FEBRUARY 2021

pennsylvania
DEPARTMENT OF TRANSPORTATION

COMMERCIAL VEHICLE NAVIGATION BEST PRACTICES & POTENTIAL SOLUTIONS

Research Findings Report

AGREEMENT E04695

PREPARED BY:

Michael Baker INTERNATIONAL

CAMBRIDGE SYSTEMATICS

DRIVE ENGINEERING

Technical Report Documentation Page

1. Report No.	2. Government Accession No.	3. Recipient's Catalog No.
FHWA-PA-2021-001-EO4695 WO 001		

4. Title and Subtitle	5. Report Date
Commercial Vehicle Navigation Best Practices & Potential Solutions Research Findings Report	February 10, 2021
	6. Performing Organization Code
7. Author(s) Todd Trautz, P.E., PTOE Patrick McTish, P.E. Allie Slizofski, P.E., PTOE Mohamed Sarraj Nicholas Vlahos, PhD Brian Stewart	**8. Performing Organization Report No.**
9. Performing Organization Name and Address Michael Baker International, Inc. 4431 North Front Street, 2nd Floor Harrisburg, PA 17110	**10. Work Unit No. (TRAIS)**
	11. Contract or Grant No. EO4695 WO 001
12. Sponsoring Agency Name and Address The Pennsylvania Department of Transportation Bureau of Planning and Research Commonwealth Keystone Building 400 North Street, 6th Floor Harrisburg, PA 17120-0064	**13. Type of Report and Period Covered** Final Report (2/5/2020 – 2/10/2021)
	14. Sponsoring Agency Code

15. Supplementary Notes

Special thanks to the Pennsylvania Department of Transportation's Bureaus of Maintenance and Operations and Planning and Research, along with each of the contributing project stakeholders such as the Pennsylvania Turnpike Commission and the Pennsylvania Motor Truck Association for their contributions and collaboration.

16. Abstract

The Pennsylvania Department of Transportation (PennDOT) initiated this research project to better understand and investigate available options and aids for the navigation of commercial vehicles on Pennsylvania roadways as one tactic to minimize degradation to highway infrastructure and highway safety by oversize and overweight vehicles. The project involved conducting national and regional best practice research and stakeholder outreach and surveys of various Pennsylvania commercial vehicle organizations, developing business and functional requirements as a framework for potential solutions, and defining implementation approaches that PennDOT and their stakeholders should consider to inform their decision-making process to advance their role in commercial vehicle navigation. Each of these project components are presented and summarized in the Commercial Vehicle Navigation Best Practices & Potential Solutions: Research Findings Report.

17. Key Words	18. Distribution Statement
commercial vehicles, commercial vehicle navigation, infrastructure preservation, oversize, overweight, national best practices, stakeholder outreach, functional requirements, implementation approach	No restrictions. This document is available from the National Technical Information Service, Springfield, VA 22161

19. Security Classif. (of this report)	20. Security Classif. (of this page)	21. No. of Pages	22. Price
Unclassified	Unclassified	28 pp., Body 112 pp., w/ Appendix	N/A

Form DOT F 1700.7 **(8-72)** **Reproduction of completed page authorized**

Table of Contents

Appendices

Executive Summary

Source: PennDOT "Drop the Boom" Campaign

The Pennsylvania Department of Transportation (PennDOT), like many transportation agencies, are faced with the daily issue of infrastructure, mobility, and highway safety degradation caused by commercial vehicles. Commercial vehicles have a rightful and critically important role in transportation, but due to their unique heights, lengths, weights, load contents, and operating characteristics, they require special attention when it comes to how a transportation agency accounts for and manages this sector of motorist.

An agency's management approach to balance the benefits of commercial vehicles with their undesirable impacts needs to be multifaceted and proactive in nature. Cornerstones for a proactive agency-led commercial vehicle program are enforcement, engineering, and education. Regarding education, this incudes media campaigns like the "Drop the Boom" campaign but there are other effective ways to educate. One of which is to provide information that someone needs so they are more likely to make better and more informed decisions. Towards this end, the PennDOT Bureau of Planning and Research, in partnership with the Bureau of Maintenance and Operations, commissioned this *Commercial Vehicle Navigation Best Practices & Potential Solutions: Research Findings Report* to investigate and provide insight on how PennDOT can leverage current and future data and technology assets to better inform commercial vehicles drivers in their navigational decisions and thus mitigate the occurrence of negative commercial vehicle impacts.

Based on national best practices research and outreach to Pennsylvania's commercial vehicle organizations, such as the Pennsylvania Motor Truck Association, collective desires for how PennDOT can use their data and assets to improve commercial vehicle driver decision making include:

- Providing up-to-date information for both pre-trip and in-trip usage
- Providing boundaryless data and conveyance of such data
- Consolidating information from various sources/systems
- Providing accessible information on a singular platform

Research and outreach yielded collective wants, desires, ideas, and needs. These were refined and used to establish business and functional requirements for an ideal commercial vehicle navigation solution that is tailored to PennDOT and Pennsylvania's commercial vehicle community.

Three potential implementation approaches are presented and contrasted, and a recommended timeline is provided that encourages a stepwise deployment to manage risk and retain flexibility over time. The three implementation approaches are:

1. **Internal Approach** – PennDOT would *build/expand and host* a user interface
2. **External Approach** – PennDOT would *collect and provide data* to outside users and technology developers but would not develop its own tools to disseminate the data
3. **Blended Approach** – PennDOT would *partner with a commercial vehicle-related technology/application developer* to create a user interface

Introduction

Pennsylvania contains roadways, bridges, and other structures with dimensional or weight restrictions. When these restrictions are ignored by drivers, the associated remedial, societal, and safety costs to address infrastructure degradation can be high.[1] Given the heights and clearances involved, commercial vehicle (CV) drivers are the predominant source of negative events involving this portion of Pennsylvania's infrastructure. Some of these situations occur because of a lack of accurate and timely information available to drivers about both the fixed infrastructure and about temporary restrictions such as construction work zones and unfolding traffic incident management strategies.

Figure 1 – Aftermath of Dec. 2015 Landis Valley Road Over US 222 Bridge Strike

The Pennsylvania Department of Transportation (PennDOT) initiated this research project to better understand available navigational aid options to inform CV drivers more proactively about weight, height, and traffic/safety condition restrictions. Beyond protecting infrastructure and improving mobility for all road users, enhancing the information exchange about these restrictions can also improve highway safety by helping prevent initial infrastructure-related crashes along with secondary crashes due to congestion or along detours. "Navigation" in this context is not intended to imply directly controlling the physical movement of the vehicle, but rather the provision of data to allow drivers to make informed decisions while still maintaining control of their vehicles' movements.

This report summarizes steps PennDOT and CV community partners can take to identify and share information that drivers need to safely operate, and it lays out requirements for the incremental development of a CV navigational aid. It also describes potential initiatives for the use of tools such as dynamic message signs and height sensor devices to augment the information exchange process.

This work was conducted under contract with PennDOT's Bureau of Planning and Research (BPR) open-end agreement number E04695, Part 1 and for PennDOT's Bureau of Maintenance and Operations (BOMO). The following report consists of the following four sections:

1. **Best Practices Research**: This section highlights the outcomes of national best practices research and peer-agency exchange conducted as part of this project (i.e., external needs assessment).
2. **Stakeholder Outreach**: This section highlights the outcomes of various outreach activities with PA's CV community completed as part of this project (i.e., internal needs assessment).
3. **Business and Functional Requirements**: This section describes the overall vision and requirements for a CV navigation aid that reflects the external and internal needs, i.e., the aid needs to do "this" and perform/provide "these" specific data and application features.
4. **Implementation Approaches**: This section presents feasible ways in which the defined system could be implemented along with their sequences and relationships, i.e., near-term actions, prerequisite actions, and long-term actions.

[1] For example: https://www.inquirer.com/philly/news/pennsylvania/truck-accidents-gps-apps-bridges-overpasses-20180218.html

Best Practices Research

Research was conducted on existing best practices for CV navigation information dissemination. The research consisted of a literature review on CV operations, and outreach to two identified "best practice" states for more in-depth information on their respective 511 systems.

Literature Review

The literature review focused on the "Traveler Information for the Commercial Vehicle Operations (CVO) Community" study completed by the Virginia Tech Transportation Institute on behalf of the Federal Highway Administration (FHWA) and the Virginia Department of Transportation (VDOT) in October 2019. Their study accomplished eight tasks:

1. Investigate available data to support the CVO community – focus on Virginia data
2. Conduct CVO community interviews and truck driver surveys
3. Conduct stakeholder interviews within VDOT and other public sectors outside VDOT as well as with the Virginia Trucking Association
4. Investigate state and federal initiatives
5. Conduct a review of private sector stakeholders – data navigation tools, telematics, etc.
6. Conduct a gap analysis
7. Formulate a high-level CVO traveler information framework
8. Identify actions to bridge the identified gaps and support the proposed CVO framework

Sources of Information

An important outcome from the truck driver outreach and survey efforts was an understanding of how drivers currently receive and prefer to receive information about various topics. **Table 1** provides the results for topics of most relevance to Pennsylvania. The first number in each cell shows how drivers are currently getting information about each topic, while the value in italics and parentheses indicates how drivers would *prefer* to get information. Drivers were asked to choose their top three sources for each Information Type category.

Table 1 – Top Information Sources for Truck Drivers (Surveyed in Virginia)

Information Type	Dispatch	VA 511	VDOT Trucking Resources	GPS, Route Application	On-board Communications/ Telematics	Virtual Message Sign	Phone Text	CB Radio	Highway Advisory Radio
Route Restrictions	32% *(24%)*	15% *(25%)*	**34%** *(30%)*	**51%** ***(39%)***	11% *(21%)*	**40%** ***(45%)***	11% *(23%)*	24% *(7%)*	5% *(4%)*
Incidents	19% *(20%)*	23% *(28%)*	10% *(17%)*	**45%** ***(39%)***	8% *(13%)*	**47%** ***(51%)***	10% *(29%)*	31% *(12%)*	9% *(6%)*
Work Zones	14% *(15%)*	18% *(30%)*	18% *(21%)*	**42%** ***(38%)***	7% *(13%)*	**56%** ***(55%)***	8% *(22%)*	30% (12%)	8% *(7%)*
Alternate Routes	19% *(20%)*	18% *(29%)*	24% *(23%)*	**53%** ***(37%)***	11% *(15%)*	**42%** ***(45%)***	8% *(23%)*	24% *(11%)*	5% *(6%)*
Truck Parking	13% *(17%)*	18% *(26%)*	18% *(20%)*	32% ***(34%)***	11% *(17%)*	**34%** ***(44%)***	10% *(21%)*	24% *(7%)*	2% *(7%)*

*Note: Values in italics are for how drivers would prefer to receive information on the noted topic. Entries over 33% in either current or preferred are **bolded**.*

Source: http://www.virginiadot.org/vtrc/main/online_reports/pdf/20-r3.pdf

Across all five Information Type categories in **Table 1**, drivers appear to be relying on CB radio far more often than they would prefer to be, with a corresponding higher preference for receiving text messages. Additionally, drivers would prefer to use GPS and routing applications at a lower rate than what they currently do for all information types except truck parking. Finally, the preference for virtual message signs is high both as a current information system and as a preferred information system. This approach is seen as very useful and accurate, though limited to a specific route and with higher associated costs for VDOT.

The study also noted a difference between drivers for small carriers who tend to have more leeway in choosing their routing but have less "accurate" tools and typically rely on Google Maps, Waze, or other non-truck specific GPS systems and drivers for large carriers that tend to restrict drivers to stay on pre-planned routes and use company approved/given GPS or telematics.

Both large and small carriers noted challenges with road closures and detours not being designed with trucks in mind, and that posted alternate routes often cannot accommodate even legal size and weight trucks. Interestingly, the Rand McNally Motor Carriers' Road Atlas in book form was also cited as a useful backup information source by both large and small carriers. This source is updated annually and shows route restriction information by state in tables which is a note to the continued need for accurate, reliable data in any format.

Information Dissemination Best Practices

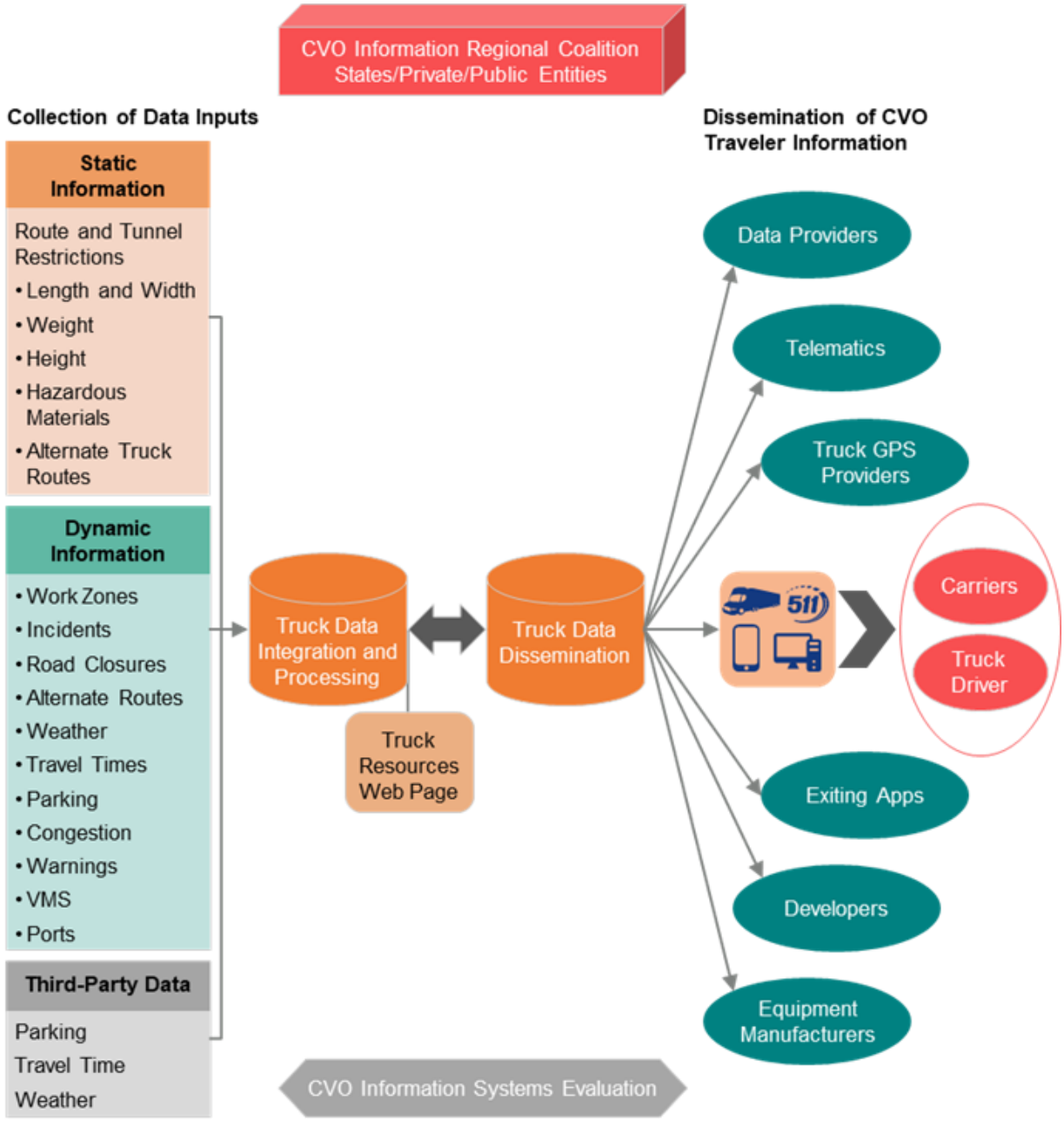
The study also highlighted truck restriction data outreach and best practices across different states. A brief description of each state's approach is provided below, with the full literature review provided in **Appendix A**:

- **Iowa** – Uses a 511 with a truck portal, available in both a high- and low-bandwidth site. The map has various layers that can be turned on and off including incidents, restrictions, construction, weather warnings, plow locations, traffic speeds, weigh stations, and real-time truck parking availability at rest areas on I-80.
- **New York** – The 511 website has height and weight restriction information available as layers, though no "truck specific" portal. The site includes a routing capability.
- **Idaho** – The 511 website has a "trucker" section with width restrictions and some height restrictions, as well as weather, construction, and other more general alerts. Weight restriction information is not available.
- **Wyoming** – Carriers can register for a free Commercial Vehicle Portal with forecasts for road and wind conditions tailored to trucking needs. The generic 511 website has size and weight restrictions as layers along with information on truck parking and Port of Entry operations, but no routing capability.
- **Georgia** – Posted structures are available for download and use in Google Maps, allowing truck drivers to use Google Maps' routing capabilities but with truck weight restrictions visible.
- **Washington** – Bridge weight and length restrictions are available but only for oversize/overweight vehicles. Height restrictions are available statewide, and drivers can enter the height of their vehicle/load and get a dynamic map showing restrictions specific to that trip.

Gap Analysis and Recommendations

The study developed a high-level commercial vehicle information framework, identified in **Figure 2**. This figure identifies the most needed types of data for commercial vehicle operations and the various pathways available to disseminate that information.

Figure 2 – High-Level Commercial Vehicle Traveler Information System Framework (Virginia)



Source: Recreated from http://www.virginiadot.org/vtrc/main/online_reports/pdf/20-r3.pdf to improve the legibility of the image in this document.

The VDOT study concluded with the identification of six key conclusions and five recommendations for VDOT. The six key conclusions from the Study are:

1. While VDOT has traditionally served as a data collector, aggregator, provider, and presenter of data, the presence of private sector stakeholders in these realms means that VDOT's main role should be as a data provider and facilitator.
2. Data limitations continue to be an issue, especially for secondary roads, vehicle-delay estimates, and alternative routing.
3. All highway, bridge, and tunnel restrictions/limitations that apply the type, size, or weight of trucks needs to be conveyed to the trucking community in a comprehensive and integrated format.
4. Carriers and drivers rely on multiple platforms to route their cargo, meaning that different tools, applications, and communication channels for different types of devices must be considered and included to the extent possible.
5. Perception of the VA 511 system by CVO stakeholders as "car-centric" reduces its effectiveness.
6. An ideal system will provide universal coverage within the state (including towns and cities) but have connectivity with other states' systems.[2]

Although the following high-level recommendations from the VDOT study are specific to conditions in Virginia, based on information gathered during other portions of this research project, many of these recommendations are applicable to Pennsylvania.

