needed to support the industry:

- Critical trucking issues (e.g., hours-of-service, compliance, safety, driver education, driver retention, truck parking, driver health and wellness, congestion, driver distraction)
- Adequacy of existing facilities
- Need for specialized/separate facilities

To conduct a direct and thorough investigation of:

- Impacts of automation on the future of the DFW’s truck industry
- Infrastructure needed to support the industry
TASK 1 - Review the Status of Automated Truck Technologies

Comprehensive Review of Autonomous Truck Technologies

Current and future technologies that can impact autonomous trucks

Available technologies across 5 levels of automations

SOCIETY OF AUTOMOTIVE ENGINEERS (SAE) AUTOMATION LEVELS

<table>
<thead>
<tr>
<th>Level</th>
<th>Automation Type</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>No Automation</td>
<td>Zero autonomy, the driver performs all driving tasks.</td>
</tr>
<tr>
<td>1</td>
<td>Driver Assistance</td>
<td>Vehicle is controlled by the driver, but some driving assist features may be included in the vehicle design.</td>
</tr>
<tr>
<td>2</td>
<td>Partial Automation</td>
<td>Vehicle has combined automated functions, like acceleration and steering, but the driver must remain engaged with the driving task and monitor the environment at all times.</td>
</tr>
<tr>
<td>3</td>
<td>Conditional Automation</td>
<td>Driver is a necessity, but is not required to monitor the environment. The driver must be ready to take control of the vehicle at all times with notice.</td>
</tr>
<tr>
<td>4</td>
<td>High Automation</td>
<td>The vehicle is capable of performing all driving functions under certain conditions. The driver may have the option to control the vehicle.</td>
</tr>
<tr>
<td>5</td>
<td>Full Automation</td>
<td>The vehicle is capable of performing all driving functions under all conditions. The driver may have the option to control the vehicle.</td>
</tr>
</tbody>
</table>

TASK 1 - Review the Status of Automated Truck Technologies

Source: Berger (2016)
**TASK 1- Review the Status of Automated Truck Technologies**

**STAGE 0 TO STAGE 2 TECHNOLOGY FOR AUTONOMOUS TRUCKING**

Currently Available *(Camden et al. 2017, Mohn 2017)*

- Forward Collison Warning
- Adaptive Cruise Control
- Automatic Braking System
- Lane Departure Warning
- Blind Spot Warning
- Electronic Stability Control
- Roll Stability Control
- Speed Limiters
- Onboard Monitoring System
- Electronic Logging Device (ELD)

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<table>
<thead>
<tr>
<th>Stage 0</th>
<th>Stage 1</th>
<th>Stage 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>No Automation</td>
<td>Driver Assistance</td>
<td>Partial Automation</td>
</tr>
<tr>
<td>&gt; Blind spot detection/ right turn assistant</td>
<td>&gt; Emergency braking system</td>
<td>&gt; Traffic jam/ construction site assistant</td>
</tr>
<tr>
<td>&gt; Collision warning system</td>
<td>&gt; Adaptive cruise control or</td>
<td>&gt; Highways assist</td>
</tr>
<tr>
<td>&gt; Lane departure warning system</td>
<td>&gt; Lane keep assist</td>
<td>&gt; Predictive powertrain control</td>
</tr>
<tr>
<td>&gt; Driver monitoring system</td>
<td>&gt; Driver-assisted truck platoon (DATP)</td>
<td>&gt; Lane change assist incl. right-tuning</td>
</tr>
<tr>
<td>&gt; Traffic sign recognition</td>
<td></td>
<td>&gt; Intelligent parking assist system</td>
</tr>
</tbody>
</table>

*Source: Berger (2016)*
STAGE 3 AND STAGE 4 TECHNOLOGY FOR AUTONOMOUS TRUCKING

Under Development and Testing


- Even some commercial stage 4 driving has been completed. (O’Kane 2019)

Source: Berger (2016)
TASK 1- Review the Status of Automated Truck Technologies

STAGE 3 TECHNOLOGY FOR AUTONOMOUS TRUCKING

Under Testing *(Stephens et al 2014)*

- V2X (Vehicle-to-Vehicle, Vehicle-to-Infrastructure) communication based technologies:
  - Intersection Movement Assist
  - Emergency Electronic Brake Lights
  - Bridge Height Inform
  - Curve Speed Warning

