Assessing the Use of Navigation Systems in the Trucking Industry
Phase 1: Driver and Carrier Survey Analyses

April 2013
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EXECUTIVE SUMMARY

There is a dearth of information and understanding on the role and scope of navigation system use in large trucks. Furthermore, the relationship between “nav” system use and safety is unclear; both in terms of safety benefits and consequences. Anecdotal evidence suggests that using nav systems that are not specifically designed for large truck operations has a detrimental impact on safety.

Recent media attention and industry concerns were the motivating factors for the selection of this topic in 2011 as a Top Priority by the American Transportation Research Institute’s (ATRI’s) Research Advisory Committee (RAC).\(^1\) As the result of this recommendation, ATRI commenced an examination of the use of nav systems by the trucking industry and what causal role those systems may have played in large truck safety events.

Given that little crash data exists that directly ties large truck crashes to nav system usage, ATRI researchers explored alternative methodologies for investigating this important safety issue. The two new approaches will 1) assess nav system usage in the industry, and 2) attempt to identify the technical basis for nav system failures and inadequacies from a truck operations perspective.

In this first phase of the research, ATRI collected and analyzed a large survey data sample on nav system usage, including perceived utility, and associated benefits and risks for truck drivers who use nav systems. Furthermore, this study identified the key priorities that nav system providers should address in order to meet the needs of the trucking industry.

The ATRI research team collected data from over 800 professional truck drivers and motor carrier executives through online and in-person surveys. ATRI’s surveys assessed stakeholders’ utilization of nav systems as well as user perceptions associated with the systems. The survey was designed to generate quantitative analyses using multiple-choice questions, though a small portion of open-ended questions were included to capture more explicit commentary. In total, there were 677 driver survey respondents and 169 carrier survey respondents.

Overall results indicate high levels of use and trust in nav system technology by industry stakeholders, especially among new drivers\(^2\) and large carriers\(^3\). According to the carrier respondents, 51 percent allowed or encouraged their drivers to use nav systems. Furthermore, 51 percent of carriers supplied nav systems in their fleets.

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\(^1\) ATRI’s Research Advisory Committee (RAC) is comprised of industry stakeholders representing motor carriers, trucking industry suppliers, labor and driver groups, law enforcement, federal government and academia. The RAC is charged with annually recommending a research agenda for the Institute.
\(^2\) Defined as having less than one year experience.
\(^3\) Carriers with 250 or more power units.
According to the driver respondents, 88 percent of their carrier employers allowed or encouraged nav system use.

The increased popularity and use of nav systems in the trucking industry have resulted in new nav system-related safety concerns. These concerns primarily center on truck driver use of nav systems that are principally designed for passenger vehicles, which may result in a truck driver following directions and routes that are inappropriate for large trucks. The majority of driver respondents (54%) who used a nav system used one specifically designed for commercial trucks. However, nearly one-third (31%) used a car-oriented nav system. Stand-alone nav units were the most commonly used nav systems according to both driver and carrier respondents.

Numerous news articles provide anecdotal support for the proposition that nav systems may have been a contributing, or even primary, factor in many large truck crashes. According to ATRI survey respondents however, these crashes may occur at a negligible rate. Only two percent of driver respondents indicated that, at some point in their career, they had been involved in a crash that they believe was caused by directions or information provided by a nav system. Responses from carriers imply a similarly low rate. In a two-part question, carriers were asked 1) how many crashes their drivers reported as being the result of a nav system error and 2) how many crashes they, the carrier, believed were due to nav system errors. According to the carriers, an average of four nav system-related crashes were reported per year for their entire fleet. However, carriers believed that, on average, only two of the four reported crashes were actually the result of nav system use.

This Phase 1 research provides an overview of the current environment of nav system use in the trucking industry, including system type and scope of use, as well as the levels of trust associated with the efficacy of navigation technologies. ATRI anticipates conducting a Phase 2 analysis that will collect and compare quantitative data on nav system-generated routes with known global positioning system- (GPS-) based truck routes and restrictions.
1.0 INTRODUCTION

As background, navigation systems use a combination of global positioning system (GPS) signals, digital map data and navigation algorithms to direct drivers to given destinations. Drivers are directed, typically turn-by-turn, by both visual and auditory outputs (map display on a screen and spoken directions). Depending on the type of “nav” system utilized, users can access information regarding speed, distance, heading and time to destination. Nav systems may also contain the locations of gas stations, truck stops, restaurants, and many other points of interest (POI) as well as posted speed limits on roadways. Given the functional benefits of these systems, it is not surprising that nav systems are becoming commonplace in the nation’s passenger and commercial vehicles. That said, the impact these devices have on driver behavior, routing decisions and safety is not fully understood. Furthermore, the role that these systems play in large truck crashes is also unknown.

Apprehensions about the safety of such systems, particularly within the trucking industry, have recently developed. These concerns have typically centered on truck drivers using a nav system designed for passenger vehicles and following system directions that may be incorrect or inappropriate for large trucks. To address this issue, the Federal Motor Carrier Safety Administration (FMCSA) recently announced new nav system training requirements for entry-level truck drivers.\(^4\) Related issues such as the potential for driver distraction have further driven legislation aimed at regulating the types of nav systems legal for use in a commercial truck.\(^5,6\)

Highlighting recent media attention and industry concerns on this subject, the American Transportation Research Institute’s (ATRI) Research Advisory Committee (RAC) identified as a top priority research topic an investigation of the methods used for providing directions to drivers. Given that little crash data exists that directly ties truck crashes to nav system use, ATRI researchers developed several approaches for investigating this important safety issue.

In this first phase, ATRI examined the extent of nav system use for providing directions to drivers as well as driver and carrier perceptions on the use of this technology. For this phase, ATRI surveyed 677 truck drivers and 169 motor carriers.

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2.0 BACKGROUND

In recent years, consumer acceptance of nav systems has increased significantly. A poll of professional truck drivers conducted in 2007 indicated that 11 percent of respondents used GPS navigation devices. This number grew to 19 percent in 2008 and 27 percent in 2009; by 2012 this population reached 54 percent. According to ABI Research, global shipments of commercial nav systems, such as those used in large trucks, will climb from 3 million in 2010 to 7.5 million by 2015.