1. VDOT Traffic Engineering and Operations Division should integrate data regarding truck routes and restrictions, including bridge weight, height, and width restrictions, and tunnel restrictions (including hazardous materials) in the same data format and on the same platform.
2. VDOT Operations Division should expand the current 511 systems (website and application) to include truck-specific data.
3. VDOT Operations Division should maximize data sharing and outreach of available information to support third-party application developers and traveler information providers.
4. VDOT Operations Division should champion the creation of a CVO Information Systems Coalition with neighboring states to leverage resources and accelerate implementation.
5. VDOT District traffic engineers should review existing signed route restrictions for adequacy, and conspicuity, and develop statewide guidelines for sign placement.

[2] For example, New England 511 (https://newengland511.org/) provides information for Maine, New Hampshire, and Vermont through a single website.

Outreach to Best Practice States

In addition to the literature review, the project team identified New York State DOT and Iowa DOT as two of the best-practice leaders from the VDOT study and reached out to them to gather further information on how they collect, maintain, and publicize truck-related information through their 511 systems. Discussion highlights from this outreach are provided in **Table 2**.

Table 2 – State DOT Outreach Information

DOT	Contacts
New York State (NYDOT)	Dave Rosenberg, Jim Davis
Discussion Highlights	
• Two websites have information available. 511ny.org shows weight and height postings that impact legal size/weight vehicles. The second is https://www.dot.ny.gov/gisapps/osowscreen which includes a more extensive list of restrictions to routing for permitted loads. • Both online systems allow users to enter a start/end point and see if routing would be impacted by restricted structures. • Height clearance shown in both systems includes a buffer (is not actual clearance). • Clearance information in both systems is supposed to be updated after any work is completed (construction, survey, etc.). • Data comes from the relevant NYSDOT Region construction/maintenance groups to NYSDOT Structures group in the main office. • NYSDOT does have a process for tracking bridge strikes (see prior technical memos). • Data on the OS/OW site is available for download (CVDataFeed) to ArcGIS or Google Earth.	
DOT	**Contacts**
Iowa State (Iowa DOT)	James Hauber, Sinclair Stolle, Jodi Clement
Discussion Highlights	
• Weight restrictions for legal loads are posted at the actual structure. There is no easily accessible online database that shows posted bridges. • New 511 site (due for release this year) shows truck restrictions that are related to construction or incidents but not long-term restrictions such as a permanently posted bridge. • List/map of embargoed bridges (weight limits for OS/OW loads), vertical clearance restrictions, and pavement restrictions are online as static maps: https://iowadot.gov/mvd/motorcarriers/Maps • The embargo bridge and pavement restriction data (for OS/OW loads) can be exported as a KMZ. • Permits are issued with a 2” clearance, bridges are signed with a 3” clearance (and only signed when the vertical clearance is less than 14’-9”, which the sign would show at 14’-6”). • District offices are responsible for measuring and reporting clearance changes to the Research and Analytics Bureau. It is then uploaded into the State’s Roadway Asset Management System (RAMS) which is ESRI Roads and Highways and then uploaded to the permit system. • Local public agencies are responsible for routing permits and maintaining and posting information on their routes. In special circumstances, some information will be posted to the State’s 511 (i.e., during flooding in southwest Iowa last year). • Bridge hits that require action from the Bridges and Structures Bureau are kept as a list, but not all bridge hits. The Traffic Management Center is supposed to be notified of all bridge strikes. • DOT is pushing all data on their 511 to Waze, but Waze is only publishing some of it. DOT ingests Waze data feed including alerts (accounts for 15% of DOT’s initial notifications for events in the state’s TMC). Waze does not have an interest in the truck driver demographic for their application. Currently they only ask if the driver is: private, taxi, motorcycle, electric.[3]	

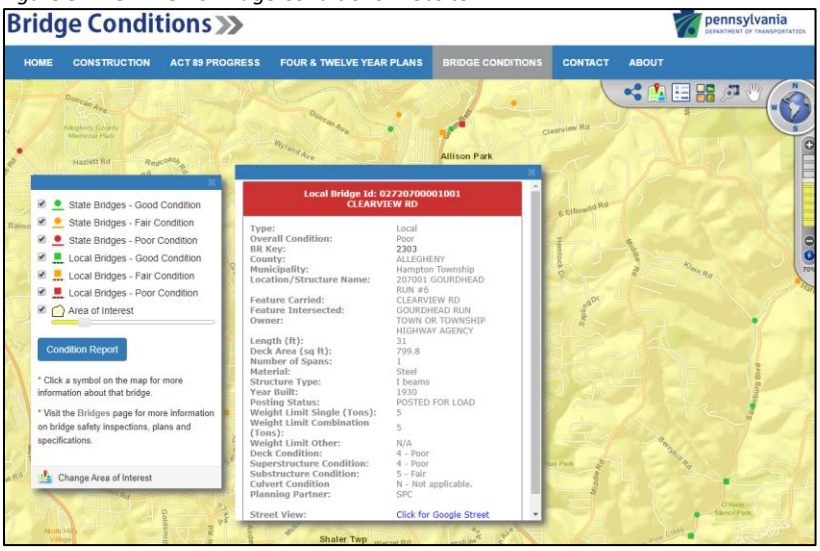
[3] PMTA also contacted Waze to assess their desire to developing commercial vehicle-specific navigation tools in relation to bridge and height clearances. Their response indicated that they do not intend to develop commercial/other large vehicle routing capabilities and will continue to focus efforts on private car drivers. Email communication on July 29, 2020.

Findings and Outcomes

While Pennsylvania's 511 system was highlighted as a best practice for its ability to provide voice alerts many of the gaps and recommendations identified in VDOT's approach to CV navigation data practices are applicable to PennDOT. In particular:

- The 511PA website (https://www.511pa.com/) does not have a commercial-vehicle portal and does not have size and weight restrictions available as a layer. The site can plot a route between origin and destination and show restrictions (weather, construction, etc.) along the route but truck-specific restrictions are not available.
- Bridge weight limits are available online at a separate site shown in **Figure 3** or at https://gis.penndot.gov/paprojects/BridgeConditionsMap.aspx but there is no routing function within this webpage and the data is included as part of overall bridge conditions rather than as a separate database. This makes it difficult for operators to quickly identify bridges in poor condition versus those with an actual weight/size restriction. One beneficial aspect of this information is that off-system (local) bridges are included in the data.

Figure 3 – PennDOT's Bridge Conditions Website



Source: https://gis.penndot.gov/paprojects/BridgeConditionsMap.aspx

- Bonded and posted road information, including posted restriction information, is available online via PennDOT's Posted and Bonded Web Viewer or as static PDF maps at https://www.penndot.gov/ProjectAndPrograms/PostedBondedRoadway/Pages/Posting-and-Bonding-Policy.aspx. These roads have weight restrictions—haulers must either be local traffic or must apply for a permit and post a bond to travel on them if they exceed the posted limit.
- Height (clearance) restriction data is not available to the public online. Clearance data is obtained via bridge inspections and aggregated in PennDOT's Bridge Management System 2 (BMS2) but is not made available for public consumption.
- Violation data, especially on bridge strikes is not comprehensive or consistently shared between enforcement agencies and PennDOT. When made aware, the BOMO Bridge Inspection and Management Section prepares an Impact Damage Report in coordination with the local Engineering District to document the details of the incident, actions taken, and remedial actions remaining, if any.

Stakeholder Outreach

Following the literature and outreach to "best practice" states, the project team contacted CV stakeholders operating in Pennsylvania to gather their insights and perspectives on the CV navigation issue. Again, two approaches were used. The first was an outreach meeting with the Pennsylvania Motor Truck Association (PMTA). The second was an online survey and follow-up web conference with additional truck and bus operators in the Commonwealth. Additional details and intermittent deliverables related to stakeholder outreach are included as **Appendix B** and **Appendix C**.

PMTA Stakeholder Meeting/Survey

An online meeting was held with the PMTA on July 22, 2020 to gather information on the methods used by the trucking industry for navigation, determining the direction they see the industry going in regarding navigation, and noting the options the trucking industry may be willing to consider in the future. PMTA noted that drivers are using a diverse set of tools for navigation, including cell phones, telematics, and truck GPS devices, as well as the 511PA website. However, the PMTA noted that truck trips often do not stop at the Commonwealth's borders, and that integrating and sharing information between states is a need. Additionally, while the information that the 511 systems give on the web is current, there is no way of getting notifications of real time hazards or detours while on route unless a smartphone application is used. Through discussion, it was determined that for a navigation method to be most effective for truckers, it should be dynamic, borderless, and offer hands-free notifications of any hazards or detours when in route.

Another discussion topic was an enhanced consideration of truck needs when planning detours. When a detour occurs due to a road incident, there are concerns that commercial vehicle drivers may be directed to access roads with which they are not familiar, on which they did not prepare to travel, and/or should not be utilizing. These challenges lead to unintended and unavoidable vehicle-infrastructure interactions such roads/bridges that they are too heavy for or underpasses that they are too tall for with no other route options.

The lack of up-to-date information about truck parking was cited as a key need, as there is currently no reliable system for relaying where available parking is for truckers or if there are any open parking areas to rest at during stops. This often manifests as drivers being forced to break laws by either driving for longer than their allotted time span looking for a parking area or being forced to park along sections of roads that are not suitable for commercial vehicle parking. PMTA mentioned that adding community features to navigation tools so truckers can indicate to each other where there is suitable parking in real time (like the crowdsourced availability data in the Trucker Path smartphone application) could be useful.

Stakeholder Organization Outreach Meeting

Based on input from the initial PMTA meeting, the project team developed a brief web survey for commercial vehicle drivers to gather their input on truck navigation issues and information sources. The

survey received 39 responses from individuals including regional, local, and over-the road drivers as well as motorcoach drivers, and dispatchers/safety managers.

Figure 4 details how respondents typically select their routes. The three main ways routes are chosen are by dispatcher, by phone applications such as Google or Waze, or by GPS devices such as Garmin or TomTom. This has several implications for sharing truck navigation data. To be of the highest value to all drivers, information must be shared across several platforms including publicly available applications as well as truck GPS devices.

Figure 4 – Stakeholder Survey Results – How are Routes Selected?

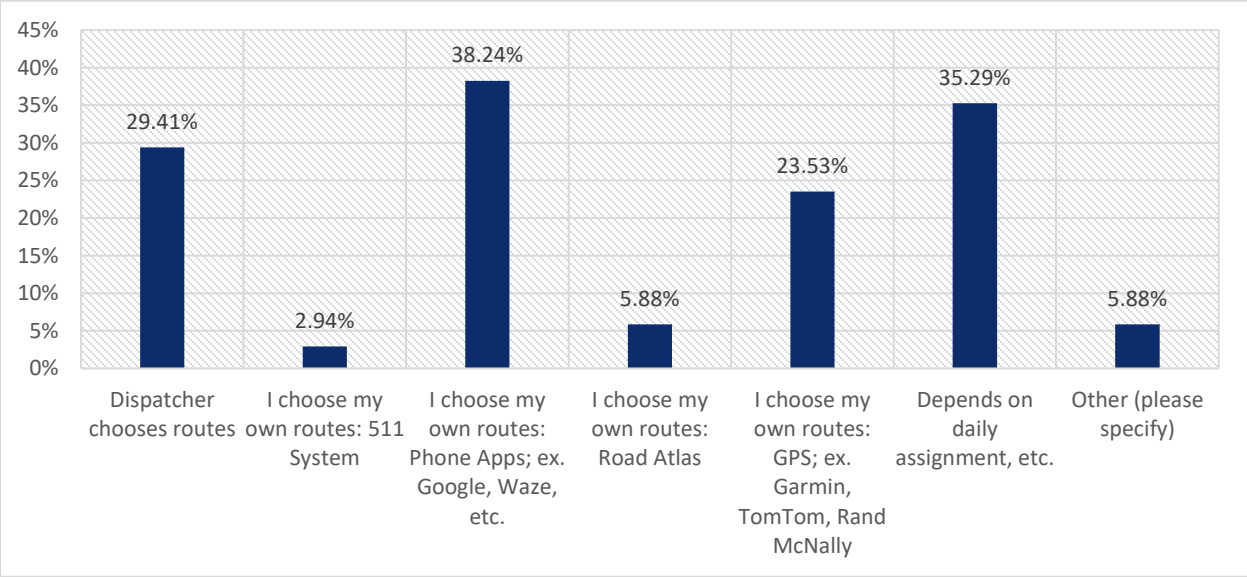


Figure 5 lists what information respondents are most interested in receiving while in route. Traffic conditions, incidents, size/weight restrictions, and detour/alternate route information are the most requested, though there was interest across all information types presented.

Figure 5 – Stakeholder Survey Results – What Travel Information Is Most Important While In-Route?

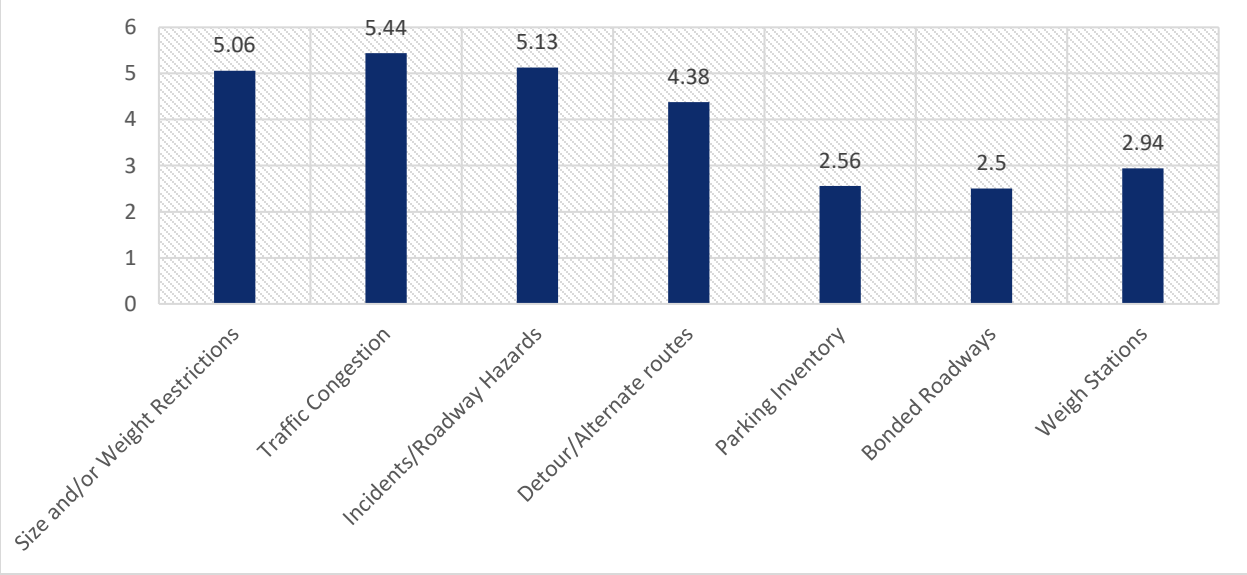
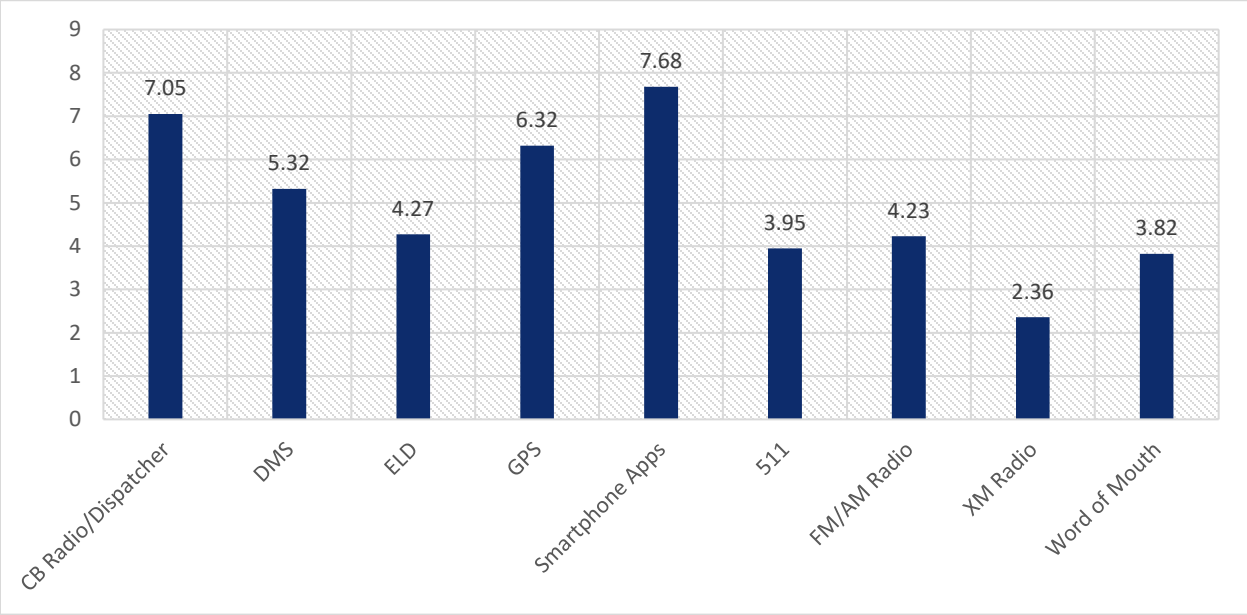


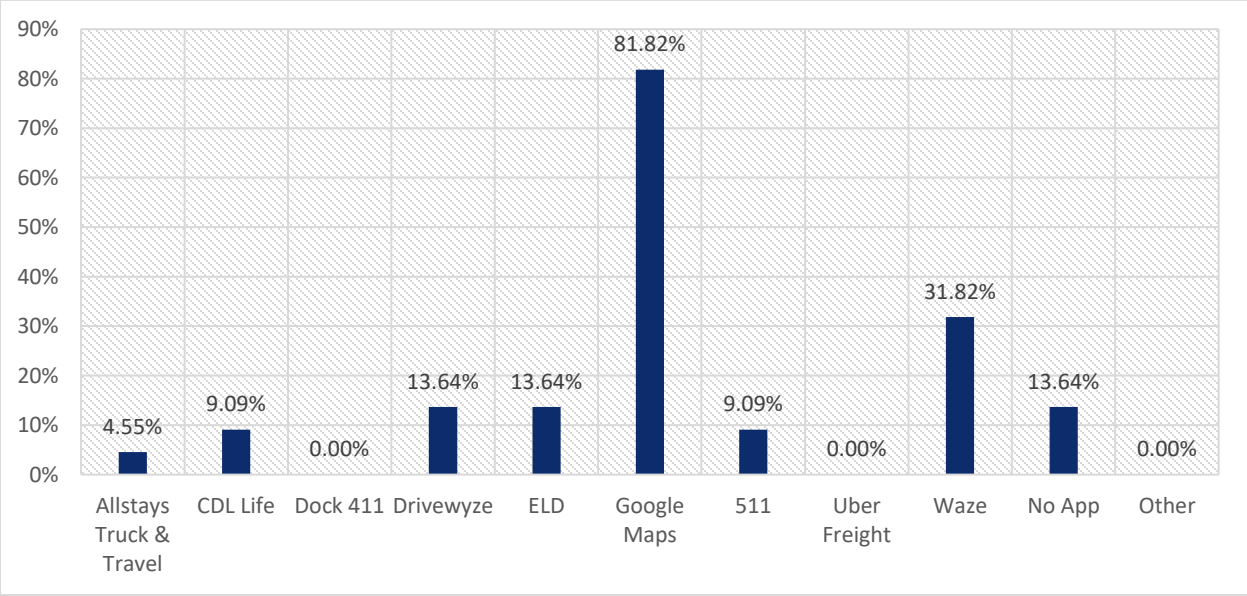
Figure 6 details what resources drivers use to make in route navigation decisions. Like information from the literature review, smartphone applications and real-time information over CB radio or from a dispatcher are the most common ways drivers make in-route decisions.