*Source: Berger (2016)*
TASK 1- Review the Status of Automated Truck Technologies

STAGE 3 TECHNOLOGY FOR AUTONOMOUS TRUCKING

Platooning:
- 10% fuel savings for the following truck (Williams et al. 2016)
- Reduced follow distance helps in improving highway capacity thus leading to reduced congestion
- Driver in following vehicle can rest or engage in other tasks thus increasing productivity
- Requires 5G LTE and legislation change regarding minimum following distance (Short and Murray 2016)

Source: Tita and Ramsey (2015)
TASK 1- Review the Status of Automated Truck Technologies

STAGE 3 TECHNOLOGY FOR AUTONOMOUS TRUCKING

Platooning: Testing

- Still in development phase and but will most likely be the transition between current trucking technology and autonomous technology (Clevenger 2019).

- Daimler has suggested that savings created from platooning does not justify the investment (Lopez 2019, SupplyChainDigest 2019)

- Peloton on the other hand says that its patented platooning tech does create savings which present a good business case (Lopez 2019, SupplyChainDigest 2019)

Source: Tita and Ramsey (2015)
TASK 1 - Review the Status of Automated Truck Technologies

STAGE 4 TECHNOLOGY FOR AUTONOMOUS TRUCKING

Highway Pilot (Semi-autonomous)

- **Uber (Newcomer and Webb 2016)**: Successfully delivered cargo for Budweiser by travelling 120 miles.
- **Daimler (Daimler 2018)**: In May 2015, the state of Nevada licensed two “Freightliner Inspiration Trucks” for normal operation on public roads.
- **Volvo (Volvo 2018)**: Developing Vera, an autonomous truck that is designed to operate in restricted areas, such as ports or warehouse districts to carry big loads along fixed routes.
- **Embark (Cliff 2017, Embark 2018)**: Embark’s retrofitted 18-wheelers can already drive themselves while on interstate highways.

*Cascadia trucks by Daimler AG with highway pilot enabled in CES 2019*  
(Source: O’Kane 2019)
TASK 1 - Review the Status of Automated Truck Technologies

STAGE 4 TECHNOLOGY FOR AUTONOMOUS TRUCKING

Highway Pilot (Semi-autonomous)

- Startsky Robotics *(Marshall 2018)*: Autonomous highway driving and remotely controlled driving in critical areas.
- TuSimple *(O’Kane 2019)*: Stage 4 test runs across different US highways and commercial delivery in partnership with 12 companies.
TASK 2 - Outline the Impacts of Automated Trucks

Comprehensive Literature Review

Impact on Truck Industry
- Critical Issues (e.g. Hours-of-service, compliance, safety, driver education, driver employment, truck parking, driver health and wellness, congestion, driver distraction)

Impact on Infrastructure
- Repurposing of existing infrastructure for automated vehicles
- Need for specialized/separate facilities (e.g. new intermodal exchange nodes, managed lanes for automated vehicles)

- FHWA
- State DOTs
- ASCE Research Database
- Academic Database
- Online Publications
TASK 2- Outline the Impacts of Automated Trucks

**Hours of Service**
Justify flexible hours of service regulations if autonomous trucks are viewed as team drivers

**Parking**
Confine currently ever-increasing parking demand due to expected flexible hours of service

**ELD Mandate**
Make ELD mandate more acceptable due to expected flexible hours of service regulations

**CSA Basics**
Reduce crashes and enhance safety in driving

**Driver Shortage**
Reduce stress of driving and less monotonous periods that will make trucking jobs more desirable

**Driver Health**
Allow more rests that will lead to better health of drivers

**Driver Distraction**
Compensate for driver distraction

**Trucking Issues**

**Economy**
Optimize fuel consumption and increase in hours of service

**ELD : Electronic Logging Device**
**CSA : Compliance, Safety, and Accountability**
TASK 2 - Outline the Impacts of Automated Trucks

**Road Signs/Markings**
Should be at least visible and at best should be able to support V2I connectivity

**Launch/Landing Pad**
Exit to exit autonomous AT tech requires design of launch and landing pad for transition and platooning

**Warehousing**
Automation of warehouse needs to be incentivized as successful implementation of AT requires automated warehouses.