However, numerous news articles provide anecdotal evidence that nav units contribute to large truck crashes. For example, bridge strikes have been particularly troublesome in the state of New York. The New York State Department of Transportation (DOT) has stated that 81 percent of these types of crashes were a consequence of large trucks using non-commercial or outdated GPS systems for navigation. These and other crash types blamed on the use of nav systems have spurred a significant amount of negative press, which has caught the attention of legislatures both in the U.S. and abroad.

Beyond concerns regarding the use of car-oriented nav systems by truck drivers, the potential for driver distraction from nav system use has been raised as another safety issue. In a 2005 review of the truck driver distraction problem, the U.S. DOT and the National Highway Traffic Safety Administration (NHTSA) acknowledged that most driver distraction research to date was primarily focused on passenger vehicles and cellular phone use. The report highlights a lack of information regarding the extent of truck driver distraction from in-vehicle technologies such as nav systems or how any such distractions may differ from those experienced by passenger car drivers.

Research investigating the impacts of these systems on truck drivers’ route choices found that deviation from suggested routes occurs relatively frequently and for different reasons. In an experiment that tracked 100 truck drivers for over two months, truck drivers kept a log of when and why they deviated from routes suggested by the nav

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12 Ibid.
system. The availability of faster or more familiar routes were the most frequently reported reasons for divergence. Other reasons included blocked access to the suggested route and to avoid congestion.\textsuperscript{16}

Additional research cites possible limitations in nav system design and elucidates warnings about nav system use. However, an equal amount of literature challenges these arguments and champions the enhancements to safety and productivity achievable in both personal and commercial vehicle deployment. Although the majority of this research focused on the utilization of nav systems in personal vehicles, a number of studies illustrate the advantages associated with nav system use by professional truck drivers. In a 2006 study, researchers conducted an eight-week trial of portable nav systems in four large truck fleets. The research found that drivers would spend an average of 676 fewer minutes (11.3 hours) annually looking for destinations if they were to use a nav system. While some of the fleets saw as much as an 89 percent reduction in lost minutes, the time benefit was largely dependent on the type of operation, with multi-drop fleets experiencing the greatest benefits. Those drivers with regular, fixed-route runs were less likely to benefit from nav systems. Since this type of operation typically travels the same routes repeatedly, the time spent programming the nav system and the occasional incorrect routing can significantly diminish the time savings relative to that experienced by other fleet types.\textsuperscript{17}

Additionally, research has found that most drivers find nav systems less distracting than maps or road atlases or following printed directions.\textsuperscript{18} Despite the strong growth in the nav system market, conventional methods for providing directions to drivers, such as printed maps, remain popular among drivers.\textsuperscript{19} In a 2012 poll of nearly 500 professional truck drivers, a standard truck road atlas was the most preferred method among the survey’s routing options (69%), followed by a GPS routing device (54%), GPS load technology (21%), and route planning software (19%).\textsuperscript{20} Nonetheless, GPS navigation products and internet-based map services are quickly replacing the atlas.\textsuperscript{21} Older drivers may still prefer paper maps, but the preponderance of consumers are switching to digital sources for their navigation needs.\textsuperscript{22}

The majority of research, conducted primarily outside of the United States, fails to adequately address nav systems used specifically by truck drivers. Furthermore, nav


\textsuperscript{22}Ibid.
system vendors often sponsor truck-oriented nav system research; significantly less literature is derived from independent scholarly sources.

3.0 METHODOLOGY

This first phase of research focused on the use of, and perspectives related to, truck driver use of nav systems.

The driver survey was designed to solicit a variety of inputs. It consisted of 17 questions related to demographics, extent/frequency of nav system use and measurements of driver perceptions of navigation technology. The carrier survey, comprised of 22 questions, focused on management perceptions and experiences with nav system use. The questions were primarily of multiple-choice, closed-ended format allowing for quantitative analysis, though a small portion of open-ended questions also generated qualitative data.

The survey was distributed at two industry events; the 2012 Mid-America Trucking Show in Louisville, Kentucky and the 2012 Georgia Motor Trucking Association’s annual Truck Driving Championships. In addition, an online version of the survey was made available and publicized through ATRI’s industry contact database and multiple state trucking associations memberships.

4.0 DRIVER SURVEY ANALYSIS

As previously noted, the ATRI research team collected data from a total of 677 professional truck drivers; distribution of the paper survey resulted in 211 responses and the online survey collected data from an additional 466 drivers. The survey is included in Appendix A.

4.1 Driver Demographics

Demographic questions were included in the survey to account for differences among participants, such as driving experience. Compared to industry averages obtained from American Trucking Trends: 2012, for-hire fleets (69%) were over-represented in the ATRI sample of drivers, while private fleets (31%) were under-represented (Figure 1). Of those drivers who reported employment in a for-hire fleet, more than half (62%) worked in the truckload (TL) sector. Figure 2 shows the distribution of drivers’ sectors of operations.

Figure 1. Truck Driver Representativeness by Segment

As displayed in Table 1, the majority of the respondents (54%) operated a 5-axle dry van vehicle configuration.
Table 1. Distribution of Primary Vehicle Configuration, Driver Responses

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<th>Configuration</th>
<th>Percent (%)</th>
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<tr>
<td>5-axle Dry Van</td>
<td>54</td>
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<tr>
<td>5-axle Flatbed</td>
<td>13</td>
</tr>
<tr>
<td>5-axle Tanker</td>
<td>5</td>
</tr>
<tr>
<td>Straight Truck</td>
<td>4</td>
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<tr>
<td>Longer Combination Vehicles (Triples, Doubles, etc.)</td>
<td>8</td>
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<tr>
<td>Other (Reefer, Dump, etc.)</td>
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The survey also captured respondents’ professional truck driving experience (Figure 3). The majority of respondents (71%) reported over 10 years of professional driving experience.

Figure 3. Distribution of Drivers’ Professional Experience

Figure 4 displays the number of respondents who reported moving freight at specific trip lengths. On average, 47 percent of respondents’ typical trips were long-haul (500 or more miles). Short-hauls (100-500 miles) constituted 39 percent of the respondents’ typical trips and local pick-up and deliveries (less than 100 miles) were 14 percent of the trips, on average.
4.2 Driver Navigation System Utilization

Drivers were asked to identify how their routes are chosen and how they typically obtain directions for these routes. The majority of drivers (59%) make their own routing decisions and provide their own directions. Of the remaining drivers, 28 percent indicated that their carrier provides directions and 12 percent use a combination of carrier and self-provided directions. A small fraction of respondents (1%) reported receiving directions by some other means such as from “specially permitted load” maps that identify specific hazmat or oversize/overweight routes.