Figure 6 – Stakeholder Survey Results – Methods to Make In-Route Navigation Decisions?



Looking at smartphone applications specifically, **Figure 7** shows that more than 80% of respondents use Google Maps while another 32% utilize Waze. This again speaks to the widespread use of common smartphone applications such as Google and Waze even though routing information from these applications do not consider the vehicle type being used or known route restrictions for commercial vehicles.

Figure 7 – Stakeholder Survey Results – Use of Smartphone Applications?



Finally, an open-ended question asked respondents how they might improve traveler information tools. Responses included:

- "Better integration of commercial size and weight limits, current detours, and incidents."
- "Combine 511PA with Google maps, so it is more real-time. Have commercial version (only) of 511PA."
- "[Provide] more up to date information."

The need for up-to-date information was mentioned by several respondents although the comments did not specify what information they felt was not updated or how often such information should be updated.

In addition to the survey, a second outreach call was held on October 6, 2020 with attendance from PennDOT, the project team, and industry stakeholders, including representatives of PMTA, Pennsylvania Asphalt Pavement Association (PAPA), and Pennsylvania Bus Association (PBA). Several key points were raised by participants:

- Bus drivers need to clear alterations to planned routes with dispatchers, they cannot alter routes based on an application or other device without approval.
- The existing 511PA system is useful but has some limitations. Attendees specifically mentioned the inability to customize the alert feature which has led some to stop using the system entirely.
- Participants identified truck parking information as a huge need.
- Participants also noted that the ability to find an alternative, safe, route during incidents is paramount. Most drivers rely on dispatchers because of hands-free requirements and the inability of commonly used navigation applications to account for truck sizes and weights when identifying potential alternative routes.

Findings/Outcomes

Based on the outreach and literature review activities conducted during this research project, a few key findings influenced development of strategies and recommendations. These findings include:

- **The need for up-to-date information for pre-trip and in-route navigational decision making:** Commercial vehicle drivers have a need for accurate, up-to-date information on several topics as part of pre-trip route planning and in-trip route decision making. These data elements include those of interest to all drivers (i.e., weather, traffic congestion, and roadway closures) as well as some that are specific to truck operations such as commercial vehicle restrictions (i.e., posted bridges, vertical clearance restrictions, posted roads) and truck parking locations/availability.
- **The need for communication/data access across state lines for pre-trip and in-route navigational decision making:** Commercial vehicles do not stop at Pennsylvania's borders – drivers must coordinate their trips to account for conditions not only in Pennsylvania but in neighboring states as well, increasing the need for a reliable and accessible source of data.
- **The need for a single data source to access desired information:** Drivers use a number of different sources to find information on the important topics including 511PA, commonly available smartphone navigation applications, commercial telematics products, information from other drivers (via CB radio) and dispatchers, as well as VMS when available. There is no single "go-to" source that has all the desired information available.

- **The need for consolidated commercial vehicle driver information:** Navigation applications such as Google Maps, Apple Maps, or Waze are commonly used by commercial vehicle operators even though these systems do not have information specific to truck drivers. This lack of consolidated driver information can lead to issues when information in the applications are relied upon, especially in situations when a detour or other route change requires a driver to deviate from a pre-planned or known route.

Business and Functional Requirements

Based on the information gathered from the best practices research and stakeholder outreach, this section presents the business and functional requirements associated with improving commercial vehicle navigation data and dissemination solutions in Pennsylvania. Business requirements describe the high-level business needs whereas the functional requirements outline the functions required to fulfill the business need.

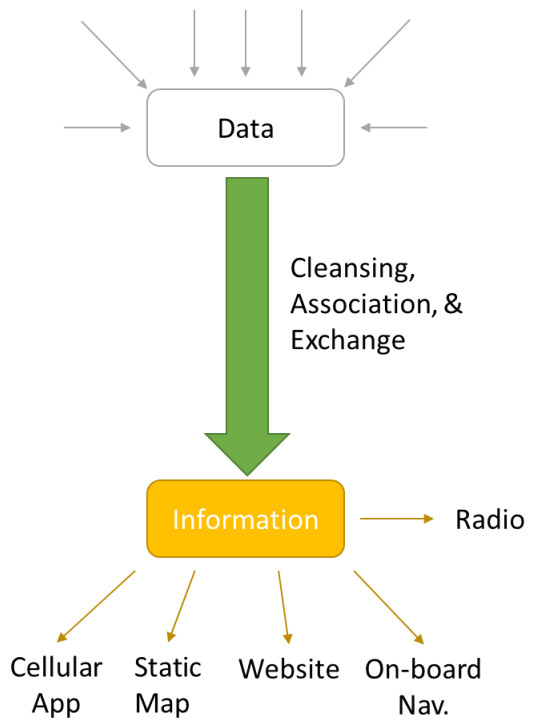
Business Requirements

In order to protect the Commonwealth's infrastructure, the safety of the traveling public, and to support economic activity, **PennDOT should make accurate, up-to-date data relevant to commercial vehicle navigation available to the public**. The data should be provided in a readily available and easy-to-use format that is available for both desktop use for pre-trip planning purposes, as well as within in-route navigational tools, such as a GPS or smartphone application. This set of information should supplement the existing posted restrictions on Pennsylvania's roadways, not replace them. Traditional navigation aids should still exist for those drivers without access, or with limited or intermittent access, to technology.

Ideal Vision

In an ideal condition, a commonly used navigation aid would allow a user to enter their vehicle characteristics. The aid, which would have both a desktop and mobile application interface, would provide routing options based on known restrictions and the user's vehicle characteristics. Changes due to weather, traffic, etc. would work the same as they do currently for automobile users but the aid would incorporate the vehicle dimensions as needed (i.e., it would not suggest a re-route for an 80,000 pound truck over a 10-ton posted bridge). The mobile interface must be compliant with all Commonwealth laws regarding distracted driving.

Figure 8 – General CV Navigational Information Exchange



Similarly, an ideal situation involves either standardization or harmonization of the information experience across jurisdictions, certainly regionally and potentially nationally or even internationally. Standardization would imply a consistent set of inputs and outputs regarding commercial vehicles

from a jurisdiction such as Pennsylvania. Harmonization would imply a minimum set of inputs and outputs but would acknowledge that jurisdictions might add additional optional inputs and outputs to address unique situations.

Standardization or harmonization of commercial vehicle inputs and outputs for navigation assistance would make it easier for commercial off the shelf products to exist in this problem space, as it would increase the potential market available to a vendor for a single product investment. The topics around commercial vehicle navigation are picking up visibility in the research area, for example both the National Cooperative Highway Research Program (NCHRP)[4] and the World Road Association[5] have announced upcoming projects regarding preventing bridge strikes, a topic which is directly relevant to commercial vehicle navigation functionality.

However, Waze, Google and other similar applications available today in the passenger vehicle market have yet to incorporate truck-specific data into their applications, and there is no indication that this stance will change in the coming years without perhaps some sort of movement towards regional or national concurrence from an association such as the American Association of State Highway and Transportation Officials (AASHTO) or NCHRP.

As a result, the following sections develop functional requirements to help PennDOT reach this ideal without the explicit assistance of existing applications noted above. The potential requirements listed below are independent of implementation method; they are what appears to be in PennDOT's best interest. A subsequent section provides three alternative implementation approaches that could satisfy these requirements.

[4] Retrieved from https://apps.trb.org/cmsfeed/TRBNetProjectDisplay.asp?ProjectID=4950
[5] Retrieved from https://www.piarc.org/ressources/documents/a92c0d3-34591-PIARC-Call-for-Proposals-Bridges-and-Tunnels-strikes.pdf

Functional Requirements

Functional requirements are divided into data requirements (what the product should utilize to generate or verify content) and tool interaction requirements (what activities the user should be able to invoke or what features the product should have).

Data Requirements

Table 3 outlines the data functional requirements, why the need is a requirement, and a brief description of the needed element.

Table 3 – Data Functional Requirements

Need	Reason	Direction/Description
Data must be maintained in an "up-to-date" manner	Stakeholder outreach revealed that data needs to be current to be trusted. A low update frequency causes user numbers to drop and updates are necessary for ever-changing scenarios, such as highway construction projects.	For each data item, the system managers should define how frequently the data is checked and/or updated. While not all data needs to be "real time", the latency of data is critical to obtain buy-in. For example, if a bridge height is changed due to a construction project and multiple months later users still see the dated clearance information, they are less likely to trust the data in the system. It is likely that some data will be updated on a fixed schedule. For example, bridges are inspected on a routine basis. Other data will be "event-driven." For example, a bridge strike must be updated in the system as soon as it is known, and as soon as the damage is sufficiently mitigated to allow traffic to resume. Detours and work-zones are other examples of data that requires more frequent updates. PennDOT would be responsible for defining minimum acceptable update cycles ("timeliness") for each data element, and the system should ideally be able to differentiate between "data whose value has not changed but has been updated as being the same" and "data whose value has not changed because the required update did not occur."
Data must have its "precision and accuracy" defined	Best practices suggest that a data dictionary accompany public data sets to define the degree of precision and accuracy by data element.	Precision: Are bridge heights defined to the inch, or the tenth of an inch? Accuracy: Is there a margin of error applied to data, for example should vertical clearance be published as actual clearance or clearance with a tolerance.

Need	Reason	Direction/Description
Data must be consistent in meaning	Stakeholder outreach revealed that data needs to be meaningful to be trusted.	For each data item, it is important for PennDOT to define how that data is measured and presented. For example, is bridge height the lowest height in all travel lanes on the roadway? Or in all travel lanes only in direction of travel? Does it matter if the highway is divided? These kinds of questions are important to develop and answer for each data element.
Data should include a set of truck-specific elements	The various data elements have been identified through the literature review, best practice research, and stakeholder outreach efforts.	Permanent (regulatory) weight and size restrictions for oversize/overweight vehicles.
		Permanent (regulatory) weight and size restrictions for legal vehicles for posted and bonded bridges.
		Permanent (regulatory) weight and size restrictions for legal vehicles due to traffic conditions.
		Temporary bridge weight and vertical clearance restrictions for legal vehicles.
		Temporary weight and size restrictions for oversize/overweight vehicles, i.e., work zones.
		Detour routes for known projects and closures.
		Detour routes for incidents (as available).
		Winter weather CV restrictions and guidance.
		Posted/Bonded roadways.
		Public truck parking locations and respective inventory of spaces/capacities.
		Public truck parking availability.
Data should include elements relevant to all vehicle operators	Best practice research and stakeholder outreach indicated that there are many different types of drivers with varying operating requirements. While there are variances there are common data elements consistent across the industry.	Incident reports.
		Traffic conditions.
		Adverse weather conditions.
Data should include information on any published "preferred truck network of highways"	Incorporate restrictions and impedances and advertise recommended routes in a proactive way.	Ability to highlight roadways based on height/weight restrictions.

Need	Reason	Direction/Description
Data between the tool and permitting systems should be consistent	Continuity of public/ industry messaging regarding restrictions.	Data used in Automated Permit Routing and Analysis System (APRAS) shall be the same as presented in the navigation database when data from the two systems overlap.
Data needs to be centralized and available between agencies	Broadened use and value of data for performance management across agencies.	Data should be packaged and available to other agencies for incorporation into their systems so multiple agencies can benefit from the data and achieve mutual gains. There is no set standard for data warehousing. Centralizing data should take an agile approach to data/system integration.
Data needs to be secure	Limit exposure and retain governance of the data.	If the quality of the data becomes compromised either in its contents or conveyance, the data will lose value. Administrator authentication may be necessary to provide protection for both the database and the users.

Tool Interaction Requirements

Table 4 outlines the tool/application functional requirements, why the need is a requirement, and a brief description of the needed element.

Table 4 – Tool Interaction Functional Requirements

Need	Reason	Direction/Description
Modification of a route during a trip based upon inputted characteristics	Ability to adapt to incidents is cited by stakeholders as a key need. Commercial vehicle drivers cannot legally or easily re-route while driving due to time, traffic laws, or parking area availability.	Ability to adapt to changing conditions based on real-time information (such as incidents).
Accept vehicle dimensions as an input	Best practices (Washington DOT)	Restrictions shown and routing should be based on vehicle dimensions as entered by the user.
Ability to plan route while accounting for vehicle dimensions and restrictions	Stakeholder outreach and best practice. Additional work on the part of the user is required if restrictions are not automatically included in the route options provided.	Tool must have a route planning feature included. Route options will account for vehicle dimensions as entered by the user and known restrictions as provided by PennDOT data. PennDOT's Automated Permit Routing/Analysis System (APRAS) has recently been overhauled and now includes a routing function for any vehicle

Need	Reason	Direction/Description
		weight/dimension restrictions, called the "bid route". This function can serve as the functional foundation for more generalized commercial vehicle purposes.
Ability to modify route while in route	Ability to adapt to incidents is cited by stakeholders as a key need.	Ability to adapt to changing conditions based on real-time information (such as incidents).
Reflect changes in truck restriction data	Best practices, stakeholder outreach	Ability to integrate trip planning function with other data elements reduces workload on users.
Useable both pre-trip and while in route	Best practice. Some 511 websites have both high and low bandwidth access	Information must be accessible on both desktop and mobile (app) environment. In a mobile environment, all state laws shall be observable.
User interface (UI) designed to be easy to use, read, and understand	Stakeholder input, best practices	User interface should be comfortable for the average user, reduce cognitive load, be consistent, use lay-person terminology and simple symbols, and limit complexity whenever possible. This would make the tool approachable to a wider audience and help with mobile/hands-free applications. Google Maps/Waze are common tools familiar to almost all users.
Hands-free UI	Stakeholder outreach, along with the legal requirements to keep focus on the road.	Drivers need to keep focus on the road/avoid distracted driving. Mobile application should be "Hands-free" utilizing voice commands and alerts.
Ability to customize most alert categories (except the most critical involving imminent danger)	Stakeholder outreach	Some dispatchers have stopped using 511PA due to repetitive alerts and the inability to distinguish between normal traffic slowdowns and serious emergencies/issues. Need to provide some ability for user to customize alarm/alert type.
Routing options should cross state boarders	Stakeholder input, best practices (regional 511 for New England)	CV operations is regional/national. PA data alone is not enough. As a result, data from PA needs to be integrated seamlessly with available data from surrounding states.
Accept, store, and prioritize inputs from various sources	Literature review, best practices	Inter-intra-agency data sources: - PennDOT Buraus - Other Commonwealth agencies - Local agencies in Pennsylvania

Need	Reason	Direction/Description
		- Agencies in other States - Private sector data providers - End users of the system Community input feature for certain elements (incidents, possibly truck parking availability – if not drawn from another data source).
Administrator data control and governance	Best practices	Review data quality and fit-for-us, i.e., if one input source says the height is 14'6" and another source says it's now 14'9".
Exportable data to outside applications, such as Google Maps/Waze	Best practices (Georgia DOT)	Data should be made available to application developers and others to use in their own systems.
Diversified data presentation (application, website, variable/dynamic message signs, etc.)	Stakeholder input, best practices (Georgia DOT) and literature review	While online/application information is considered very useful, variable/dynamic message signs consistently rank as a preferred method to receive (some) information, particularly about changes in otherwise routine conditions (incidents).

Implementation

As described earlier when discussing the "ideal vision" for a commercial vehicle data navigation solution, part of the challenge in implementation is the uncertainty regarding regional or national standardization or harmonization, and the corresponding uncertainty of any sort of corresponding investments by third parties.

On one extreme, if a national body such as Transportation Research Board or AASHTO quickly settled on a standard for system requirements (as AASHTO has done for decades in areas such as bridge management systems), then the path is very clear: PennDOT would be best served by making small temporary investments around the most critical requirements and trying to become a pilot state for a national product developed by a third party. It would be understood that at least a portion of the initial PennDOT investment would not have long-term benefit, and that shorter lifespan might in turn affect PennDOT's prioritization of how to proceed.

On the other extreme, what happens if the problem is too complex to reach a national requirements standard? For example, in oversize/overweight permitting, it took over a decade for most states (via the now retired AASHTO Subcommittee on Highway Transport) to determine minimum requirements for twenty elements of oversize/overweight permit attributes and restrictions. In a scenario where a solution is six or seven years away, or worse yet never coming, PennDOT simply cannot wait and must make a longer-term investment decision sooner.