**Managed Lanes**
Good alternative when adoption of autonomous trucks is low (Less than 50% for 2 lane highway)

**Dedicated Lanes**
Should be adopted when autonomous trucking is adopted highly (50% or higher for 2 lane highway)

**Charging Stations**
Non attainment statutes will push AT tech towards electric vehicles. Hence, electric vehicle charging network should be expanded to reduce range anxiety

**Roadside Equipment**
V2I tech, which complements onboard equipment of ATs, requires roadside HD cameras, 5G antennae, and link to cloud-based traffic management system

**Parking**
To automate parking and improve logistics, real-time parking monitoring infrastructure should be installed
TASK 3: Design Survey Questionnaire

Subjects of interest

What are the risks and opportunities associated with adopting automated trucks with various automation levels in the DFW region?

Survey questions

- Short and concise
- Complemented with brief descriptions
- A combination of multiple choice and text questions
- Space for comments and capability to upload documents will be provided to the respondents

Note: The data collection will take place after acquiring approval of the UT Arlington Institutional Review Board (IRB) and coordinating with relevant parties.
TASK 4- Conduct the Survey

Distribution of the Surveys

- Trucking Companies
- Commercial Drivers
- AV Truck Developers

Analysis

- Descriptive Statistics
- Critical Analysis of Survey Results

Most pressing risks/opportunities of adopting automated trucks in various automation levels in the DFW region
TASK 5 - Follow up with the survey respondents to provide recommendations

Follow up with Survey Correspondents

- Provide more detailed understanding of risks and opportunities
- Provide recommendations to manage successful transition
- Considers socioeconomic and infrastructure barriers

Findings from Discussion

Recommendations for Freight Planning
TASK 6 - Prepare Final Report

Final report documents

1. Conduct AV Technology Review
2. Conduct Impact Review
3. Prepare Questionnaire
4. Conduct Survey and Analyze
5. Follow-up and Recommendations
6. Prepare Final Report

Expected Key Findings

1- Impact on truck Industry’s critical issues
2- Impact on freight transportation infrastructure
3- Recommendations for freight planning to accommodate use of AV in freight transportation
DELIVERABLES

- Quarterly reports documenting work progress,
- Technology review (Task 1),
- Impact analysis (Task 2),
- Survey questions (Task 3),
- Survey descriptive statistics, critical analysis of survey results, and the most pressing risks and opportunities (Task 4),
- Recommendations for successful transition (Task 5),
- Draft of final report for NCTCOG review and comments, and
- Final project report.
# PROJECT SCHEDULE

<table>
<thead>
<tr>
<th>Task</th>
<th>FY 2018-2019</th>
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<tbody>
<tr>
<td></td>
<td>DEC</td>
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<tr>
<td>1. Review Technologies</td>
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<tr>
<td>2. Outline Impacts</td>
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<tr>
<td>3. Design Survey Questionnaire</td>
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<tr>
<td>4. Conduct Survey</td>
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<td>5. Provide Recommendations</td>
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<td>6. Final Reports</td>
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<td>Quarterly Reports</td>
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<td></td>
<td>Feb 24</td>
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<tr>
<td>Project Meetings</td>
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<td>As needed or upon NCTCOG request</td>
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CONTACTS AND ROLES

Jeff Hathcock
NCTCOG Project Manager
Email: jhathcock@nctcog.org

Mohsen Shahandashti, Ph.D., P.E.
UTA Principle Investigator
Email: mohsen@uta.edu

Binaya Pudasaini
UTA PhD Student
Email: binaya.pudasaini@mavs.uta.edu
REFERENCES

Berger, R. (2016). Automated Trucks: The next big disruptor in the automotive industry?