Respondents were then asked to identify the methods most often used to provide directions. Stand-alone nav units, such as those manufactured by Rand McNally, Garmin and PC Miler, were the most commonly used method (41%) for providing directions (Figure 5). In-cab/installed nav systems such as those provided by Qualcomm, PC Miler, and PeopleNet, were the next most commonly used method (17%), followed by hard copy atlases or road maps (15%). Respondents used printed directions (7%) such as those from web-based applications (Google Maps or MapQuest) and directions from a dispatcher (7%) in equal proportions. Use of smartphone-based nav systems constituted five percent of drivers’ responses. Nine percent of survey respondents reported receiving directions through a combination of methods or through an alternative approach such as a route card or from instructions given by the shipper or receiver.
Drivers were asked how often they use a nav system in their trucks and to what degree motor carriers regulate their usage. A large majority (88%) indicated that nav systems were allowed or encouraged, but only 22 percent of those respondents indicated that a nav system was provided by their carrier. Only one percent of drivers responded that their employing carrier specifically prohibited the use of a nav system while five percent said their carrier discouraged their use but had no formal policy. Respondents who chose “other” (6%) indicated that they are either self-employed with no formal policy or that their carrier has no formal policy and use of such systems is neither encouraged nor discouraged.

Drivers were then asked to identify the usage frequency of nav systems in their trucks. While 15 percent of the drivers surveyed typically do not use a nav system at all, approximately 22 percent use a system when they are unfamiliar with the route. Others use a nav system only when they have questions about the route provided by their carrier (2%) or have lost their way (1%). However, over half (60%) of the respondents have a nav system running for all travel, even if the driver is familiar with the route (Figure 6). Reasons drivers use nav systems on a known route may include accessing the secondary benefits of the nav system, such as fuel mileage, traffic data, posted speed limits and locations of POI.
When asked how often they needed a nav system but did not have one, half of the drivers (50%) answered “Never” (Table 2). Given the number of drivers that reported using a nav system at least sometimes, this likely indicates that drivers were never without a system rather than never needed one.

Table 2. Distribution of Drivers’ Need for a Navigation System

<table>
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<th>Occurrence of Need</th>
<th>Percent (%)</th>
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<tr>
<td>Daily</td>
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<td>At least once a week</td>
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<td>Less than once a month</td>
<td>12</td>
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<td>Several times a year</td>
<td>15</td>
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<td>Never</td>
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Totals do not equal 100% due to rounding.

Of the drivers who used a nav system, 54 percent use a system specifically designed for truck routes and operations while 31 percent\(^{24}\) did not use a truck-specific device (Figure 7). While the majority of ATRI survey respondents use a truck-specific system, a 2010 study reported that nearly 60 percent of long-haul truck drivers who use a nav

\(^{24}\) 23% passenger car device; 8% smartphone application.
system employ a device designed for passenger vehicles. Several factors may account for this difference. Large truck-oriented nav systems may be more widely available now and drivers may be more aware of the potential negative impacts of using car-oriented systems.

**Figure 7. Distribution of Navigation Systems Designed for Truck Use, Driver Responses**

Respondents who used a truck-specific nav system were asked what types of units they used. Rand McNally units (39%) were most commonly used by these drivers, followed by Garmin (21%), Qualcomm (18%) and PC Miler (9%). Other types (13%) listed by the respondents included Magellan, TomTom and TeleType.

Of the drivers who utilized a carrier-provided nav system, 80 percent reported that the system is specifically designed for truck routes. Fourteen percent used a system that was not designed specifically for use in a commercial truck (an application on a smartphone phone [3%] or a nav system designed for passenger vehicle use [11%]) and six percent did not use a nav system. These results suggest that carriers are providing far more truck-oriented nav systems than passenger vehicle devices.

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4.3 Driver Attitudes toward Navigation Technologies

Beyond empirical data on system use, drivers were asked a series of questions to gauge their opinions and perspectives on nav system efficacy and benefits. The majority of drivers are at least “somewhat” trusting that the directions provided are accurate (67%); an additional six percent of drivers are very trusting and use a nav system without reviewing directions before starting their route (Figure 8).

Fifteen percent of drivers who use a nav system always double check the directions before starting their route because they do not trust the system’s accuracy. Only three percent do not use a nav system because they do not trust that directions are reliable.

![Figure 8. Distribution of Drivers’ Trust in Navigation Systems](image)

To draw on the participants’ actual experiences, drivers were given a list of positive and negative nav system attributes. When asked what benefits they liked, respondents most often highlighted that the system kept track of miles traveled and calculated how far the driver still needed to travel on their route (14%) (Figure 9). Those who answered “other” (3%) listed the following examples as features they liked:

- remembers locations;
- records time stopped and average speed;
- provides directions through Bluetooth; and
- makes it easy to communicate arrival time to customer.
When truck drivers were asked which attributes they liked least, the most commonly selected response was that the system was outdated (22%) (e.g. did not have road improvement updates). Respondents who answered “other” (6%) noted that they have never had problems with their nav system and therefore had no dislikes, or had never used one (Figure 10). Examples of specific dislikes provided by the respondents included:

- the commercial truck model is expensive;
- the nav system is slow to recalculate; and
- the nav system does not include permissible truck routes around restricted areas and often routes a very long and indirect way around a restriction.
When asked about crash experiences related to nav systems, only two percent of respondents indicated involvement in a crash that the driver believed was due to nav system information or directions. When asked to select a nav system error that contributed to the crash, the respondents generally indicated that the system directed the driver to a road unsuitable for trucks, with inadequate bridge/overpass clearance, and/or where a turnaround maneuver was not possible. These participants also indicated that a combination of multiple nav system errors was believed to contribute to the crash.

Finally, respondents were asked to share any additional comments or opinions they had relating to the use of nav systems in large trucks. The commentary suggested that nav systems are useful tools for the trucking industry and that drivers, overall, liked their nav systems. Other remarks noted that these systems are not wholly reliable and suggested features that could increase the utility of such systems. These additional comments\(^\text{26}\) included the following:

- “They should be mounted on the dash not the windshield. They are just another tool to be used like the atlas or verbal instructions. The driver is responsible for

\(^{26}\) With minor editing for grammar and readability.
making the final decision on what to do like turn here, stop, or which route to take.”