Unfortunately, the current situation is not clear enough to understand which direction may prevail. As a result, PennDOT is best served to think about the problem iteratively:

- What makes the best sense in the long-term if there is no national (or at least regional) standard?
- What makes the best sense in the short-term (within the next couple of years) if PennDOT believes:
    - That a national or regional standard will eventually emerge?
    - That a national or regional standard will not eventually emerge?

For either a short-term or a long-term implementation, there are three alternative approaches to meeting the business and functional requirements identified in the previous section. At a high level, these alternatives are:

1. **Internal Approach** – PennDOT would *build/expand and host* a user interface to provide data and information to aid commercial vehicle driver decision making.
2. **External Approach** – PennDOT would *collect and provide data* to outside users and technology developers but would not develop its own tools to disseminate the data.
3. **Blended Approach** – PennDOT would *partner with a commercial vehicle-related technology/application developer* to create a user interface to assist with commercial vehicle navigation, which then might be extended or reused in other states.

Each of these approaches are valid both in a shorter time frame and a longer time frame, and each is valid if there is or is not a long-term national or regional standardization of requirements. Each approach is described in further detail below, and the final portion of this section compares the three approaches across several criteria.

Internal Approach

An internal approach to providing commercial vehicles with enhanced navigational data would involve the enhancement and upgrading of the existing 511PA system to address the data and functional requirements identified previously. This approach would keep all aspects of the updated website and an accompanying smart phone/mobile user interface within PennDOT's purview. Features that can be initially addressed include permanent (regulatory) weight and size restrictions for both legal and oversize/overweight vehicles, and detour routes for known projects/closures and incidents.

An internal approach can be expected to have a generally similar user experience as the existing 511PA portal. The solution would logically be branded as part of 511PA, and carriers who are familiar with the concept of 511 systems in each state would understand how to find the system. If a carrier is intrastate, or for an interstate carrier if neighboring states are slower than Pennsylvania in implementing solutions, then the disbenefit of having to launch the 511PA solution would be minimal.

The key benefit of this approach is control. PennDOT would be able to oversee and customize all aspects of the data and user interface to ensure that they are best meeting their customer's needs. Additional benefits of upgrading the existing 511PA portal include increasing the longevity of the portal and integrating data into a singular platform. Long-term benefits include upgrading different PennDOT databases to incorporate this data, including APRAS and RCRS.

The key negative of this approach is that it requires a larger commitment from PennDOT in terms of resources (staff, time, IT, etc.) to implement. It also implies that interstate carriers will have to switch between the tools they use in other states and the tool for use in Pennsylvania. An internal approach is also likely to have the largest up-front technology cost. Finally, PennDOT will have to market the approach, as it currently needs to market its general 511 solutions. These costs may be substantial to obtain a market usage sufficiently high enough to provide a meaningful return on investment.

External Approach

An external approach would envision PennDOT acting as a data clearinghouse or publisher. PennDOT would be responsible for updating and maintaining all the relevant commercial vehicle-related data and providing access to that data for free through a warehouse or API to any developer or application that requests it. PennDOT could maintain a basic 511PA site that focuses on non-commercial vehicle needs but would not develop a user interface beyond what currently exists.

The user experience may be very similar to how passenger vehicle drivers currently use Waze, Google Maps, or similar products. General knowledge of such products is high, marketing is already managed by the platform owner, and the user can expect an experience that is familiar, comfortable, and trusted.

The key benefit of this approach is that it disperses the net cost and complexity for PennDOT, with the agency focusing on gathering, maintaining, and publishing data. PennDOT does not have to be heavily involved in marketing, and adoption rates should be expected to be higher than an internal development approach. The key negative of this approach is that PennDOT has limited ability to directly influence the end user—they are reliant on outside applications or developers who determine how the data is used and displayed. Finally, while PennDOT would make the data available for free, the specific application or developer could charge the end-user for their services, reducing the potential reach of the data.

The biggest challenge is simple: PennDOT cannot force an external system to exist on a national or regional level. If external systems exist which could meet the functional requirements, the decision is rather obvious. The risk is that such a system may never come, as platform owners continue to chase other enhancements with a higher direct financial return on their investment.

One thing which PennDOT can do, even if it adopts an internal approach, is that it still can make its data available to other potential vendors. This strategy would allow PennDOT to take an incremental approach with its internal development while still positioning itself for an eventual migration to an external solution should one or more products become available.

Blended Approach

The disconnect between a vendor's financial return and PennDOT's infrastructure and safety return provides a point of entry to a potential blended approach. In a blended approach, PennDOT would identify (through an RFP or other competitive process) and work in cooperation with a developer or other outside entity using a public-private partnership (P3) model to develop, implement, and maintain a commercial vehicle data user interface. The exact requirements and roles would need to be developed based on the selected partner, but PennDOT would have a role in gathering and maintaining some data sets (which ones may change depending on the selected partner), creating performance standards and monitoring performance, and maintaining the resulting relationship over an extended duration.

To the end user, the user experience would be similar to that of the external approach: a comfortable platform with which the user is already familiar and the ability to incorporate multistate trips for interstate carriers (even if there is no navigation assistance at first on the trip portions outside of Pennsylvania).

The key benefit of this approach is that it allows PennDOT to focus on areas where it has technical expertise (i.e., maintaining and updating vertical clearance restrictions) and combine that with areas where an outside developer would have expertise (i.e., user interface development or other data elements such as traffic notifications). Marketing would be shared in some manner, but a vendor could be expected to have considerable expertise and reach in this area. This approach would also allow PennDOT to better control costs to the end-user such as making a requirement that the application or developer provide the data to the public for free. PennDOT could also align its costs more tightly with expected infrastructure and safety benefits to provide a more practical return on its investment.

The key negative in this approach is that it will require significant coordination and cooperation between the vendor and PennDOT, potentially for many years. It presumes that either national or regional standardization will not occur, or that if it occurs the PennDOT/Vendor solution becomes a market leader. If national or regional standardization occurs and the PennDOT/Vendor solution does not become the market leader, then there is a risk of substantial downstream costs to PennDOT to migrate into the recognized solution. This is not a fatal risk, as for example most AASHTOWare products do not enjoy subscription by one hundred percent of states.

An example of the market leader position is found in the truck inspection tracking software realm, where the Iowa Department of Transportation partnered with a vendor to develop a program for truck inspections, but then the Department markets the tool to other states (with fees) in an attempt to both continue development and build a de facto national standard in that tool space. Adopting a blended approach at first allows PennDOT to try and build a sufficient coalition of interested states to help drive the industry towards national standardization or harmonization.

Examples of companies currently involved in other relationships for commercial vehicle data navigation include those in realms with existing carrier relationships:

- Weigh station bypass providers such as Help (PrePass), Intelligent Imaging Systems (Drivewyze), or Norpass.
- Telematics/GPS/Electronic Log providers such as Garmin, PTV Navigator, TomTom, or CoPilot Truck.
- Truck Parking Applications or developers such as Trucker Path or Truck Specialized Parking Services.

Another potential negative factor for following a blended approach may be time. The process of procuring, contracting, and jointly developing a blended solution is likely to take a year to two years.

Comparison of Approaches

Table 5 identifies criteria and evaluates each potential implementation approach against these criteria to aid in understanding the pros and cons of each approach and to compare them. The ability of each approach to meet or fulfil the identified criteria is scored as "high," "medium," or "low."

Table 5 – Criteria-based Evaluation of Implementation Approaches

Comparison Criteria	Criteria Description	Implementation Approach		
		Internal	External	Blended
Ability to Begin Implementing	Given current and reasonable projections of future resources (money, staffing, etc.) how quickly can implementation begin?	High	High	Medium
Adaptability	Ability to adapt to meet changing end user needs, new data sets, or other changes.	High	Low	Medium
Complexity	How easily can the approach be used from both the user side and maintenance side?	High	Low	Medium
Cost of Ownership	In addition to owning the data, what is the adding cost of scalability and server maintenance?	High	High	High
Cost to End User	Ability to influence or control the cost of the product to its intended user group.	High	Low	Medium
Customizability	Can the approach be geared toward specific users?	Low	High	Medium
Data Governance	Control over data quality and how it is provided to the end user.	High	Low	Medium
Impact on IT Resources	Required IT resources to support and maintain the product.	High	Low	Low
Impact on Marketing Resources	Initial and ongoing marketing effort required to promote and sustain value in the product.	High	Low	Medium
Integration with Other States	Can the approach integrate easily with systems deployed by other states? Integration also impacts likelihood of use for interstate carriers.	High	Unclear	Medium
Level of Risk	Risks include project cost and schedule adherence.	High	Low	Medium
Level of Support	How much internal training, staff support, and infrastructure maintenance is required by both the Business and IT?	High	Low	Medium
Leveraging Existing Investments	Ability to leverage past and present investments such as those made into 511PA.	High	Medium	Medium
Likelihood of Use	How likely is it that the intended user group will utilize the product? At an extreme, even a free solution is worthless if nobody uses it.	Medium	Medium	High
Minimize Disruptions	Ability to co-exist with existing hardware/IT infrastructure, staff functions, and business practices.	Medium	High	Medium
Real-time Updates	Timeliness and assurance that any updates or edits to the data reach end users.	High	Low	High
Scalability	Ability of the approach to scale-up storage, resources, and bandwidth if/when the need arises with minimal disruptions to end users.	Medium	High	Medium
Security	Authentication and certification concerns should replace what is currently at risk.	High	Medium	Low
Sustainability	How well does the approach do in supporting itself?	High	Low	Medium

Considerations

While the purpose of the previous section was to define and compare the three implementation approaches, this section highlights three important implementation considerations that PennDOT and their partners should adhere to help guide and inform implementation action.

Authoritative Data

Before work can begin on developing a user experience for implementation, the available and missing data must be reconciled. For each data element, a minimum of the following attributes should be identified:

- **The original (or "authoritative") source of the data.** While a bridge's actual height clearance is measured in the field and stored in a database, the bridge's allowed height clearance for permitting is derived from that original measurement. In this case, the process by which the original measurement was stored is considered authoritative.
- **Whether the system(s) housing the data are designed for use for operational, maintenance, planning, or financial use.** A long interstate work zone spanning multiple exits may be defined for the length and overall planned duration of a reconstruction project. The actual work being done on any day, however, may not utilize the entire work zone and thus a carrier may be given information for an unnecessarily long detour. Such negative experiences will detract from carrier confidence in a solution.
- **Accuracy, precision, and consistency of the data.** Reflected in the proposed data functional requirements, it is important to understand how accuracy and precision of various pieces of data interact with each other, as both accuracy and precision dwindle as more interactions are introduced. As a generic example, a key field with a value of "1,000 (+/- 20)" being multiplied by a more speculative field with a value of "20 (+/- 4)" yields a true answer of not 20,000 but "between 15,680 and 24,480." Misunderstanding what your data is capable of representing can have disastrous implications in an operational setting. Finally, the data must be measured consistently, for example protocols about which bridge height clearance to use when multiple potential clearances exist.
- **The length of time for which a piece of data is "valid."** Returning to the bridge example, bridges are generally inspected every other year, with some well-defined exceptions.
- **The feasibility of the data integration.** It is important to understand the data available that would be most beneficial to commercial vehicle drivers and how easily it can be integrated into the approach selected.

A data analysis of what data is in the agency's ownership, how it is traditionally used, how accurate and precise it is, and how long it is valid is crucial for understanding potential defects which may need to be corrected in parallel to system implementation.

Proof of Concept and Requirements Refinement

Before the long-term decision about implementation is reached, it would be prudent to invest in a brief proof of concept for an internally developed system. The proof of concept would not attempt to build the entire system, but to provide enough to test out the access, usage, and updating of data as well as the user experience for pilot industry users. Such an exercise will help PennDOT refine much more detailed functional and system requirements, and sharpen the decision making between internal, external, and blended paths towards full implementation.

It would also be prudent to share the findings and perhaps even the process of developing the proof of concept with a regional transportation organization. Examples of relevant organizations include the Eastern Transportation Coalition and the Northeast Region of AASHTO (NASTO). It would be appropriate for PennDOT to take a regional leadership role in determining if an external or blended solution may be available at a multi-state level.

Long-Term Deployment Decision

After the requirements are refined, the long-term deployment approach should become clear. Having a proof of concept which can be shown to the commercial vehicle industry and to potential technology partners will also assist in identifying what must occur in terms of technology, finances, and legal agreements to enable a solution following any of the implementation directions.

Timeline

It is recommended to approach implementation as a series of related decisions, where each decision informs the appropriate next step. This series of decisions, tied to time frames, is summarized below and detailed in **Table 6**. In this way, implementation is constrained and done in a thoughtful sequential manner that manages risk and allows for flexibility.

- **Initial Step**: Implementation starts with deciding to invest and implement Year 1 activities. Establishes intent and motivation to explore more.
- **Year 1**: Fact finding and formulation of an implementation approach to invest further in.
- **Year 2 & Year 3**: An implementation approach is chosen and pursued.
- **Year 4 & Beyond**: Evaluate progress and adapt implementation approach.

Table 6 – High Level Timeline for Implementation

Time Frame	Internal	External	Blended
Initial Step	• Make decision on investment level and to start implementation		
Year 1	• Begin work on internal proof of concept • Conduct outreach to regional organizations • Discuss blended concepts through webinar with potential partners • Develop data dictionary including precision, accuracy, consistency, and update definitions • Make decision on Year 2 investment level and preferred approach		
Years 2 & 3	• Implement proof of concept • Develop more robust internal system while following PennDOT IT practices	• Publish data to any interested parties • Continue outreach with potential vendors to adopt the PA data • Edit data structures based on feedback • Make decision about continued viability	• Year 2: Publish RFP for a blended solution, potentially as a public-private partnership, and select vendor • Year 3: Roll out initial joint solution
Year 4 & Beyond	• Determine if continued investment is appropriate or pivot to a different approach	• No actions other than upkeep of data, presumes an external product will exist by Year 4	• Continue maintenance and refinement for contractual period • Determine if continued investment is appropriate or pivot to a different approach

Appendix A

Task 2.1 - Literature and Peer Review

Technical Memorandum Deliverable

Date:	April 23, 2020
To:	Jerome Frederick *Senior Civil Engineer* *Traffic Systems and Performance* *Bureau of Maintenance & Operations, PennDOT*
From:	Todd Trautz, P.E., PTOE *Project Manager, Michael Baker International*
CC:	Heather Sorce, *Research Project Manager, Bureau of Planning & Research, PennDOT* Brian Stewart, *Integrated Planning and Policy, Cambridge Systematics* Allie Slizofski, P.E., PTOE, *Principal, Drive Engineering*
Subject:	E04695 Part 1 – Commercial Vehicle Navigation Research Task 2.1 – Literature and Peer Review Task 2.1 Technical Memorandum Deliverable **FINAL**

INTRODUCTION

Pennsylvania contains a number of bridges and other structures with dimensional or weight restrictions. When these restrictions are ignored, the associated costs to repair or replace the structure, and the cost to the public to reroute can be high.[1] Pennsylvania DOT (PennDOT) initiated this project to better understand available options for proactively informing truck drivers about weight, height, and other restrictions. This initial task (Task 2.1) includes two pieces: 1) a literature review and 2) results from interviews with two State DOTs identified as best-practice leaders in this topic area.

LITERATURE REVIEW

The literature review focused primarily on the "Traveler Information for the Commercial Vehicle Operations Community," (referred to as the "study" for the remainder of this document) completed by the Virginia Tech Transportation Institute on behalf of the Federal Highway Administration (FHWA) and the Virginia Department of Transportation (VDOT) in October 2019. A review of the references used within this study did not identify any additional resources that require further review.

Research Overview and Process/Method

The study used Virginia as a base state to explore commercial vehicle operators (CVO) navigation and traveler information practices across the United States, understand CVO needs for information, and document available data resources. This information was used to recommend a framework for a comprehensive Virginia CVO information system as well as provide specific recommendations for improvement to the existing CVO traveler information system in Virginia.

To accomplish this, the study completed eight tasks:

1. Investigate available data to support the CVO community

[1] For example: https://www.inquirer.com/philly/news/pennsylvania/truck-accidents-gps-apps-bridges-overpasses-20180218.html

   a. Focused on Virginia data with some consideration of national sources
2. Conduct CVO community interviews and surveys
   a. Phone interviews with Virginia-based carriers
      i. 23 interviews with small carriers (less than 37 trucks)
      ii. Number of interviews with large carriers not known
   b. Truck driver surveys (178 total) conducted at rest areas in Virginia, a truck service facility, and at a Virginia Trucking Association statewide truck driver's meeting
3. Conduct stakeholder interviews
   a. VDOT departments, public-sector outside VDOT, and the Virginia Trucking Association
4. Investigate state and federal initiatives
   a. Highlight best practices and federal efforts in these areas
5. Conduct a review of private sector stakeholders
   a. Third-party data providers, navigation tools, telematics, and applications
6. Conduct a gap analysis which identified six areas of concern:
   a. Truck route restrictions
   b. Work zones, incidents, and traffic congestion
   c. Truck parking
   d. Alternate truck routes
   e. Access to information and research
   f. Regional integration
7. Formulate a high-level CVO traveler information framework
   a. Show high level relationships and design details
8. Identify actions to bridge the identified gaps and support the proposed CVO framework
   a. Recommended VDOT actions identified in each gap area

From the gap analysis, Task 6a has the most direct relevance to this PennDOT effort and will be the focus of the remainder of the literature review. Tasks 6b and 6d also have some overlap with the need for route restriction information and will be included in the review as appropriate.

Initial Findings

Channels of Information

After cataloguing public and private data sources available to truck drivers in Virginia, the study surveyed truck drivers to identify how they currently receive and prefer to receive information about various topics. **Table 1** shows the results for topics of most relevance to Pennsylvania. The first number shows how drivers are currently getting information about each topic, the value in italics indicates how they would *prefer* to get information. Drivers were asked to choose their top 3 sources for each Information Type category.