REFERENCES


Truck Specialized Parking Services

Largest provider of accurate real-time truck parking availability information

Scott Grenerth
sgrenerth@tsps.io
844.879.877 X 712
419.306.7575
May 23rd 2018
Discussion

- The National Issue
- TSPS Experience and Capabilities
- Shared Solution Opportunities
- Your State/Local Challenges
- Action Now
Regulated by time, the pressure is on

- Must have a 10hr break between driving, also 30 minute break
- April 1st electronic logging mandate = strict compliance
- Excessive loading/unloading times out of driver’s control

Regulated by time, but paid by the ____?
Truckers are Increasingly Frustrated

How long does it take to park?

Less Than 60 Minutes: 44%
Less Than 30 Minutes: 12%
Less Than 15 Minutes: 5%
1 HOUR OR LONGER: 39%

Not enough inventory; not enough information

Does ELD help?
The Truck Parking Problem

1. Increases truck emissions 10-20%
2. Reduces mobility on the major highway networks 5-15%
3. Contributes to accidents
4. Illegal, unsafe parking reduces driver safety
5. Illegal, unsafe parking impacts cargo security
6. Negatively impacts the cost of goods to consumers in your state
The Truck Parking Problem

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3. Contributes to accidents
4. Illegal, *unsafe parking* reduces driver safety
5. Illegal, *unsafe parking* impacts cargo security
6. Negatively impacts the cost of goods to consumers in your state
Trucker safety

Photo: Fox 2 Detroit
June 27\textsuperscript{th}, 2014
Aleris Rolled Products, Lewisport, KY to Thyssenkrupp, Detroit, MI

Photo: Scott Grenerth
July 3rd, 2014
Unauthorized/illegal parking

Iowa rest area. Ohio rest area...

Photo: Rick Fredricksen/Iowa Public Radio
Other locations

- Exit ramp shoulder, secondary street shoulder.
  - Damage $

- Unauthorized parking, retail store lot.
  - Damage to pavement $, truck is “booted”

- Far away from where the load is delivering, picking up.
  - Congested traffic, lost productivity for the next day...
Kriska to Unilever
Regulated by the hour paid by the ___
Jason’s Law Truck Parking Survey

Introduction

This report documents the findings of the Jason’s Law Truck Parking Survey. This survey is a requirement of The Moving Ahead for Progress in the 21st Century (MAP-21); P.L. 112-141 legislation that became effective on October 1, 2012. “Jason’s Law” was established to provide a national priority on the adequacy of long-term parking for commercial motor vehicles on the National Highway System (NHS) to the safety of motorized and non-motorized users and for commercial motor vehicle operators. Specifically, Jason’s Law requires the U.S. Department of Transportation (DOT) to conduct a survey and comparative assessment in consultation with relevant State motor carrier representatives to:

1. Evaluate the capability of each State to provide adequate parking and rest facilities for commercial motor vehicles engaged in interstate transportation;
2. Assess the volume of commercial motor vehicle traffic in each State; and
3. Develop a system of metrics to measure the adequacy of commercial motor vehicle parking facilities in each State.

The DOT is required to make the results of this work publicly available on a website and periodically update the survey. Even without the legislated requirements, the issue of truck parking has long been a priority for the DOT and its operating administrations. Jason’s Law helps to advance a more comprehensive set of programs, efforts, and research to improve truck parking and provide States and Metropolitan Planning Organizations with resources to identify parking needs and to encourage improvements and investments.

Jason’s Law is named in honor of Jason Rivera. On March 4, 2009, Jason stopped for a delivery in Virginia and then headed toward a delivery destination in South Carolina. While only 12 miles from the delivery location, he needed to find parking to rest through the night as his arrival location was not yet open to receive deliveries. Jason did not have a safe place to park. Jason had learned from truckers familiar with the area that a nearby abandoned gas station was a safe location to park and proceed to park there for the night. Tragically, he was attacked and murdered at this location while he slept with his killer taking both his life and $700 that he had in his wallet.

Since his death, Jason’s wife, Hope Rivera, has worked diligently to bring attention to the national truck parking shortage problem. Her efforts, along with those of countless family members, friends, and representatives from the trucking industry, helped to push forth legislation to focus national attention on the issue. After several versions of the Jason’s Law legislative language were brought to Congress, the legislative language described above was incorporated into MAP-21.