- “I always check the directions against Google and a phone call to shipper or receiver. Once I know the GPS is correct, I use it as an aid on where to turn and how much mileage is left. Also I know it isn’t always correct but more often than not it tells which lanes to be in ahead to follow the correct highway in the city.”
- “Need weather radar for locations of severe weather.”
- “Need more truck-friendly systems on the market.”
- “There are not many nav systems for trucks. We need more nav info for truck routing, speed changes, and restricted truck routes.”
- “Not updated enough with highway info.”
- “Units should be used to enhance performance. Not to be 100 percent counted on. Sometimes common sense is all that works.”
- “These are good tools, but it is a driver’s responsibility to verify routing.”

4.4 Driver Experience Comparisons

The ATRI research team hypothesized that driver experience may be a factor in determining nav system use. Survey responses were therefore separated by experience level to explore the relationship between nav system use and years of professional driving experience. As shown in Figure 11, drivers with less than one year of experience are more likely than drivers with more than 10 years of experience to use a nav system for all travel. Likewise, newer drivers were more likely to be at least somewhat trusting of the routes provided by the nav system.

Figure 11. Driver Navigation System Use and Trust Level by Years of Driving Experience
4.5 Driver Survey Key Findings

Key findings of the driver survey include:

- The majority of drivers (59%) made their own routing decisions and provided their own directions.
- Stand-alone nav systems were the most commonly used method for providing directions to truck drivers (41%).
- Over half (60%) of the respondents use a nav system on all of their trips, even if the driver is familiar with the route.
- Of the respondents who reported using a nav system, most drivers used a system designed specifically for truck routes (54%). However, nearly one third (31%) used systems designed for use in a passenger vehicle.
- Of the drivers who reported that their carrier provided a nav system, 80 percent stated that it was designed specifically for truck routes.
- Trust in nav systems is high with 73 percent of drivers being at least somewhat trusting of the systems (67% were “somewhat” trusting and 6% were “very” trusting).

5.0 CARRIER SURVEY ANALYSIS

In order to gain an understanding of motor carrier opinions, an online survey was conducted which yielded responses from 169 industry executives. The survey is included in Appendix B.

5.1 Carrier Demographics

As in the driver survey, demographic questions were included in the carrier survey to assess respondent differences, such as fleet type and number of power units. Similar to the driver results, for-hire respondents were over-represented in the survey sample population (79% compared to the national average of 33% of carriers), while private fleets were under-represented (21% versus the national average of 53%). As shown in Figure 12, the majority (62%) of for-hire fleets operated in the TL sector, which is consistent with the driver responses.
Nearly half of the carriers surveyed (49%) operate small fleets with fewer than 50 power units. Carriers with 50-249 power units represented 24 percent of respondents followed by fleet sizes of 250-999 (14%) and 1,000 or more (14%) power units. As shown in Table 3, a 5-axle dry van was the most popular vehicle configuration (45%). Additionally, Figure 13 displays the number of respondents who reported moving freight for particular trip lengths. On average, 40 percent of trips made by the respondents’ fleets were long-haul trips (500 or more miles); 38 percent were short-haul trips (100-500 miles) and 22 percent were local/pick-up and delivery trips (less than 100 miles).

<table>
<thead>
<tr>
<th>Configuration</th>
<th>Percent (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>5-axle Dry Van</td>
<td>45</td>
</tr>
<tr>
<td>5-axle Flatbed</td>
<td>15</td>
</tr>
<tr>
<td>5-axle Refrigerated Trailer</td>
<td>15</td>
</tr>
<tr>
<td>5-axle Tanker</td>
<td>10</td>
</tr>
<tr>
<td>Other (Reefer, Dump, etc.)</td>
<td>9</td>
</tr>
<tr>
<td>Longer Combination Vehicles (Triples, Doubles, etc.)</td>
<td>4</td>
</tr>
<tr>
<td>Straight Trucks</td>
<td>3</td>
</tr>
</tbody>
</table>

Totals do not equal 100% due to rounding.
5.2 Carrier Navigation System Utilization

The research team asked carriers to identify the source of routing information for their drivers. The majority of carriers indicated that both the driver and the carrier have a role in the planning of a driver’s route for both pre-trip routing (58%) and route changes (57%) (Table 4). A slightly higher percentage (21%) of carriers reported providing directions to drivers for pre-trip routing than allowed drivers to determine their own routes (15%), while carriers (19%) and drivers (19%) were equally responsible for determining appropriate route changes during a trip. Only a small fraction of respondents reported receiving directions by another source such as the customer or as the result of specially permitted routes for oversize or hazmat loads.

### Table 4. Percent of Routing Responsibility by Provider

<table>
<thead>
<tr>
<th>Provider</th>
<th>Pre-trip Routing (%)</th>
<th>Route Changes (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>A combination of both the carrier and the driver provide directions</td>
<td>58</td>
<td>57</td>
</tr>
<tr>
<td>Carrier provides directions to drivers (drivers do not have authority to plan or change their routes)</td>
<td>21</td>
<td>19</td>
</tr>
<tr>
<td>Drivers provide their own directions (drivers never receive routing information from the carrier)</td>
<td>15</td>
<td>19</td>
</tr>
<tr>
<td>Other</td>
<td>6</td>
<td>5</td>
</tr>
</tbody>
</table>
The next survey question asked carriers how many trucks in their fleet were equipped with a nav system that was installed/supplied by the carrier. Fifty-one percent of the respondents provided nav systems for at least some of their trucks while 49 percent do not supply these systems in any of their vehicles. As shown in Table 5, when separated by fleet size, carriers with both 250-999 and 1,000 or more power units were most likely to provide nav systems for the large majority of the trucks in their fleets (76%-100%). Carriers with fewer than 50 power units were the least likely to equip their vehicles with these systems. This disparity may be due to large carriers tending to have capital available for technology purchases and subscription services, while small carriers may be unable to justify the cost.

<table>
<thead>
<tr>
<th>Fleet Size</th>
<th>None (%)</th>
<th>25% or less</th>
<th>26-50%</th>
<th>51-75%</th>
<th>76-100%</th>
</tr>
</thead>
<tbody>
<tr>
<td>1,000+</td>
<td>30</td>
<td>22</td>
<td>9</td>
<td>0</td>
<td>39</td>
</tr>
<tr>
<td>250-999</td>
<td>48</td>
<td>4</td>
<td>0</td>
<td>4</td>
<td>43</td>
</tr>
<tr>
<td>50-249</td>
<td>45</td>
<td>18</td>
<td>3</td>
<td>10</td>
<td>25</td>
</tr>
<tr>
<td>Less than 50</td>
<td>60</td>
<td>4</td>
<td>4</td>
<td>4</td>
<td>28</td>
</tr>
</tbody>
</table>

Totals do not equal 100% due to rounding.