Table 1 – Top Information Sources for Truck Drivers

Information Type	Dispatch	VA 511	VDOT Trucking Resources	GPS, Route Application	On-board Communications/ Telematics	Virtual Message Sign	Phone Text	CB Radio	Highway Advisory Radio
Route Restrictions	32% *(24%)*	15% *(25%)*	**34%** *(30%)*	**51%** ***(39%)***	11% *(21%)*	**40%** ***(45%)***	11% *(23%)*	24% *(7%)*	5% *(4%)*
Incidents	19% *(20%)*	23% *(28%)*	10% *(17%)*	**45%** ***(39%)***	8% *(13%)*	**47%** ***(51%)***	10% *(29%)*	31% *(12%)*	9% *(6%)*
Work Zones	14% *(15%)*	18% *(30%)*	18% *(21%)*	**42%** ***(38%)***	7% *(13%)*	**56%** ***(55%)***	8% *(22%)*	30% (12%)	8% *(7%)*
Alternate Routes	19% *(20%)*	18% *(29%)*	24% *(23%)*	**53%** ***(37%)***	11% *(15%)*	**42%** ***(45%)***	8% *(23%)*	24% *(11%)*	5% *(6%)*
Truck Parking	13% *(17%)*	18% *(26%)*	18% *(20%)*	32% ***(34%)***	11% *(17%)*	**34%** ***(44%)***	10% *(21%)*	24% *(7%)*	2% *(7%)*

*Note: Values in italics are for how drivers would prefer to receive information on the noted topic. Entries over 33% in either current or preferred are **bolded**.*

Additional information types included in the survey were travel times, weather, weigh station location, weigh station status, food and hotel, maintenance, and delay at ports.

Across all five information categories shown above, drivers appear to be relying on CB radio far more often than they would prefer to be, with a corresponding higher preference for receiving text messages. Also interesting is that drivers would prefer to use GPS and routing applications at a lower rate than what they currently do for all information types except truck parking. Finally, the preference for virtual message signs is high both as a current information system and as a preferred information system. This approach is seen as very useful and accurate, though limited to a specific route and with higher associated costs for the DOT.

Small vs. Large Fleets – Information Differences

One critical area examined in length in this study was the impact of fleet size on truck routing information reception and decision-making. Based on carrier interviews, the study noted that drivers for small carriers tend to have more leeway in choosing their routing but have less "accurate" tools and typically rely on Google Maps, Waze, or other non-truck specific GPS systems. Depending on the driver, independent owner-operators may have even less technology available (some still rely on printed maps) and typically do not have dispatchers or other back-office personnel that they can rely on to provide assistance during incidents that force a change in routing even though they may have more discretion in choosing that new route.

Large carriers tend to restrict drivers to stay on pre-planned routes and use company approved/given GPS or telematics. Omnitracs and PeopleNet are most common, followed by Verizon, Garmin, Telenav, and TomTom. This information can be supplemented internally by other drivers in the fleet. These drivers also have better access to back-office support (dispatchers) who can help find solutions to issues.

Both large and small carriers noted challenges with road closures and detours not being designed with trucks in mind, and that posted alternate routes often cannot accommodate even legal size and weight trucks.

Interestingly, the Rand McNally Motor Carriers' Road Atlas was cited as a useful backup information source by both large and small carriers. This information is updated annually and shows route restriction information by state in tables. Structures located on county roads or local roads are not included, and discrepancies in the data can exist due to roadway features (curvature and slope) or infrastructure maintenance. This indicates a continued need for a reliable, detailed source of information, even if it is in a paper format in today's technology-focused world.

Restriction Information in Best Practice States

The study also examined a number of states that have developed truck-specific 511 systems, commercial vehicle portals, truck parking applications, and geofenced 511 systems. The report discussed these systems thematically, but they are described by state below.

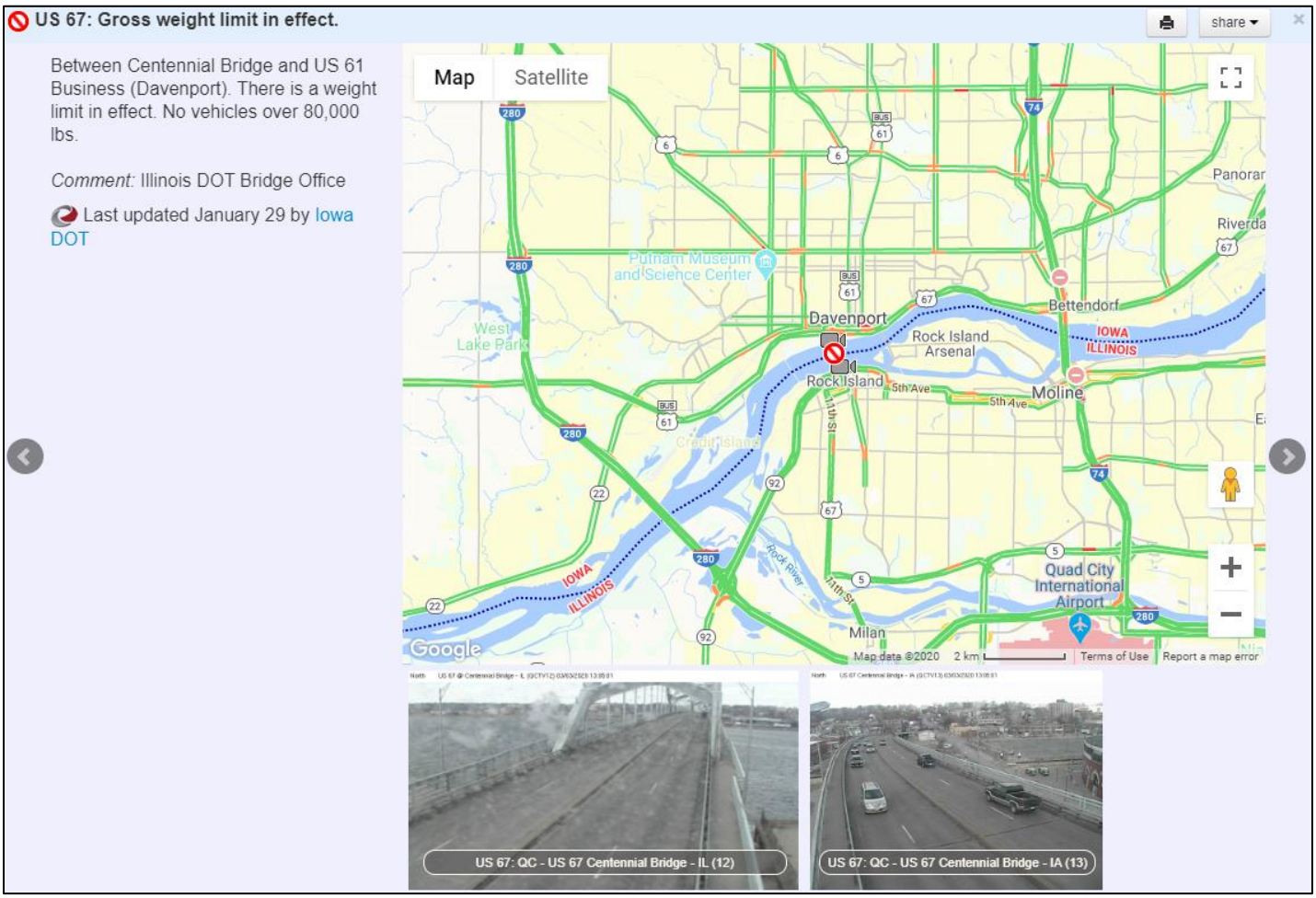
Iowa Department of Transportation

Iowa DOT has developed a 511 with a truck portal. Users can choose either a low-bandwidth and a high-bandwidth site, aiding use by mobile users. The map has various layers that can be turned on and off including incidents, restrictions, construction, weather warnings, plow locations, traffic speeds, weigh stations, and real-time truck parking availability at rest areas on I-80. The website shows truck restrictions associated with construction or incidents—more permanent size and weight restrictions for permitted loads are available in static map and list formats.[2] A screenshot of this system is shown in **Figure 1**. There is also a "Tell Me" feature which allows users to get hands-free, eyes-free audio notifications of traffic events. Iowa DOT is in the process of transitioning to a new 511 site that will have many of the same features but in a more user-friendly interface. [3]

[2] Note that the embargoed bridge map is updated whenever a load rating changes. The vertical clearance map and log are published annually in the spring, and changes during the year are published in a change log updated as they occur as well as updated in the OS/OW permit system. https://iowadot.gov/mvd/motorcarriers/maps.

[3] https://new.511ia.org/events/IACARS4-23149/@-96.49649,39.87224,-89.9761,43.64444,8?show=truckersReports

Figure 1 – Iowa DOT 511



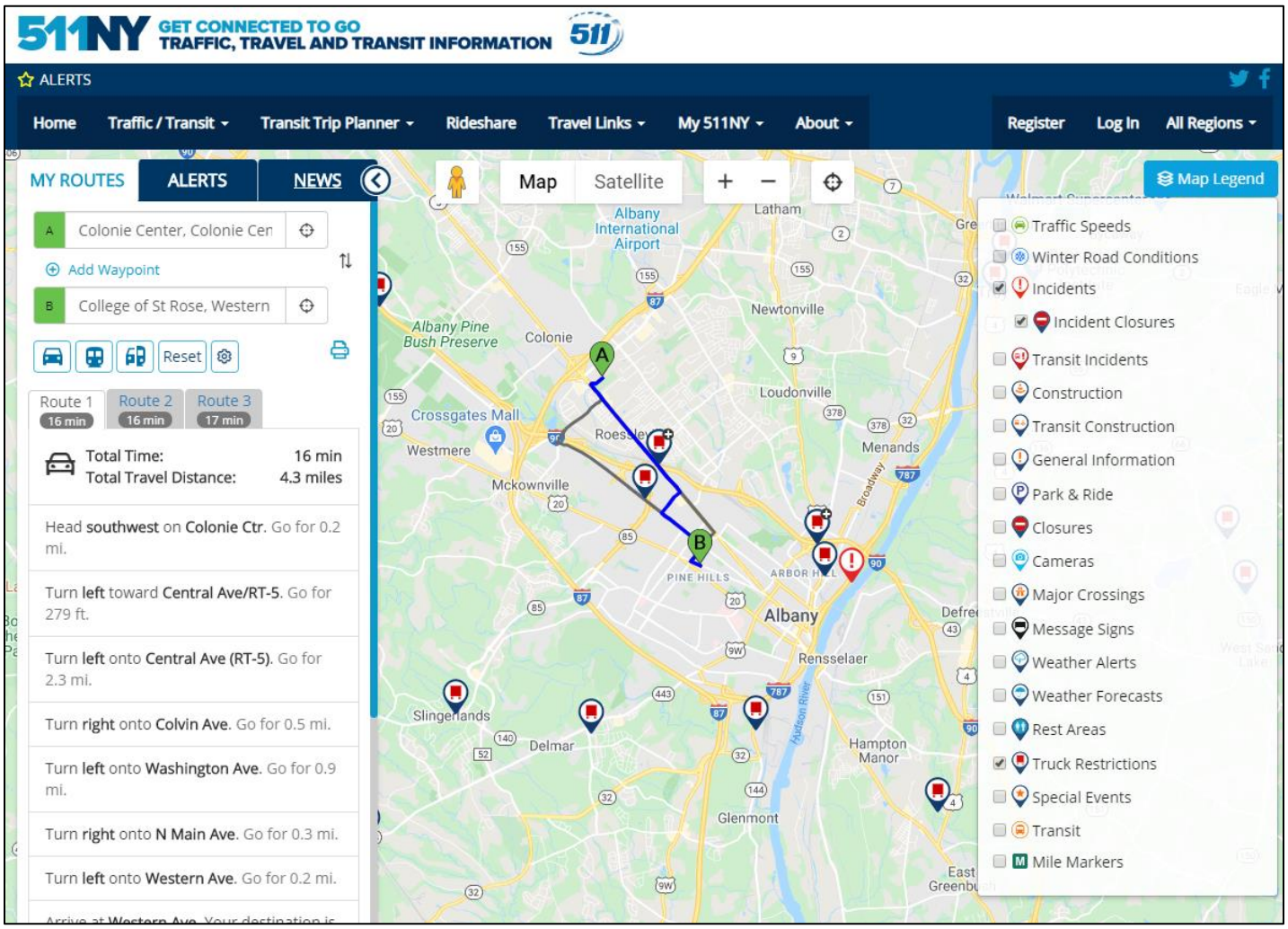
Source: Iowa DOT

New York State Department of Transportation

Although New York's 511 system does not have a "trucker" specific portal, the main site does have height and weight restriction information available as a layer. The data includes structures that are not part of the state highway system. The system also has a routing capability which, while not truck-specific, does allow a truck driver to enter their start and end point and see any restrictions along the proposed route. One challenge of this system is that weight restrictions are listed as a number ("16" or "15" for example). This is the weight limit (in tons) which may not be known by new drivers or those not familiar with operating in New York.[4]

[4] New York has a separate website with more detailed information about posted bridges, located at: https://www.dot.ny.gov/postedbridges. The state also has a separate routing feature for permitted loads with additional restriction data (eg., bridges with an 80,000 weight limit) at: https://www.dot.ny.gov/gisapps/osowscreen

Figure 2 – New York State 511 (Example Routing with Restrictions)

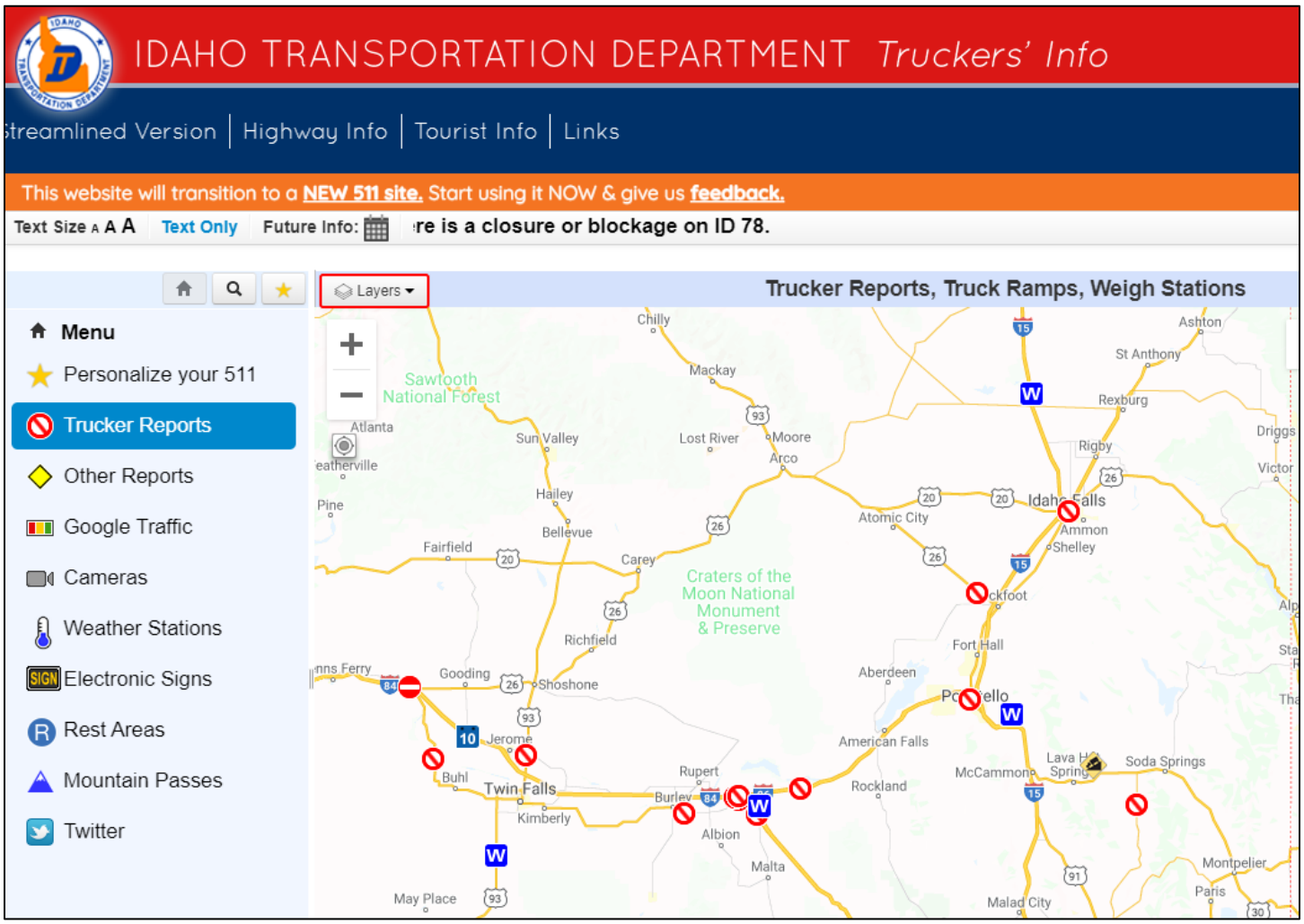


Source: New York State DOT

Idaho Department of Transportation

Idaho's 511 website has a "traveler" and a "truckers" portion, and both offer full feature or streamlined approaches to help facilitate use on mobile devices. The truckers site includes truck-related information, other reports (such as animals, construction, etc.), weather alerts, rest area information, traffic, and live cameras. The site does not incorporate any bridge weight restriction information, though width restrictions (mostly in relation to construction work) and a couple of height restrictions are shown as part of the "trucker report" layer.