Truck Parking – A National Challenge

Truck parking shortages are a national safety concern. An inadequate supply of truck parking spaces can result in two negative consequences: first, tired truck drivers may continue to drive because they have difficulty finding a place to park for rest and, second, truck drivers may choose to park at unsafe locations, such as on the shoulder of the road, exit ramps, or vacant lots, if they are unable to locate official, available parking. Numerous public, private, academic, and non-profit studies have been completed on the adequacy of truck parking, and these studies have some common findings, including an expected growth in truck activity, severe shortages of parking for trucks, lack of information on truck parking opportunities, and challenges due to limited delivery windows and specific rest requirements. More detail on these studies is provided below.

Previous Truck Parking Studies and Key Findings

The U.S. Department of Transportation

The DOT has completed several studies addressing the Nation’s truck parking needs:

- To evaluate safety issues related to driver rest requirements, the 1996 Commercial Driver Rest and Parking Requirements: Making Space for Safety study investigated the need for truck parking facilities acknowledging the difference between publicly supplied truck parking spaces and spaces available at privately operated facilities.
- To evaluate the amount of parking availability in 2002, the FHWA completed the Study of Adequacy of Truck Parking Facilities, which addressed an array of issues tied to truck parking and determined that the demand for truck parking spaces was underserved by the supply.
Lessons Learned at TSPS

- Technology increases the value of each asset through better utilization
- Users have indicated a willingness to pay (real-time availability, reservations, mobility, security)
- Underutilized real estate is attracting investment for truck parking and storage
Opportunity

PROVIDE BETTER UTILIZATION OF TIME-SENSITIVE PARKING ASSETS THROUGH ACCURATE REAL-TIME INFORMATION MANAGEMENT AND EXPANDED PARKING OPTIONS
Result

PROVIDE BETTER UTILIZATION OF TIME-SENSITIVE PARKING ASSETS THROUGH ACCURATE REAL-TIME INFORMATION MANAGEMENT
TSPS Product Suite

- Real-Time Parking Availability
- Predictive Parking
- Online Reservations
- Dynamic Routing
- Daily Service Limit Alerts
- Enable Under-Utilized Facilities

ASSET UTILIZATION
It’s better than nothing.

Information is only useful when it’s accurate.

When was last update?

– Was the trucker able to see every parking space?

Policy may have changed

– No more parking in this shopping center, abandoned lot...
Roadmap: Functional Expansion Using Accurate Data

- Non-traditional truck yard **management services** (SaaS)
- **Border crossing** applications (truck wait time)
- Truck parking **reservations** services (Q3)
- **Chain-Up** services (Q4)
- **Predictive** parking (Q1, 2019)
- Support for platooning, CAV parking requirements, ELD integration
- Urban center commercial delivery parking optimization (Smart Cities)
TSPS Today

- **4 states:**
  - 77 facilities under contract to deliver real-time availability (public and private)

- **2 states:**
  - 3 private facilities under partnership contract for secure intermodal truck operational parking and storage

- **4 states:**
  - In discussion to re-open and operate closed rest areas

- Selected on Smart Cities (Columbus, OH) team
  - Urban CV parking

**~25,000 trucks per day have opportunity to take advantage of the service**
Client & Industry Recognition

JTL CARRIERS LLC,
9218 WYNDHAM HILLS COURT,
FRANKLIN, WI 53132

Truck Smart Parking Services
4196 Central Street
Detroit, Michigan
48210

Attention: Scott McKenna, Director

Dear Scott,

Re: Truck Smart Parking Services, I-94 corridor.

November 30, 2015


to: TSPS Inc.