For those trucks that are equipped with a nav system provided by the carrier, stand-alone units were the most common type of equipment (50%) followed by embedded nav systems (32%) and other nav technologies such as a company-provided smartphone (19%). Of these systems, 79 percent provide truck-specific routing information while 21 percent are designed for general traffic/passenger vehicles. These findings are very similar to the driver responses (80% of carrier-provided nav systems were truck-specific and 14% were designed for passenger vehicle use) and support the idea that carriers are providing far more truck-oriented nav systems than passenger vehicle devices.

For those trucks not equipped with a company-provided nav system, 32 percent of carrier respondents most often use printed directions from a web-based application such as Google Maps or Map Quest to provide directions for a driver’s route. Carriers also identified the following as route information sources supplied to drivers: dispatchers (29%), atlases or road maps (19%), navigation/routing applications on a cellular phone (3%) and other methods (13%) such as printed directions from customer databases or state websites. Only four percent of the carriers never provide directions to the driver.

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27 18% passenger car device; 4% smartphone application. Total does not equal 100% due to rounding.
5.3 Carrier Attitudes toward Navigation Technology

The survey then asked carriers if they had any specific rules or policies on nav system use by their drivers. As shown in Figure 14, nearly half of the respondents (41%) did not have a formal policy and neither encouraged nor discouraged use. The majority (51%), however, allowed or encouraged nav system use.

**Figure 14. Distribution of Carrier Navigation Use Policy**

Generally, carriers felt that nav systems are effective at providing benefits that outweigh the cost of providing the system. Of the 51 percent of carriers who provide nav systems in at least some of their trucks, 21 percent felt that the systems are very effective (benefits always outweigh cost) and 21 percent found them to be somewhat effective (benefits sometimes outweigh the cost). A small proportion of respondents (3%) thought the systems were not effective and benefits provided by the systems never outweighed the cost. Of the 49 percent of carriers who do not provide nav systems, 24 percent intend to provide them in the future while 31 percent do not. As a follow-up question, carriers who do not provide nav systems were asked if their drivers ever requested one. Forty-eight percent of these carriers have not received any requests while 36 percent have received requests but not often, and 17 percent have received these requests frequently.

Regardless of the fleet’s nav system use, carriers indicated a general trust in the accuracy of the systems. The majority (54%) were somewhat trusting (“drivers should review directions before starting a route”) while a smaller proportion of respondents
(8%) were very trusting. Other carriers did not trust the accuracy and either encouraged drivers to double check directions before starting a route (23%) or discouraged the use of a nav system (10%) because they do not believe the directions are reliable. A small portion of carriers (5%) had no opinion of a nav system’s accuracy or were not familiar with this technology.

Finally, the survey investigated crash experiences in which the driver or the carrier believed the crash was due to nav system error. In a two-part question, carriers were asked 1) how many crashes their drivers reported as being the result of a nav system error and 2) how many crashes they, the carrier, believed were due to the systems. According to the carriers, an average of four nav system-related crashes were reported per year for their entire fleet. However, carriers believed that, on average, only two of the four reported crashes were actually the result of a nav system error.

Carriers then described the nav system error believed to contribute to the crash. Among the 33 percent of carriers who reported nav system-related crashes, the most common error was directing the driver to a road unsuitable for trucks (41%), followed by navigating to roads with inadequate bridge/overpass clearance (34%, Figure 15).

**Figure 15. Distribution of Navigation System Errors, Carrier Responses**

In an open-ended question, carriers were asked to describe the most common crash types that have occurred due to nav system errors. The crash types reported as most common included:
• bridge strike;
• car strike;
• jackknife;
• stuck in dirt/ditch;
• collision with low hanging tree limbs or power lines;
• collision with stationary object; and
• rollover.

Next, carriers were provided two lists of possible nav system attributes (one positive and one negative). When asked what benefits they liked most about the nav systems in their fleets, respondents indicated that “scheduling assistance” – keeping track of miles traveled and how far the driver still needed to drive (13%) – was the most popular feature. Carriers also liked that the system automatically re-routed drivers for an unplanned turn (12%) or an unplanned stop (12%), that the verbal directions were provided in real time (12%), and that the nav system was less distracting than other methods of receiving directions (12%; Figure 16). Those who answered “other” (3%) listed the following as attributes they liked:

• communication with dispatcher through nav system screen;
• ability to send messages; and
• monitoring of vehicle speed compared to highway posted truck speed limit.
Of the possible negative attributes of nav systems, the least liked were: the system did not always find the driver’s destination (19%) and the route was incorrect or unsafe for trucks (19%; Figure 17). Carriers who answered “other” (7%) cited incomplete databases such as those lacking bridge heights, difficulties with entering destinations, and trouble adjusting screen brightness as additional nav system “dislikes.”
Finally, carriers were asked if there were any further comments or opinions about the use of nav systems in large trucks that they would like to share. Recurring themes included inadequate/incomplete navigation data, routing to inappropriate/unsafe roadways, driver distraction caused by the nav system and the desire for states to make truck routing information publically available on state websites.

While a majority of carriers (51%) had previously reported that they allow or encourage nav system use by their drivers, comments provided to this open-ended question strongly discourage complete driver reliance upon a nav system and assert that drivers must always be alert and attentive to roadway signage. By synthesizing the additional comments, a set of safety practices regarding truck navigation use arose. Carrier comments suggested drivers follow the pre-route guidelines and safety measures listed below:

- If possible, ask the customer to provide directions before starting your route. “They [nav systems] can help at times but nothing beats actually calling the location you are going to and asking for directions - they usually know where they are and the best, safest route to them.”

\[28\] With minor editing for grammar and readability.
• Review your route using a truck atlas.
  “Even with a nav system every driver should know how to use a road map. Unfortunately, thanks to nav systems, many don't and end up finding out the hard way that the nav systems are not to be fully trusted with the routing they provide.”