Figure 3 – Idaho 511 System



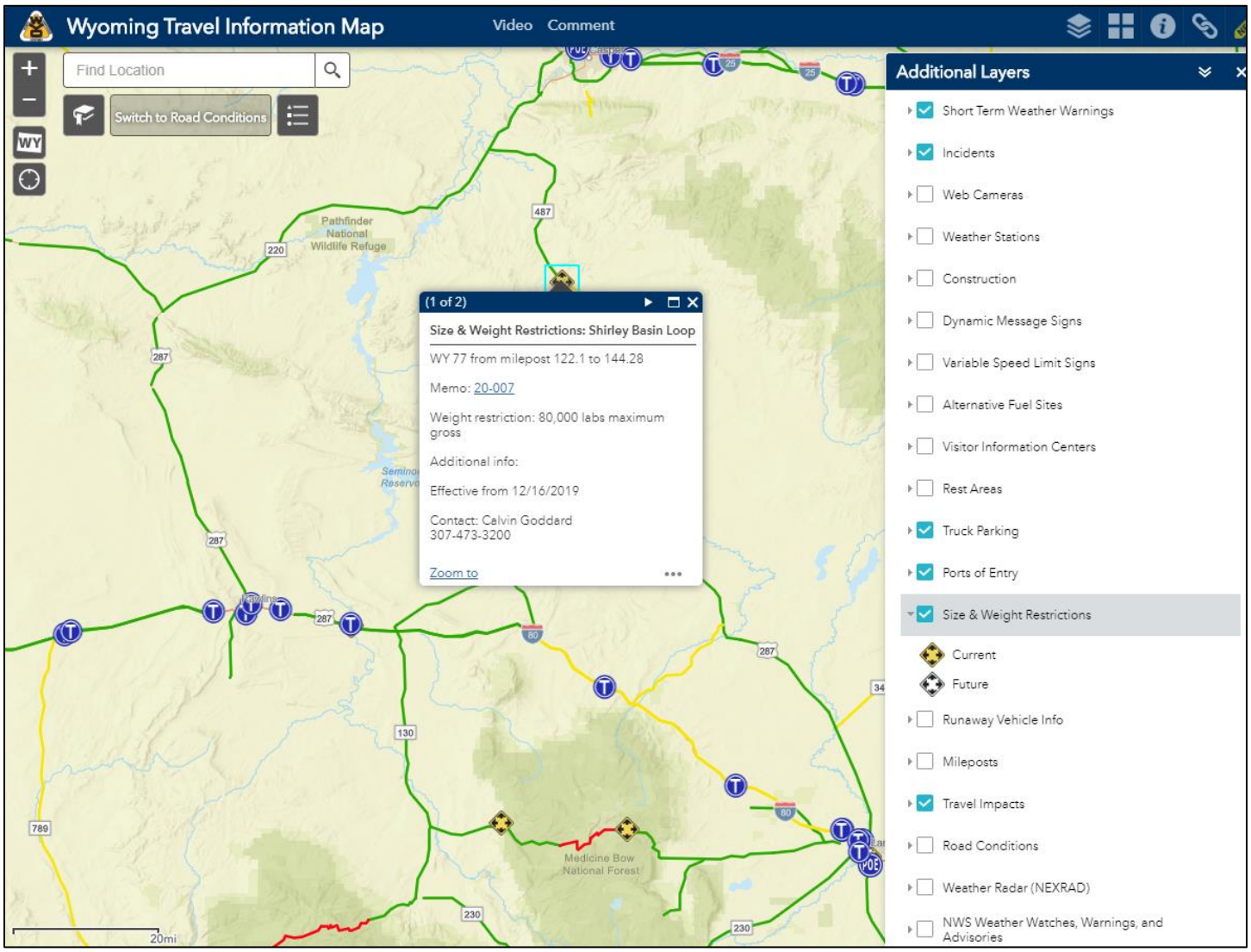
Source: Iowa DOT

Wyoming Department of Transportation

Wyoming's Commercial Vehicle Operations Portal gives access to forecasted road conditions and wind information which includes "worst condition" forecasts with the most severe conditions expected. This information is tailored to truck-specific weather challenges. Carriers must register (for free) to access this information.

In addition, the state's 511 site (shown in **Figure 4**) includes size and weight restrictions as a layer that can be accessed on the map along with information on truck parking and Ports of Entry operations. There is no routing capability within the 511 so information on this map must be compared separately to a driver's intended route.

Figure 4 – Wyoming 511 System



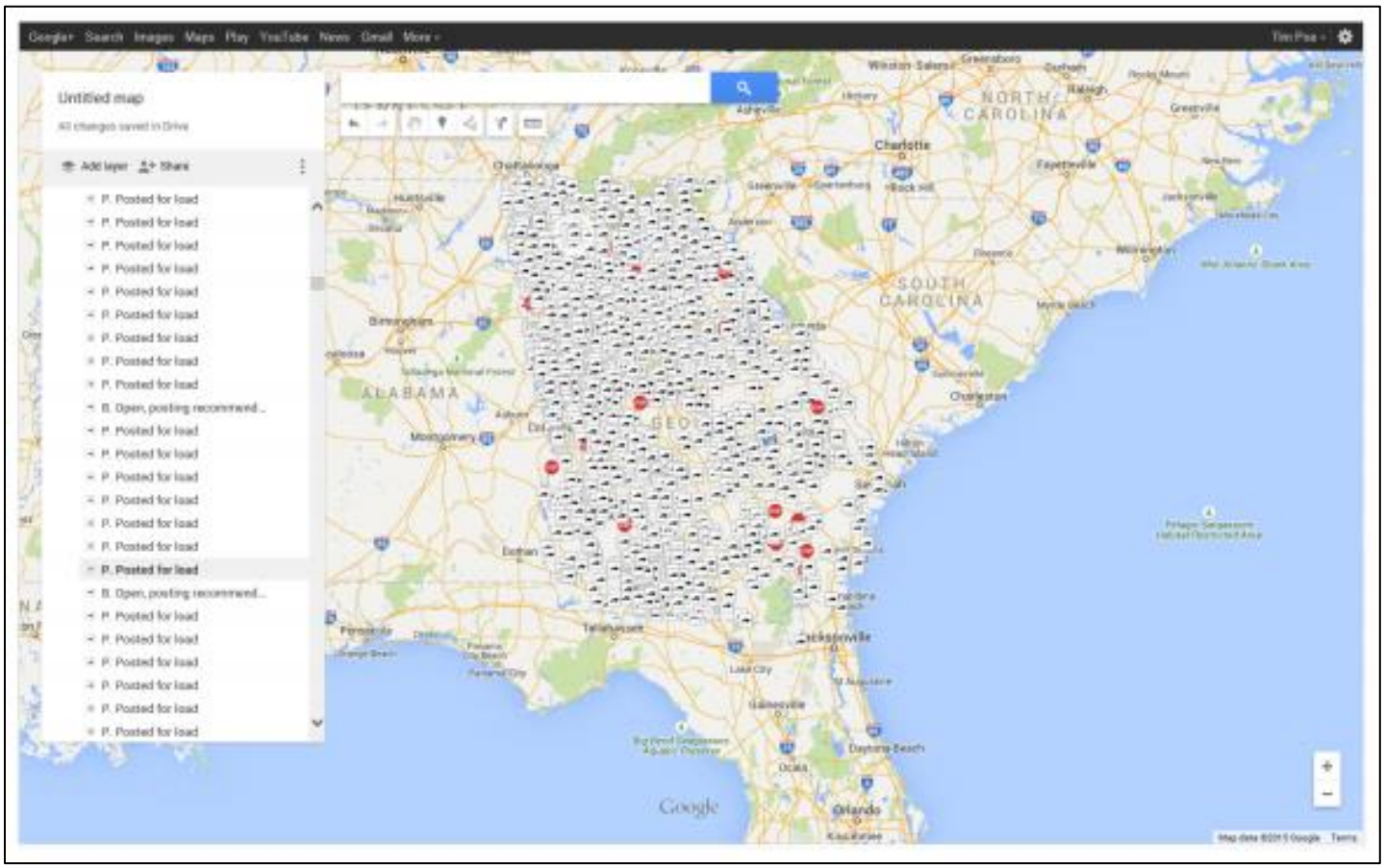
Source: Wyoming DOT

Georgia Department of Transportation

Georgia DOT provides an ArcGIS KML file that can be downloaded into Google Maps with list of posted and weight restricted bridges. By opening the file in Google Maps, users can enter an origin and destination and see if the proposed route would travel over a posted structure. If so, they can change their routing. It is unclear if this information is accessible using the mobile Google Maps application. This approach may be challenging for smaller carriers or drivers who may struggle to download the appropriate programs and correctly merge the data.[5]

[5] To bring the bridge data into Google Maps, a user must create a Google account.

Figure 5 – Georgia 511 System



Source:http://www.dot.ga.gov/PartnerSmart/permits/Documents/PostedBridges/Avoiding%20Posted%20Bridges%20with%20bug%20warning-07102015002%20BMU%20comments.pdf

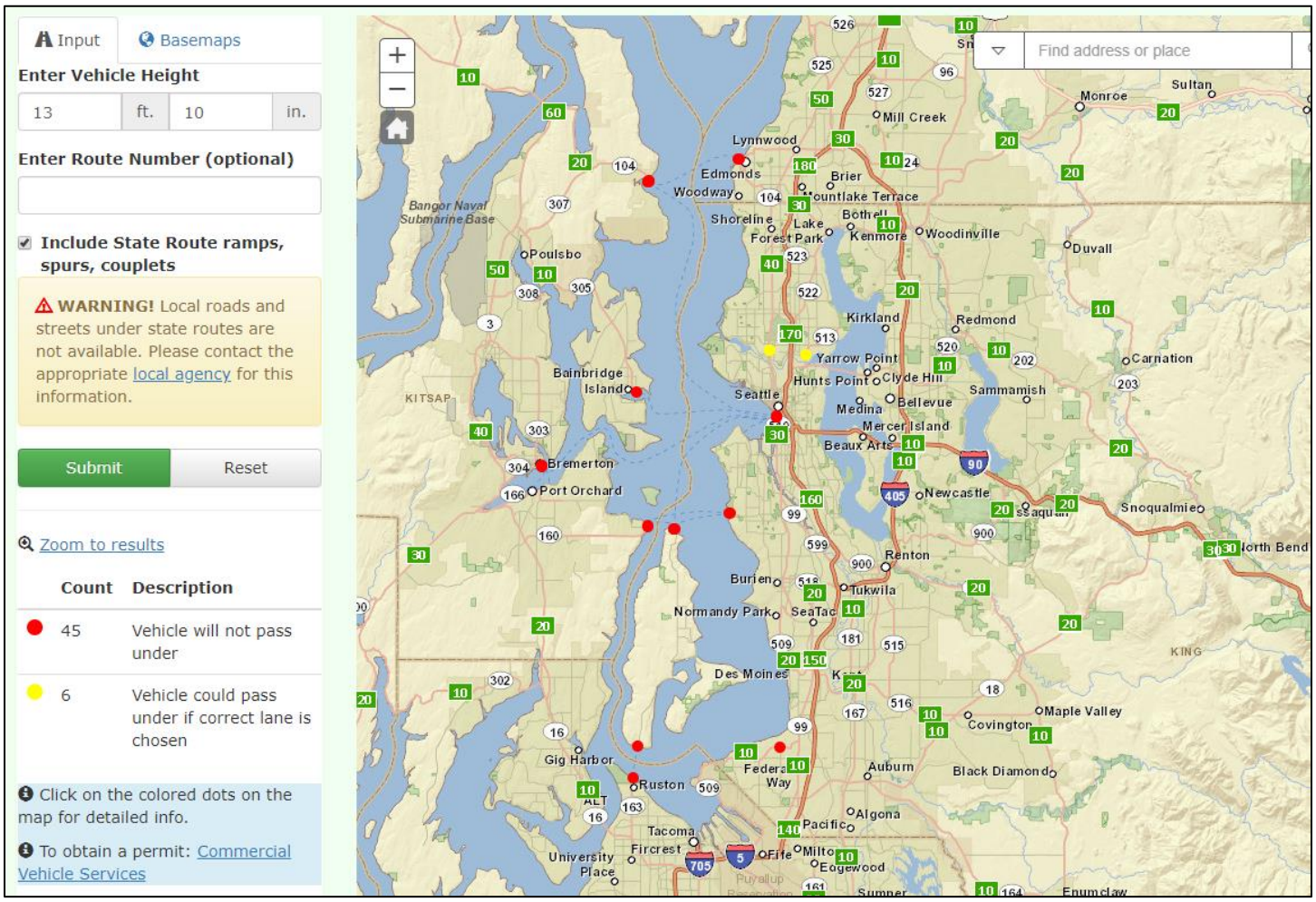
Washington State Department of Transportation

Washington State DOT has a trip planner, shown in **Figure 6**, that identifies height clearance issues along a route based on a specific vehicle's height as input by the user (up to 16 feet). This allows trucks a user to quickly identify height restrictions for both legal size trucks (14 feet or less) and over-height trucks. If the vehicle will fit under a structure only using a specific lane, that information is also included. While specific to height restrictions, this extra layer of information and the ability to input vehicle dimensions is very useful. Note that local roads and streets that pass *under* state routes are not included in the database.

Bridge restrictions (length and weight) are available on a separate WSDOT webpage but are limited to restrictions on oversize/overweight (OS/OW) loads.[6]

[6] https://www.wsdot.wa.gov/commercialvehicle/restrictions/default.aspx?View=Main&refnum=321&action=1

Figure 6 – Washington State 511 System



Source: WSDOT

Pennsylvania Department of Transportation

Pennsylvania's 511 system includes a number of features that, while not specific to truck drivers, offer some interesting options to drivers. The system can send voice alerts based on user-defined geofenced areas and can define if the alerts are for traffic in only one direction of travel or both. The user can also set a period of time that the messages repeat, all of which help ensure that that drivers keep their eyes on the road. Finally, the system includes extended coverage to New Jersey and West Virginia.

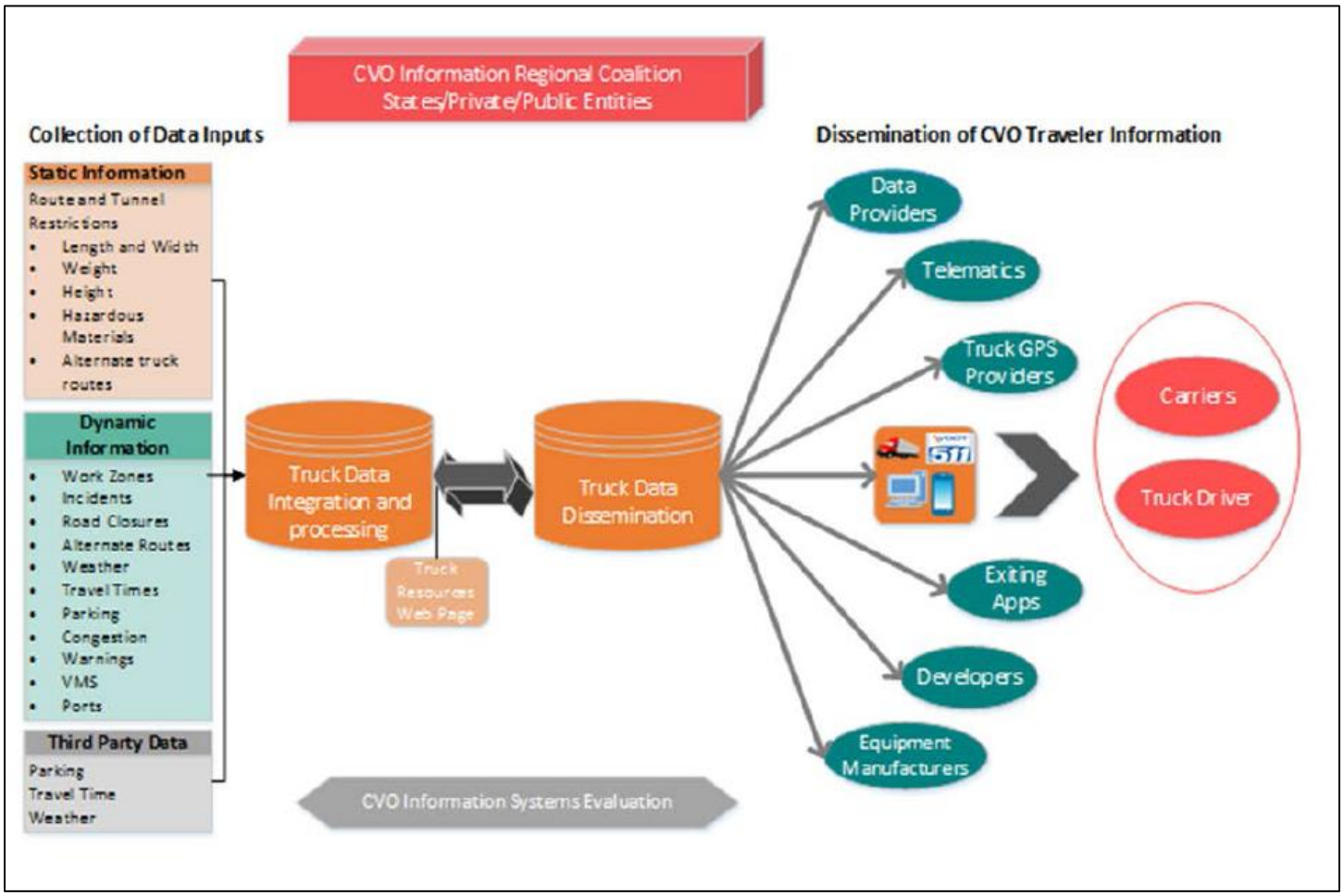
Other – Work Zone Notification

The study also noted that work zone alerts are becoming more common. Alabama DOT, Arizona DOT, Maricopa County DOT (Phoenix area), and Kentucky DOT have all recently developed work zone notification systems which provide in-vehicle information to truck drivers.

Gap Analysis and Recommendations

The study developed a high-level commercial vehicle information framework shown in **Figure 7**.

Figure 7 – High-Level Commercial Vehicle Traveler Information System Framework



The study noted that there are a number of gaps between current practices at the high-level framework shown above. Specifically, gaps were identified across six categories: 1) Truck route restrictions, 2) work zones, incidents, and traffic congestion, 3) truck parking, 4) alternate truck routes, 5) Access to information and outreach, and 6) regional integration. Relevant for this work, the 1st, 2nd, 4th, and 5th categories are outlined below with the objective for each type of information and the types of gaps identified. Note that these gaps are specific to Virginia DOT; issues that are also a concern for Pennsylvania based on current conditions are **bolded** and some are discussed further in the "Pennsylvania Data Comparison" section below.