SUBJECT: TSPS, Inc. and Smart Truck Parking Services

Truck Smart Parking Services – Confidential - Not for Distribution
Project financing options:

1. Client pays installation and O&M
2. Grants cover all or some of installation and O&M
3. Client leases the platform including services
4. P3 service model: TSPS pays and gets revenue stream until all costs are recovered, then client may get share of reservation and other user fees.
5. P3 real-estate model: Facility owner contributes the facility. TSPS contributes the technology. Revenue share after costs recovered.
Discussion

- Our platform exists;
- Install base ~100 by end of year;
- Data feed integration (TMC, 511, etc.);
- Option to install and maintain signs;
- Demand is there for a reservations service to subsidize the costs;
- We are prepared to assist with grant requests
Truck Parking Models

Options:

1. Shipper/receiver provides parking on-site
2. Shipper/receiver partners with provider to operate parking
   – Adjacent land, cooperatively within industrial park...
3. State/municipality partnership
   • Mutually beneficial terms
Your role to ensure safe and efficient transportation

1. Work with shippers/receivers to provide parking options
2. Let shippers/receivers/municipalities know there are partners to provide parking solutions
3. Work with a partner to provide accurate real-time parking information and capacity
Truck Specialized Parking Services

Largest provider of accurate real-time truck parking availability information

Scott Grenerth
sgrenerth@tspsi.o
844.879.877 X 712
419.306.7575
May 23rd 2018
STATEWIDE TRUCK PARKING STUDY

Texas Freight Mobility Plan Implementation
Lack of available parking causes “Informal Parking”
PROJECT OVERVIEW
## Truck Parking Study Overview

<table>
<thead>
<tr>
<th>PURPOSE</th>
<th>Assess and address truck parking needs with practical, innovative and cost-effective strategies</th>
</tr>
</thead>
</table>
| GOALS | • Enhance the safety, mobility and efficiency on the Texas Multimodal Freight Network  
• Develop actionable strategies to meet truck parking needs across the state  
• Use technology to optimize existing truck parking assets |
| OBJECTIVES | • Improve safety on the roadways  
• Identify specific needs for truck parking in Texas  
• Assess the ability of current public and private facilities to address truck parking needs  
• Identify technologies and other strategies to address truck parking needs  
• Assess the ability of current and future technologies to help drivers  
• Recommend strategies to improve truck parking across the state of Texas  
• Develop an action plan for technology implementation |
Truck Parking Study Tasks

Collect Data and Identify Best Practices → Conduct Inventory and Utilization Analysis → Current and Future Conditions Analysis

Data Collection and Analysis

Round 1 Stakeholder Workshops → Stakeholder Surveys → Stakeholder Interviews

Round 2 Stakeholder Workshops → Develop Recommendations → Implementation Strategies → Final Report

Stakeholder Engagement
Challenges

- Inadequate truck parking
- Promising solutions, but no best practices yet
- Fragmented technology use
- Local laws that stymie or promote innovation
- Autonomous vehicles and truck parking?
- HOS/ELD changes will impact solutions
WE NEED YOUR INPUT
Topics for Discussion

- Is truck parking an issue in the region? If so, what are issues?
- Where is informal truck parking occurring?
- Where is more truck parking needed?
- What are some strategies to address the issues?
- What role can TxDOT play?
http://Camsys.participoll.com/

URL and QR Code are also shown at the bottom of your agenda
Interactive Discussion Questions

Please select a choice to test the polling:

a) Yes
b) No
c) Maybe

During any question, you can enter additional comments in the text box below the answer choices.

http://Camsys.participoll.com/
1. What is the greatest truck parking challenge in this region?

a) Truck parking does not exist in highly developed areas
b) Existing parking is occupied or reserved near pickup/delivery
c) Congestion and Hours of Service limitations
d) Ordinances or regulations preventing overnight truck parking
e) Other (please comment)

http://Camsys.participoll.com/
Interactive Discussion Questions

2. What is the most critical effect of informal truck parking?

a) Congestion  
b) Productivity  
c) Safety  
d) Air Quality  
e) Economic Development  
f) Other (please comment)

http://Camsys.participoll.com/
3. What technologies do you prefer for getting information about truck parking?

a) Smartphone/In-Cab apps
b) Web-based systems which dispatchers can use
c) Variable message signs on the highway
d) Dedicated radio station messaging
e) Other (please comment)

http://Camsys.participoll.com/
Questions?

Take our quick freight survey any time:
https://texasfreightstudies.metroquest.com/

Round 2 of Workshops in Summer 2019
Preliminary results of projects to be presented