• While driving, stay alert for recent roadway changes that may not be in your nav system.
  “THERE IS NO GOOD SUBSTITUTE FOR AN ALERT DRIVER. Professional drivers understand it is their responsibility to look and plan ahead. If we can make that easier, fantastic! But in the end, they have to be alert for road signs of detours, bridges out, weight limits, etc. that can be posted overnight.”

• If you find yourself in a situation where you have been routed onto a roadway unsuitable for trucks, contact local law enforcement for assistance.
  “The correct thing to do is stop and call the police, however, a lot of drivers get scared when the police get called in and fear that they might receive a citation.”

Other carriers took this opportunity to express more positive views of nav systems. Comments from these carriers highlighted additional benefits of nav system use such as fuel conservation. These comments included the following:

• “Proven navigation systems, specific for truck routing, are excellent tools for minimizing out-of-route miles (fuel conservation), reducing accidents due to getting lost, lessening driver frustration, and improving customer service levels.”

• “The nav systems we are using also include Hours of Service recording which helps us comply with the regulations.”

• “Nav systems are the future and have definitely helped in reducing accidents. The benefits far outweigh the number of bad routes given.”

5.4 Carrier Survey Key Findings
This survey solicited information from carriers relating to methods for providing directions to drivers. Key findings of the survey included:

• The majority of carriers indicated that both the driver and the carrier have a role in the planning of a driver’s route for both pre-trip routing (58%) and route changes (57%).
• For those trucks that are equipped with a nav system provided by the carrier, stand-alone nav units (50%) were most common followed by embedded nav systems (32%) and other navigation technologies such as a company-provided smartphone (19%).

• The majority of carriers (51%) allow or encourage nav system use.

• Generally, carriers feel that nav systems are effective at providing benefits that outweigh the cost of providing the system.

• Among carriers who reported crashes due to a nav system error, the most common error was directing the driver to a road unsuitable for trucks (41%) followed by navigating to roads with inadequate bridge/overpass clearance (34%).

6.0 CONCLUSION

This Phase 1 analysis revealed several trends regarding the use of nav systems by the trucking industry. Drivers, for example, are more likely purchase a nav system for themselves rather than be provided one by a carrier. This is likely due to the fact that the majority of drivers surveyed (59%) have the authority to make their own routing decisions and provide their own directions. Stand-alone units, which are smaller and portable, were more widely used by drivers (41%) than the more expensive embedded nav systems (17%).

The majority of carriers (62%) and drivers (73%) were “somewhat” or “very” trusting of nav system accuracy. Carriers also felt that nav systems are effective at providing benefits that outweigh the cost of providing the system. Despite the high levels of trust and perceived benefits, nearly half of the carriers (49%) do not supply these systems in any of their vehicles. Carriers with 250 or more power units were most likely to equip their vehicles with nav systems while carriers with fewer than 50 power units were least likely.

The majority of carriers (51%) allow or encourage drivers to use nav systems yet may not provide a system in their trucks. In instances where a carrier does not provide one, drivers may be inclined to use car-oriented systems, which are typically less expensive than truck-specific versions. In fact, one-third of driver respondents (31%) did not use a nav system specifically designed for commercial truck operations. Furthermore, some carriers may be directly contributing to this unsafe practice. Of the 51 percent of carriers who provided nav systems to their drivers, 21 percent supplied systems that were designed for passenger cars.

Despite recent media attention and growing industry concerns over nav system use by professional truck drivers, responses to ATRI’s survey provide evidence that nav
system-related crashes may occur less frequently than hypothesized. Only two percent of driver respondents indicated that, at some point in their career, they had been involved in a crash that they believe was caused by directions or information provided by a nav system. Responses from carriers imply a similarly low rate. In order to accurately measure the rate at which nav systems contribute to large truck crashes, the industry needs an empirical crash data analysis. However, little crash data exists that directly ties truck crashes to nav system use.

While the rate at which nav system-related crashes occur is unknown, they do occur with some frequency. Respondents who had a nav system-related crash indicated that the system directed the driver to a road unsuitable for trucks, such as those with an inadequate bridge/overpass clearance or where a turnaround maneuver was not possible. Carriers noted bridge strikes, car strikes, and jackknives as the most common crash types that occur due to a nav system error.

The results of Phase 1 also highlight the most liked and disliked nav system attributes. Given the popularity and ever-increasing use of this technology within the trucking industry, nav system manufacturers can take advantage of this information to modify their systems to better meet the needs of truck drivers and motor carriers. Drivers and carriers both chose incorrect or unsafe routes for large trucks and “dated” route information as their most disliked attributes. System manufacturers should therefore ensure that their commercial truck products contain appropriate information (e.g. bridge height and restricted route data) as well as ensure that timely updates are made to existing systems. Furthermore, features such as the verbal commands being too hard to hear and the screen being too small for drivers to see easily could be adjusted to better suit the in-cab environment in which truck drivers operate. Such modifications may also have the potential to increase safety and further reduce the number of nav system-related crashes.

6.1 Next Steps

While the rate at which nav systems contribute to large truck crashes is still unknown, this Phase 1 research offers important insight on the use and perceptions of nav systems in the trucking industry and identifies the types of crashes that typically occur due to nav system errors. Building upon this knowledge, Phase 2 will attempt to identify the technical basis for nav system failures and inadequacies from a truck operations perspective. ATRI anticipates that Phase 2 will further determine the role of nav system use on trucking industry safety.
APPENDIX A

METHODS FOR PROVIDING DIRECTIONS TO DRIVERS:
DRIVER SURVEY
Providing Directions to Drivers Survey

The American Transportation Research Institute (ATRI) is conducting a survey of professional truck drivers to explore the use of navigation systems that use global positioning system (GPS) technology in commercial motor vehicles. This survey seeks to further understand the perceived risks and benefits of using navigation systems, as well as the attitudes of drivers towards this technology. The findings of this survey will be used in research that addresses preferences in methods of providing directions to drivers and investigates the prevalence of use of navigation systems by commercial drivers. Thank you for your participation.

Confidentiality Statement – All responses to this survey will be kept completely confidential. ATRI will utilize and report information in cleansed, aggregate form only.