- Truck Route Restrictions: Objective – "Provide truck drivers with truck route and height and weight restrictions information."
  - **Not every truck has a truck GPS navigation tool**
  - **Google, Waze do not contain truck route restriction information**

  - **Restrictions not clearly identified; signs placed when there is no possible corrective action**
  - **Route restriction length information is a static map**
  - Posted bridge information is a static spreadsheet
  - **Bridge height information is not available (must be requested by email)**
  - **No integrated length, weight, and height restriction map**
  - **No information included in 511 system**
  - No routing capabilities at all in 511 system
  - **Violation locations and reasons not recorded**
  - **Not all stakeholders are aware of VA data portals**
  - **Incomplete coverage of static information in towns and cities**
- Work zone, incidents, and traffic congestion: Objective – "Improve truck driver and carrier awareness of work zones, incidents, and congestion."
  - **Limited truck awareness that they will encounter a work zone or incident zone**
  - **Lack of information on the impact of the delay**
  - **Not all telematics provide the incident information on the in-cab communication device**
  - Carriers not aware of VA 511 notifications
  - The majority of the systems do not provide push notifications of incidents
- Alternate Truck Routes: Objective – "Improve alternate truck route selection and notification."
  - **Alternate routes not defined with trucks in mind**
  - **Guidance signs very far from one another**
  - No information in 511
  - **No specific guidance posted on most telematics**
  - No clear identification on VA SmarterRoads portal
- Access to information: Objective – "Improve access to truck traveler information; increase data availability and awareness; maximize use of data available."
  - **The information was in some cases difficult to find**
  - **Outreach improvement**
  - **Third party data providers not aware of all data available**
  - **There is no formal procedure to reach developers of existing applications**

Stakeholders generally indicated that up-to-date, complete, and accurate roadway restriction information is critical for the safe and efficient movement of trucks in a state. The study also noted a special concern with truck route restriction violations which is shared amongst many state DOTs. Since carriers select and plan their routes in different ways and allow different levels of autonomy for their drivers (typically large carriers allow less autonomy), the outreach methods must vary to reach different audiences. Small carriers tend to rely on Google Maps, Waze, or other apps that do not have sophisticated telematics or in some cases a "truck" mode.

To address these truck route restriction gaps, the study developed nine recommendations:

1. Integrate all truck restriction data on one platform (length, width, height, weight, hazardous material) and review restrictions on secondary roads (which are not updated regularly)

2. Develop pre-trip/stop routing tools that consider length and width restrictions
3. Develop pre-trip/stop routing tools that include data on posted bridges and bridge height clearances
4. Combine recommendations 1 and 2
5. Develop a routing application that can be used pre-trip or during trip
6. Create a dynamic routing and notification application
7. Incorporate truck route restriction information on VA511 by creating a truck layer
8. Evaluate sign locations showing route restrictions
9. Create a database of truck restriction violations and locations

Conclusions and Overarching Recommendations

The study concluded with the identification of six main conclusions and five recommendations for VDOT. The six key conclusions from the study are:

1. While VDOT has traditionally served as a data collector, aggregator, provider, and presenter of data, the presence of private sector stakeholders in these realms means that VDOT's main role should be as a data provider and facilitator.
2. Data limitations continue to be an issue, especially for secondary roads, delay estimates, and alternative routing.
3. All highway, bridge, and tunnel restrictions/limitations that apply the type, size, or weight of trucks needs to be conveyed to the trucking community in a comprehensive and integrated format.
4. Carriers and drivers rely on multiple platforms to route their cargo, meaning that different tools, applications, and communication channels for different types of devices must be considered and included to the extent possible.
5. Perception of the VA 511 system by CVO stakeholders as "car-centric" reduces its effectiveness.
6. An ideal system will provide universal coverage within the state (including towns and cities) but have connectivity with other states' systems.

Finally, high-level recommendations for VDOT are included. Although specific to conditions in Virginia, based on information gathered during future tasks, many of these recommendations may be applicable to Pennsylvania.

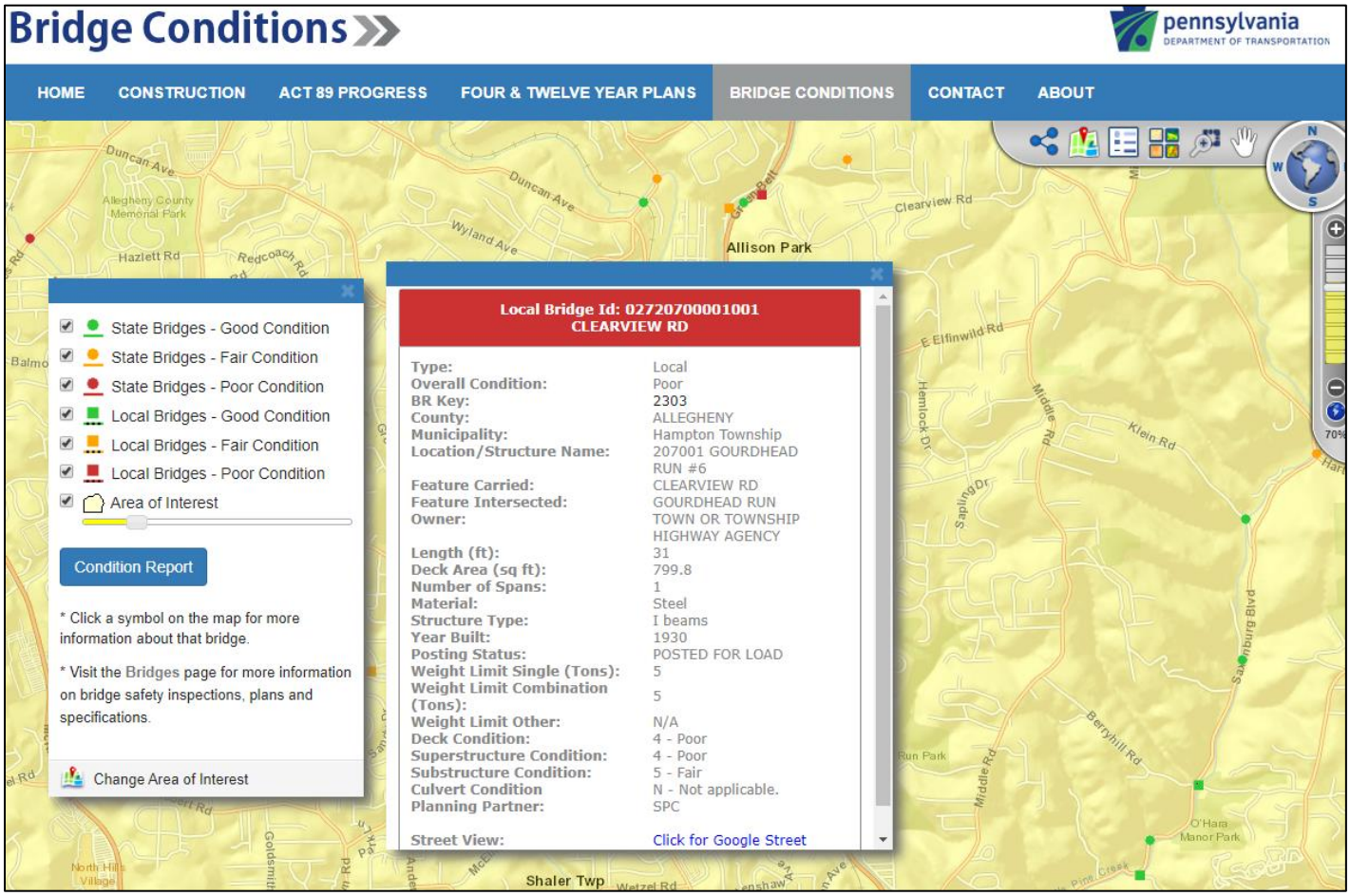
1. VDOT Traffic Engineering and Operations Division should integrate data regarding truck routes and restrictions, including bridge weight, height, and width restrictions, and tunnel restrictions (including hazardous materials) in the same data format and on the same platform.
2. VDOT Operations Division should expand the current 511 systems (website and application) to include truck-specific data.
3. VDOT Operations Division should maximize data sharing and outreach of available information to support third-party application developers and traveler information providers.
4. CDOT Operations Division should champion the creation of a CVO Information Systems Coalition with neighboring states to leverage resources and accelerate implementation.
5. VDOT District traffic engineers should review existing signed route restrictions for adequacy, and conspicuity, and develop statewide guidelines for sign placement.

Pennsylvania Data Comparison

Pennsylvania's 511 system was highlighted as a best practice for its ability to provide voice alerts. However, many of the gaps and recommendations identified above that are specific to truck route restrictions are applicable to PennDOT. In particular:

- The PA 511 website (https://www.511pa.com/) does not have a commercial-vehicle portal and does not have size and weight restrictions available as a layer. The site can plot a route between origin and destination and show restrictions (weather, construction, etc.) along the route but truck-specific restrictions are not available.
- Bridge weight limits are available online at a separate site (https://gis.penndot.gov/paprojects/BridgeConditionsMap.aspx) but there is no routing function and the data is included as part of overall bridge conditions rather than as a separate database. This makes it difficult for operators to quickly identify bridges in poor condition versus those with an actual weight limit. See **Figure 8** below for a screenshot of the system. One beneficial aspect of this information is that off-system (local) bridges are included in the data.

Figure 8 – Pennsylvania Bridge Conditions Website



Source: https://gis.penndot.gov/paprojects/BridgeConditionsMap.aspx

- Bonded and posted road information is available online (PennDOT's Posted and Bonded Web Viewer) and as static pdf maps (https://www.penndot.gov/ProjectAndPrograms/PostedBondedRoadway/Pages/Posting-and-Bonding-Policy.aspx). These roads have weight restrictions—haulers must either be local traffic or must apply for a permit and post a bond to travel on them if they exceed the posted limit.
- Height (clearance) restriction data is not available to the public online. Clearance data is obtained via bridge inspections and aggregated in PennDOT's Bridge Management System 2 (BMS2) but not made available for public consumption.
- Violation data, especially on bridge strikes is not comprehensive or routinely shared between enforcement agencies and PennDOT.

STATE DOT OUTREACH

The project team identified the NYSDOT and Iowa DOT as two of the best-practice leaders from the Virginia Study and reached out to them to gather further information. Topics of conversation included the following and their responses are shown in **Table 2**.

- Is the following information publicly available?
  - Length, height, width, weight restrictions
- Is vertical clearance information actual clearance or clearance with a tolerance?
- How often is the restriction data updated? By whom? (eg., is clearance height updated after construction/repairs?)
- Is information for off-system routes (local, county, etc.) collected and published by the State?
  - How is this information obtained and how often?
  - How is data quality confirmed?
- How is truck restriction information presented to the public? Is it tied in with an online routing application, or can it be downloaded into a third-party app or telematics?
- Does the State track bridge strikes?
  - How is the information gathered (State Police or local police reports)?
  - Is this information coded as a sign violation only or are there a separate flag for these incidents?
- Have you received any feedback from industry about things they like or would prefer to see?
- Have you had any interaction with private telematics suppliers or applications?

Table 2 – State DOT Outreach Information

State	Contact	Discussion
NY	Dave Rosenberg and Jim Davis	• Two websites have information available. 511ny.org shows weight and height postings that impact legal size/weight vehicles. The second is https://www.dot.ny.gov/gisapps/osowscreen which includes a more extensive list of restrictions to routing for permitted loads. • Both online systems allow users to enter a start/end point and see if routing would be impacted by restricted structures. • Height clearance shown in both systems includes a buffer (is not actual clearance).

State	Contact	Discussion
		• Clearance information in both systems is supposed to be updated after any work is completed (construction, survey, etc.). • Data comes from the relevant NYSDOT Region construction/maintenance groups to NYSDOT Structures group in the main office. • NYSDOT does have a process for tracking bridge strikes (see below). • Data on the OS/OW site is available for download (CVDataFeed) to ArcGIS or Google Earth.
IA	James Hauber, Sinclair Stolle, Jodi Clement	• Weight restrictions for legal loads are posted at the actual structure. There is no easily accessible online database that shows posted bridges. • New 511 site (due for release this year) shows truck restrictions that are related to construction or incidents but not long-term restrictions such as a permanently posted bridge. • List/map of embargoed bridges (weight limits for OS/OW loads), vertical clearance restrictions, and pavement restrictions are online as static maps: https://iowadot.gov/mvd/motorcarriers/Maps • The embargo bridge and pavement restriction data (for OS/OW loads) can be exported as a KMZ file. • Permits are issued with a 2" clearance, bridges are signed with a 3" clearance (and only signed when the vertical clearance is less than 14'-9", which the sign would show at 14'-6"). • District offices are responsible for measuring and reporting clearance changes to the Research and Analytics Bureau. It is then uploaded into the State's Roadway Asset Management System (RAMS) which is ESRI Roads and Highways and then uploaded to the permit system. • Local public agencies are responsible for routing permits and maintaining and posting information on their routes. In special circumstances, some information will be posted to the State's 511 (eg, during flooding in southwest Iowa last year). • Bridge hits that require action from the Bridges and Structures Bureau are kept as a list, but not all bridge hits. The Traffic Management Center is supposed to be notified of all bridge strikes • DOT is pushing all data on their 511 to Waze, but Waze is only publishing some of it. DOT ingests Waze data feed including alerts (accounts for 15% of DOT's initial notifications for events in the state's TMC). Waze does not have an interest in the truck driver demographic for their application. Currently they only ask if the driver is: private, taxi, motorcycle, electric.

Additional Information

NYSDOT's Main Office Structures group has been recording bridge strikes since 2011. Information comes in via NYSDOT regional offices, transportation management centers (TMCs), the Statewide Transportation Information Coordination Center (STICC), or media reports. The majority of bridge hit reports are generated when police are called to the scene. Minor bridge hits (hits to railings or if the vehicle leaves the scene) may not be reported, so the list kept by Structures is not comprehensive.

Bridge hits are generally reported to NYSDOT Main Office Structures group using an Incident Notification Form with the following information:

- Bridge location/direction/time and date of incident
- type of vehicle - tractor trailer/box truck/bus/train/boat etc.
- incident details which describes the bridge hit
- update details which describes Lanes blocked/traffic detoured and police action
- Bridge inspection result – no damage/minor/moderate/major damage
- Fatality/injury

In addition, New York State's efforts to prevent bridge strikes was profiled in an internal 2016 PennDOT initiated report, "Bridge Strike Prevention National Best Practices Summary and Recommendations Report." Although outside the scope of this technical memorandum, the relevant information from outreach efforts conducted for that report are quoted below.

> *"The New York State Department of Transportation is one of the most active state agencies leading the implementation of preventative strategies dealing with bridge strikes. New York, especially New York City, has many inadequate roadways not initially designed to accommodate modern commercial vehicles. The New York Parkway system has several overpasses that are continuously impacted by commercial vehicles utilizing the Parkway system. To combat this, in 2014 New York constructed several overheight vehicle detectors at the entrance ramps along the entire Parkway system. The overheight detection systems not only alerts the driver through the use of flashing yellow lights, sirens and dynamic messaging signs, but also alerts local authorities to help remove the vehicle from the Parkway system with minimal impacts to traffic. In addition to the installations along the Parkway system, several existing, locally operated, overheight vehicle detection systems were connected to a Traffic Management Center (TMC), improving both the prevention of and response to bridge strikes across the state. New York not only has employed the use of technology to prevent bridge strikes, but has also assembled a task force directly responsible for a robust preventative system. The task force meets monthly with stakeholders to discuss and resolve prevailing issues associated with bridge strikes throughout the state. Each time a bridge is struck by an overheight vehicle, the state assesses what existing preventative strategies were present at the time of the crash and whether additional mitigations are warranted to prevent future collisions. Preventative strategies range from additional signage or pavement markings up to and including the installation of overheight vehicle detection systems. The state also offers online information including maps detailing vertical clearances of overhead structures throughout the state in an attempt to publicize the data, thus allowing truck operators to determine appropriate routing."*

Appendix B

Task 2.2 - Stakeholder Meeting with PA Motor Truck Association

Technical Memorandum Deliverable

Date:	August 18, 2020
To:	Jerome Frederick *Senior Civil Engineer* *Traffic Systems and Performance* *Bureau of Maintenance & Operations, PennDOT*
From:	Todd Trautz, P.E., PTOE *Project Manager, Michael Baker International*
CC:	Heather Sorce, *Research Project Manager, Bureau of Planning & Research, PennDOT* Brian Stewart, *Integrated Planning and Policy, Cambridge Systematics* Allie Slizofski, P.E., PTOE, *Principal, Drive Engineering*
Subject:	E04695 Part 1 – Commercial Vehicle Navigation Research Task 2.2 – Stakeholder Meeting with PMTA Task 2.2 Technical Memorandum Deliverable
Enclosures:	Enclosure A – PMTA Meeting Summary Package Enclosure B – PMTA Survey Results

INTRODUCTION

Pennsylvania contains a number of bridges and other structures with dimensional or weight restrictions. When these restrictions are ignored, the associated costs to repair or replace the structure, and the cost to the public to reroute can be high. The Pennsylvania Department of Transportation (PennDOT) initiated this project to better understand available options for proactively informing truck drivers about weight, height, and other restrictions. The initial task, Task 2.1, included a literature review and results from interviews with two State DOTs identified as best-practice leaders in this topic area. The second task, Task 2.2, included the outcomes of an outreach meeting with the Pennsylvania Motor Truck Association (PMTA) aimed at gathering their insights and perspectives on the truck navigation issue. This technical memorandum is a summary of the outcomes of the Task 2.2 PMTA outreach meeting.

PMTA MEETING

A virtual meeting with PMTA was held on July 22, 2020 via WebEx. The goal of this meeting was to gather information on the methods used by the trucking industry for navigation, determining the direction they see the industry going in regarding navigation, and noting the options the trucking industry may be willing to consider in the future. Attendees included members from the PennDOT Bureau of Planning and Research, PennDOT Bureau of Maintenance and Operations, Consulting Team (Michael Baker International, Cambridge Systematics, Drive Engineering), and PMTA. A meeting summary package, including a list of meeting attendees and a record copy of the presentation, is included with this memorandum as **Enclosure A**. Before the meeting, a survey (https://www.surveymonkey.com/r/ZD7Z72S) was prepared and distributed to PMTA meeting attendees to engage them and prime their thinking prior to the meeting so as to further meeting discussions. The results of this survey are included in **Enclosure B**.

MEETING OUTCOMES

The meeting with PMTA provided insight into the issues that concern the trucking sector with regards to navigation and communication methods and preferences. The meeting offered a time to jointly discuss issues and collaborate to develop ideas that could inform solutions.

Navigation Methods

During the meeting, different methods of navigation were discussed, including current industry methods, Pennsylvania practices, and issues with the current methods of navigation. It was noted that drivers all use different routing software which makes communicating issues to drivers difficult. There is a need to find the right tool to get information to the ones who need it most. According to PMTA, many members utilize a cell phone for their navigation.