1. What segment of the trucking industry do you primarily operate in? (Please select one)
   - For-hire
   - Private Fleet

2. If you operate in the for-hire industry, which sector best describes your company? (please select one)
   - Truckload
   - Less-Than-Truckload
   - Specialized: Tankers
   - Specialized: Flatbed
   - Express / Parcel Service
   - Other (please specify) 

3. What is the vehicle configuration that you primarily operate? (please select one)
   - 5-axle Dry Van
   - 5-axle Flatbed
   - 5-axle Tanker
   - Straight Truck
   - Longer-Combination Vehicles (Doubles, Triples, etc.)
   - Other (please specify) 

Page 1
## Providing Directions to Drivers Survey

### 4. What percentage of the time do you move freight for the following trip lengths? (percentages must total 100%)
- **Local (less than 100 miles)**
- **Short Haul (100-500 miles)**
- **Long Haul (500 or more miles)**

### 5. How many years have you been driving professionally?
- Less than 1 year
- 1-3 years
- 4-6 years
- 6-10 years
- More than 10 years

### 6. Who makes decisions about routing and provides directions?
- My carrier provides directions
- I provide my own directions
- Other (please specify)

### 7. What method is most often used to provide directions for your route (either by you or your carrier)? (please select one)
- In-cab/installed navigation computer system
- Standalone navigation unit in my truck (e.g. Garmin, TomTom, Magellan)
- Navigation/routing application on my cellular phone
- Printed directions from web based applications (e.g. Google Maps, MapQuest)
- Atlas or Road Map (hard copy)
- Dispatcher
- Other (please specify)
### Providing Directions to Drivers Survey

8. **Does your carrier have any specific rules or policies about the use of navigation systems by drivers? (please select one)**
   - [ ] Yes, they are allowed and provided
   - [ ] Yes, they are allowed but not provided
   - [ ] They are encouraged but no formal policy
   - [ ] They are discouraged but no formal policy
   - [ ] Use of navigation systems is not allowed
   - [ ] Other (please specify)

9. **How often do you use a navigation system in your commercial vehicle? (please select one)**
   - [ ] For all travel, even if I am familiar with my route
   - [ ] Only when I am unfamiliar with a route
   - [ ] Only when I have questions about the route provided by my carrier
   - [ ] Only when I have lost my way
   - [ ] I do not use a navigation system

10. **Is the navigation system specifically designed for truck routes & operations? (please select one)**
    - [ ] Yes (please specify what type of unit is used in question 11 immediately following this one)
    - [ ] No, it is an application on my cellular phone
    - [ ] No, it is designed for use in a passenger car
    - [ ] I do not use a navigation system

11. **If you answered "yes" to question 10, please specify type of navigation system here:**

12. **How often have you needed a navigation system but did not have one?**
    - [ ] Daily
    - [ ] At least once a week
    - [ ] Less than once a month
    - [ ] Several times year
    - [ ] Never
Providing Directions to Drivers Survey

13. How much do you trust the accuracy of the navigation system's routes & information?
   - Very Trusting (I do not review directions before starting my route)
   - Somewhat Trusting (I review directions before starting my route)
   - Don’t Trust (I distrust the directions and I always double check directions before starting my route)
   - Do Not Use (I do not use a navigation system because I do not trust that directions are reliably correct)
   - Do Not Use (I do not own a navigation system)

14. Have you ever been involved in an accident in your commercial vehicle that you believe was due to directions provided by a navigation system?
   - Yes
   - No
   - I do not use a navigation system

15. If you have been in an accident in your commercial vehicle that you believe was due to directions or information provided by a navigation system, how would you describe the system error that contributed to the accident? (Select all that apply)
   - The navigation system directed me to a road unsuitable for trucks
   - The navigation system directed me to a road with inadequate bridge/overpass clearance
   - The navigation system directed me to an incorrect road and a turn around maneuver was not possible
   - The directions were delayed or did not allow enough warning time prior to a maneuver
   - The navigation system directed me to a road with an impassable feature (roundabout, at-grade crossing, narrow turn, etc.)
   - I was distracted by the navigation system
   - I have not been in an accident in my commercial vehicle that I believe was due to directions provided by a navigation system.
   - Other (please specify)
### Providing Directions to Drivers Survey

**16. If you have used a navigation system in your commercial vehicle, what did you like most about the system? (Select all that apply)**

- [ ] Verbal directions were provided in real time
- [ ] The screen was mounted in a convenient position
- [ ] The navigation system verbal commands were easy to hear
- [ ] The navigation system automatically re-routed when I made an unplanned stop
- [ ] The navigation system knew places where I could stop (points of interest)
- [ ] The navigation system automatically re-routed when I made an unplanned turn
- [ ] The directions were easy to understand
- [ ] The navigation system was less distracting than other methods of receiving directions
- [ ] The navigation system helped me with scheduling by keeping track of miles traveled and how far I still needed to travel
- [ ] Other (please specify)

**17. If you have used a navigation system in your commercial vehicle, what did you like least about the system? (Select all that apply)**

- [ ] The directions were delayed or did not allow enough warning time
- [ ] The screen was too small
- [ ] The verbal commands were hard to hear or annoying
- [ ] The navigation system was dated (i.e., did not know changes due to road improvements)
- [ ] The navigation system could not find my destination
- [ ] The navigation system route was incorrect or unsafe for trucks
- [ ] The directions were complicated or confusing
- [ ] The navigation system was more distracting than other methods of receiving directions
- [ ] The navigation system took a longer route and interfered with scheduling
- [ ] Other (please specify)
18. Do you have any further comments or opinions about the use of navigation systems in commercial vehicles or other methods used for providing directions to professional drivers that you would like to share with us? If so, please use the comment box below.
APPENDIX B

METHODS FOR PROVIDING DIRECTIONS TO DRIVERS:
CARRIER SURVEY
## Methods For Providing Directions to Drivers - Carrier Survey

The American Transportation Research Institute (ATRI) is conducting a survey of motor carriers to explore the use of navigation systems that use global positioning system (GPS) technology in commercial motor vehicles. This survey seeks to further understand the perceived risks and benefits of using navigation systems, as well as the attitudes of carriers towards this technology. The findings of this survey will be used in research that addresses preferences in methods of providing directions to drivers and investigates the prevalence of use of navigation systems by commercial drivers. Thank you for your participation.

**Confidentiality Statement** - All responses to this survey will be kept completely confidential. ATRI will utilize and report information in cleansed, aggregate form only.

1. **How many power units does your fleet operate? (Please select one)**
   - [ ] Less than 50
   - [ ] 50-249
   - [ ] 250-999
   - [ ] 1,000+

2. **In what segment of the trucking industry does your fleet primarily operate? (Please select one)**
   - [ ] For-Hire
   - [ ] Private Fleet

3. **If you operate in the for-hire industry, which sector best describes your company? (Please select one)**
   - [ ] Truckload
   - [ ] Less-Than-Truckload
   - [ ] Specialized: Tankers
   - [ ] Specialized: Flatbed
   - [ ] Express / Parcel Service
   - [ ] Other (please specify):
### Methods For Providing Directions to Drivers - Carrier Survey

**4. What is the vehicle configuration primarily operated by your fleet? (Please select one)**

- [ ] 5-axle Refrigerated Trailer
- [ ] 5-axle Dry Van
- [ ] 5-axle Flatbed
- [ ] 5-axle Tanker
- [ ] Straight Truck
- [ ] Longer Combination Vehicles (Doubles, Triples, etc.)
- [ ] Other (please specify)

**5. Please indicate the percentage of your fleet’s average trip length for the following groupings. (Percentages must total 100%)**

<table>
<thead>
<tr>
<th>Trip Type</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Local/Pick Up and Delivery (less than 100 miles)</td>
<td></td>
</tr>
<tr>
<td>Short/Line Haul (100-500 miles)</td>
<td></td>
</tr>
<tr>
<td>Long Haul (500 or more miles)</td>
<td></td>
</tr>
</tbody>
</table>

**6. Who provides routing information to your drivers for pre-trip routing and route changes during the trip?**

<table>
<thead>
<tr>
<th></th>
<th>Pre-trip routing</th>
<th>Route changes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Carrier provides directions to drivers (drivers do not have authority to plan or change their routes)</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>Drivers provide their own directions (drivers never receive routing information from the carrier)</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>Directions are provided by both the carrier and the driver</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>Other</td>
<td>☐</td>
<td>☐</td>
</tr>
</tbody>
</table>

If Other (please explain):

[Textbox for additional information]
Methods For Providing Directions to Drivers - Carrier Survey

7. What percentage of trucks in your fleet are equipped with a navigation system that was installed/supplied by the carrier? (Please select one)
   - None
   - 25% or less
   - 26-50%
   - 51-75%
   - 76-100%

8. For those trucks in your fleet equipped with a navigation system, which of the following technologies are used?
   - Embedded navigation system
   - Standalone navigation unit (e.g. Garmin, TomTom)
   - Other (e.g. a smartphone or other device)

Please specify technology used here:
Methods For Providing Directions to Drivers - Carrier Survey

9. For those trucks not equipped with a navigation system, what method is most often used to provide directions for a driver's route? (Please select one)

- Navigation/routing application on a cellular phone
- Printed directions from web based applications (e.g. Google Maps, MapQuest)
- Atlas or Road Map (hard copy)
- Dispatcher
- We never provide directions to the driver
- All fleet trucks are equipped with a navigation system
- Other (please specify)

10. Do you have any specific rules or policies about the use of navigation systems by drivers? (Please select one)

- Yes, they are allowed and provided to drivers
- Yes, they are allowed but not provided to drivers
- They are encouraged but no formal policy
- They are discouraged but no formal policy
- Use of navigation systems is neither discouraged or encouraged and there is no formal policy
- Use of navigation systems is not allowed
- Other (please specify)

11. If you provide drivers with a navigation system, is the navigation system's software and information specifically designed for truck routes and operations?

- Yes
- No, it is designed for general traffic / passenger cars
- No, it is an application available on the driver's cellular phone
- Do not provide a navigation system
<table>
<thead>
<tr>
<th>Question</th>
<th>Options</th>
</tr>
</thead>
</table>
| 12. If you provide drivers with a navigation system, how effective are navigation systems at providing benefits that outweigh the cost of providing the system? | Very Effective – benefits always outweigh the cost  
Somewhat Effective - benefits sometimes outweigh the cost  
Not Effective – benefits never outweigh the cost  
Do not provide a navigation system and do not intend to provide  
Do not provide a navigation system but intend to provide in the future |
| 13. If you do not provide drivers with a navigation system, do they ever request one?   | Receive requests often  
Have received requests but not often  
Have not received requests |
| 14. As a carrier, how much do you trust the accuracy of a navigation system's routes and information to provide safe and reliable directions to your drivers (regardless of whether your fleet uses them or not)? | Vary Trusting (I believe the directions are safe and reliable)  
Somewhat Trusting (Drivers should review directions before starting a route)  
Do Not Trust (I distrust the directions and would encourage drivers to double check directions before starting a route)  
Do Not Trust (I do not encourage the use of a navigation system because I do not trust that directions are reliably correct)  
No Opinion/Not Familiar (Do not use/do not own a navigation system) |
| 15. Have any of your drivers ever been involved in an accident in a fleet vehicle that that the driver believes was due to directions provided by a navigation system? | Yes  
No  
Drivers do not use a navigation system |

If "Yes", how many in the last year?  
[ ]
Methods For Providing Directions to Drivers - Carrier Survey

16. Have any of your drivers ever been involved in an accident while on duty that the carrier believes was due to a navigation system error?
   ○ Yes
   ○ No
   ○ Drivers do not use a navigation system

   If “Yes”, how many in the last year?

17. If you have drivers who have been in an accident while on duty that you believed to be due to a navigation system error, how would you describe the navigation system error that contributed to the accident? (Select all that apply)
   ○ The navigation system directed the driver to a road unsuitable for trucks
   ○ The navigation system directed the driver to a road with inadequate bridge/overpass clearance
   ○ The navigation system directed the driver to an incorrect road and a turnaround maneuver was not possible
   ○ The directions were delayed or did not allow enough warning time prior to a maneuver
   ○ The navigation system directed the driver to a road with an impassable feature (roundabout, end-grade crossing, narrow turn, etc.)
   ○ The driver was distracted by the navigation system
   ○ No drivers have been in an accident while on duty due to a navigation system error
   ○ Other (please specify)

18. In reference to the question 17, please describe the top three crash types that have occurred due to navigation system errors (e.g. bridge strike, rollover, jackknife). If none, skip to question 19.
22. Do you have any further comments or opinions about the use of navigation systems in commercial vehicles or other methods used for providing directions to professional drivers that you would like to share with us? If so, please use the comment box below.
Assessing the Use of Navigation Systems in the Trucking Industry
Phase 1: Driver and Carrier Survey Analyses

April 2013

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