PMTA indicated that another commonly used and helpful navigation method is the 511PA system. The general issue with State 511 systems is that there are many attributes that vary between states, and there are barriers to effectively share data across borders and thus across systems. Additionally, the information that the 511 systems give on the web is current, but there is no way of getting notifications of real time hazards or detours while on route unless a smartphone application is used. Through discussion, it was determined that for a navigation method to be most effective for truckers, it should be dynamic, borderless, and offer hands-free notifications of any hazards or detours when in route.

Important Issues

During the meeting, it was indicated that when a detour occurs due to a road incident, there are concerns that commercial vehicle drivers may be directed to access roads they are not familiar with, did not prepare to travel on, and/or should not be traveling on, which leads to unintended and unavoidable vehicle-infrastructure interactions such roads/bridges that they are too heavy for or underpasses that they are too tall for with no other route options.

Another issue that was discussed during the meeting was how difficult it is to locate accessible and available truck parking locations whether they are rest areas or commercial facilities. There is currently no reliable system for relaying where available parking is for truckers or if there are any open parking areas to rest at during stops. This often manifests as drivers being forced to break laws by either driving for longer than their allotted time span looking for a parking area or being forced to park along sections of roads that are not suitable for commercial vehicle parking. By identifying where there are gaps in suitable parking and rest areas are and implementing free parking areas along heavily traveled areas was discussed as a potential solution. Another potential solution includes adding community features to navigation tools so truckers can indicate to each other where there is suitable parking in real time.

Outreach

Through the discussion with PMTA, it was determined that the best mode of outreach to the PA trucking sectors would be surveys sent out to truckers. It was noted that the surveys may have a low response rate, but creating a short, engaging, to the point survey may help to increase the number of responses. Hearing from the community who is affected by these navigation issues will give credibility to outcomes from this project. PMTA expressed interest in assisting with reviewing the outreach plan and offering input to get the best results. PMTA also offered to assist in sending out the surveys to members as they have a comprehensive contact list.

NEXT STEPS

The next step of the project is to create a trucking community outreach survey to receive input on the preferred navigation methods and obtain feedback on navigation improvement options that could be implemented in the future. This outreach will be conducted through a short, easy to follow survey that will be sent to PMTA for review and distribution. The draft of this outreach plan will be discussed during the August 2020 monthly project status meeting.

Enclosure A

PMTA Meeting Summary Package

MEETING SUMMARY

Agenda:	Action Items:
1. Introductions The meeting's sign-in sheet and presentation are enclosed with this meeting summary for reference.	➢ n/a
2. Problem Statements a. Problem Statements Todd led a discussion regarding the problem statements for the project, including oversize/overweight vehicles degrading highway infrastructure at an accelerated rate, negative effects on highway safety/traffic operations, and violations of size/weight restrictions. b. Landis Valley Road Bridge Strike Todd provided an example of the impacts oversize/overweight vehicles have on highway infrastructure through the Landis Valley Road bridge strike example. – Joe indicated when there are detours due to a road incident, truck drivers are concerned about being directed onto a route they are not familiar with. The drivers are unaware if they are crossing over a bridge with too much load or passing under a structure with a height restriction. Additionally, everyone uses a different routing software, making things challenging when communicating these issues. – There is a need to find the right tool to get information to the people who need it most, whether that be GPS or on-board systems. – Using 511 systems is difficult going over state lines as there isn't one system across state borders. – Height information on bridges exists in Pennsylvania but is just not accessible to all, or more importantly, the information isn't packaged in a way appropriate for broad public consumption.	➢ n/a

MEETING SUMMARY

3. Project Purpose and Overview ○ Todd provided an overview of the project, explained the back history of the underlying issue and gave an overview of previously conducted PennDOT projects and studies in this topic area.	➢ n/a
4. CV Navigation Methods a. Industry Information Channels ○ Todd led a discussion concerning the findings of a FHWA-DOT study, "Travel Information for the Commercial Vehicle Operations Community", that was completed in 2019 and highlighted key categorial findings regarding navigation information sources, differences between small and large truck fleets, common navigational tools, and DOT best practices. – Joe commented that GPS is outdated as soon as you buy it. It was speculated that most members utilize a cell phone and have adapted to it. GPS is not very dynamic and doesn't account for highway infrastructure changes. – Brian agreed and there are issues with all navigational tools. He was most interested in learning about the use of the traditional road atlas, believing its interest comes from an aging truck driver population. Age and experience of the driver dictates the comfort level with tools. ○ Best DOT practices include New York's and Washington's 511 systems. – States vary on the data attributes and functional features provided in their 511 systems. b. Pennsylvania's Practices Based on other DOT's 511 systems, Todd discussed PennDOT's 511 system and how it compares to other states. – Joe has had a positive experience with 511PA and sees the platform for trucks to opt into a notification system for their cell phone that is immediately up to date. – Information that would be beneficial for truck drivers include known rest areas, commercial and public	➢ n/a

MEETING SUMMARY

parking areas, and making truck parking dynamic through the use of a community feature. – Hands free notifications are necessary as drivers cannot be looking at devices while driving. c. Gaps/Issues Todd discussed known gaps/issues from the FHWA-VDOT report, including truck route restrictions, truck parking, and alternate truck routes. Many of these issues are also found in Pennsylvania.	
5. Engaging the PA Trucking Sectors a. Trucking Community Outreach Plan ○ Todd led a discussion on ways to engage with the PA trucking community as part of the project via an Outreach Plan. The plan would be informed through the previously completed literature review and based on the PMTA meeting discussion. A goal for the Outreach Plan would be to target specific audiences and differentiate between the various forms of trucking entities, groups, and sectors. – Small, medium, and large outfits need to be targeted ○ Outreach approach options include remote invitation-based meetings, an online survey, or a combination of meetings and surveys. – Brandon indicated that surveys will likely have a very low response rate due to recent experiences. Joe added that any surveys needs to be short, engaging, to the point, and not too thought provoking. – Hearing from the community gives credibility for changes being made. ○ PMTA will be a part of the outreach plan review and will assist in reviewing the developing a community survey to hopefully get a higher response rate.	➢ **The Project team** will develop a trucking community survey and will provide to PMTA for their review by mid-August 2020.
6. Closing Remarks/Adjourned a. Final Remarks ○ There is a need for dynamic navigation updates made to the 511PA system ○ Notifications are necessary for truckers, and a key issue is the ability to identify parking and rest areas.	➢ **MBI** to prepare and distribute a meeting summary.

MEETING SUMMARY

b. Next Steps ○ The Project Team will create a trucking community outreach survey and distribute it to the group. ○ The Project Team will prepare for a discussion around the outreach survey on the next project status call.	

If you have any questions or comments, please contact the Project Manager: Todd Trautz, PE, PTOE at Todd.Trautz@mbakerintl.com or (717) 254-0544.

E04695

PMTA Meeting Sign-in Sheet

Meeting Name: E04695, PennDOT – PMTA Commercial Vehicle Navigation Meeting WebEx			Date: 7/22/2020	Time: 9:00 – 11:00 AM
Attendee Name	**Organization/Representing**	**Phone Number**	**E-mail Address**	
Todd Trautz	Michael Baker International	717-221-2058	todd.trautz@mbakerintl.com	
Alyssa Weishaar	Michael Baker International	717-221-2018	alyssa.weishaar@mbakerintl.com	
Jerome Frederick	PennDOT Bureau of Maintenance and Operations	717-265-7557	jerfrederi@pa.gov	
Heather Sorce	PennDOT Bureau of Planning and Research	717-214-9508	hsorce@pa.gov	
Ryan McNary	PennDOT Bureau of Maintenance and Operations	717-346-4404	rymcnary@pa.gov	
Brian Stewart	Cambridge Systematics	646-364-5487	bstewart@camsys.com	
Nick Vlahos	Cambridge Systematics	630-430-5409	nvlahos@camsys.com	
Mohamed Sarraj	Drive Engineering	215-367-5535 ext. 121	mohameds@driveengineering.com	
Joe Butzer	PMTA, Interim President	717-761-7122 ext. 107	jbutzer@pmta.org	
Ken Morder	PMTA, Director of Safety	717-761-7122	kmorder@pmta.org	
Brandon Moree	PMTA, Director of Communications	717-761-7122	bmoree@pmta.org	

PENNDOT-PMTA COMMERCIAL VEHICLE NAVIGATION DISCUSSION

JULY 22, 2020

9:00 AM TO 11:00 AM

pennsylvania
DEPARTMENT OF TRANSPORTATION

AGENDA

Introductions

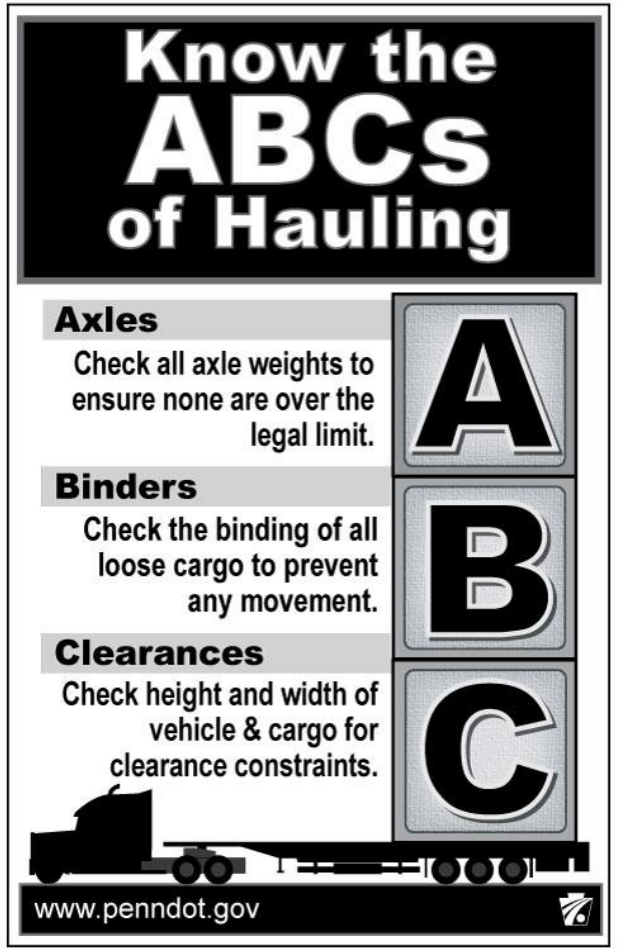
Problem Statements

Project Purpose and Overview

CV Navigation Methods

a. Industry
b. PA Practice
c. Gaps/Issues

Engaging the PA Trucking Sectors



PROBLEM STATEMENTS

- Oversize and/or overweight vehicles degrade highway infrastructure at an accelerated rate.
- Infrastructure degradation negatively effects highway safety and traffic operations.
- Incorrect route selection may result in violations of size and weight restrictions.

W12-2
Low Clearance

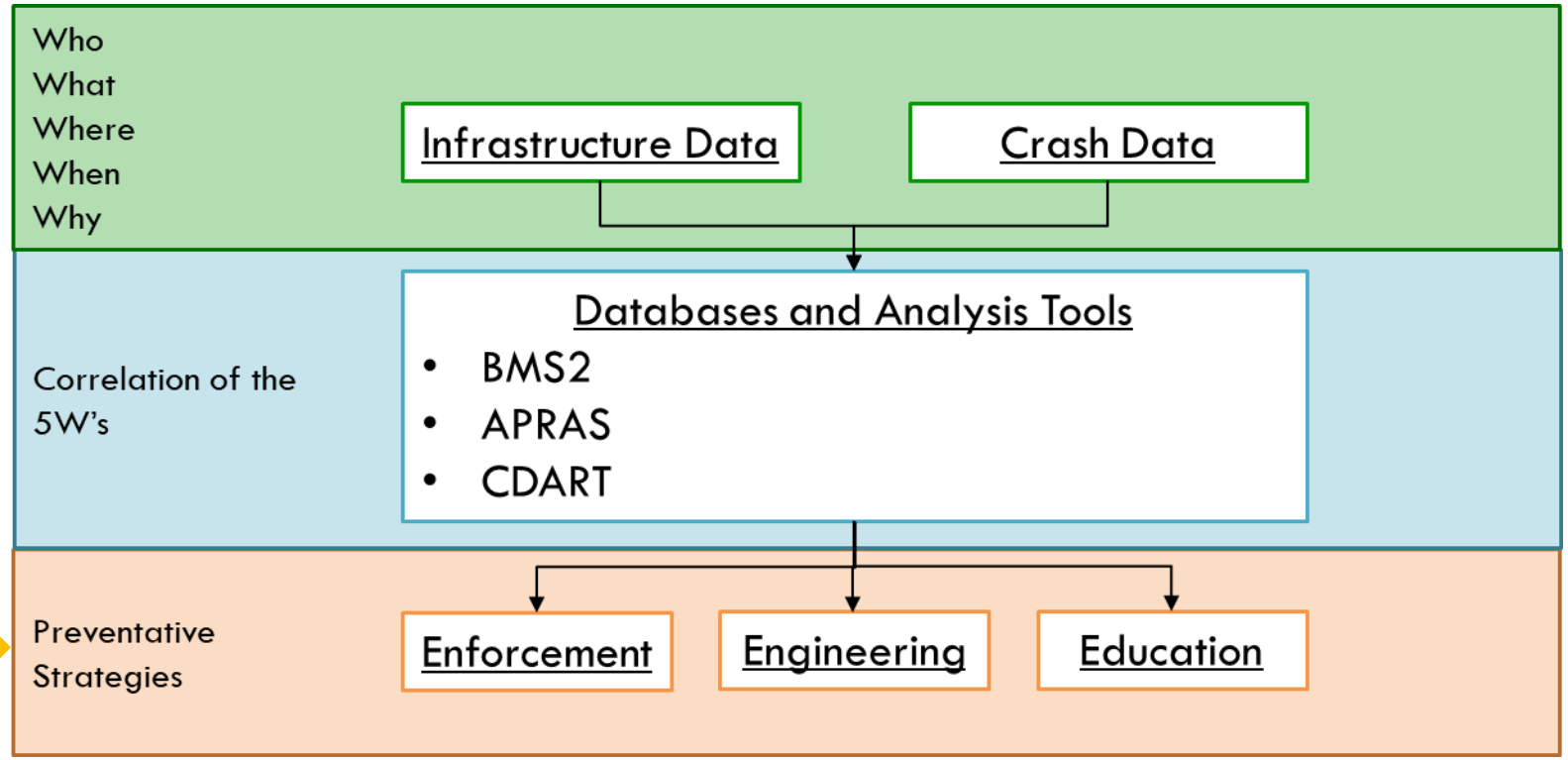
PROBLEM STATEMENTS

Landis Valley Road Bridge Strike Estimated Impact

DESCRIPTION	DURATION	ESTIMATED ECONOMIC IMPACT
RULD's Along US 222 Day of Incident	3:00 PM - 9:00 PM	$785,000.00
RULD's Along US 30 EB Day of Incident	3:00 PM - 9:00 PM	$693,000.00
RULD's Along US 30 WB Day of Incident	3:00 PM - 9:00 PM	$422,000.00
3 Secondary Crashes along US 30 Within Queue of US 222	N/A	Unknown
RULD's for Landis Valley Road - Full Detour	3 Weeks	$631,000.00
RULD's for Landis Valley Road - One Lane Detour	9 Months	$5,052,000.00
Estimated Landis Valley Road Bridge Repairs	3-4 Months	$565,616.00
RULD's Along US 222 During Bridge Repairs	5 Days - Single Lane	$470,000.00
	LANDIS VALLEY ROAD TOTAL ECONOMIC IMPACT:	**$8,618,616.00**

PROJECT PURPOSE/OVERVIEW

There is not a single solution



PROJECT PURPOSE/OVERVIEW

<u>Recommendations from August 2016 Bridge Strike Prevention Report</u>

1. Educational materials
   - Drop the Boom Campaign
   - A-B-C checklist for drivers
2. Industry partnerships
3. 511PA low-clearance mapping
4. Crash reporting and asset management linkage
5. Risk assessment tool

"Develop interactive map data to be included within 511PA. The data utilized should be provided for developers to be incorporated into GPS navigation software."

PROJECT PURPOSE/OVERVIEW

E04695 - Best Practices/Potential Solutions for Commercial Vehicle Navigation

Task #	Task Title [Lead]	F	M	A	M	J	J	A	S	O	N	D	J	F
Task 1: Project Management/Administration														
1.1	**Project Management/Administration [Joint]**	x	x	x	x	x	x	x	x	x	x	x	x	x
Task 2: Other Administrative Activities														
2.1	**Literature and Peer Review [CS] - *Complete***													
	– *Lit. Review & Peer WebEx Meetings*	x	x											
	– *Report*			x										
2.2	**Stakeholder Meeting with PMTA [MBI]**													
	– Meeting Prep			x	x	x	x							
	– Meeting						x							
	– Meeting Summary						x							
2.3	**Trucking Company and Individual Outreach [MBI]**													
	– Outreach Plan					x	x	x						
	– WebEx Meetings (6 max)							x	x					
	– Report								x	x				
2.4	**Overall Findings Report [MBI]**													
	– DRAFT Report									x	x	x		
	– FINAL DRAFT Report											x	x	
	– FINAL Report													x

NAVIGATION METHODS

Industry Information Channels

FHWA-VDOT "Traveler Information for the Commercial Vehicle Operations Community", October 2019

Top Information Sources for Truck Drivers

*Note: Values in italics are for how drivers would prefer to receive information on the noted topic. Entries over 33% in either current or preferred are **bolded**.*

Information Type	Dispatch	VA 511	VDOT Trucking Resources	GPS, Route Application	On-board Communications/ Telematics	Virtual Message Sign	Phone Text	CB Radio	Highway Advisory Radio
Route Restrictions	32% *(24%)*	15% *(25%)*	**34%** *(30%)*	**51%** ***(39%)***	11% *(21%)*	**40%** ***(45%)***	11% *(23%)*	24% *(7%)*	5% *(4%)*
Incidents	19% *(20%)*	23% *(28%)*	10% *(17%)*	**45%** ***(39%)***	8% *(13%)*	**47%** ***(51%)***	10% *(29%)*	31% *(12%)*	9% *(6%)*
Work Zones	14% *(15%)*	18% *(30%)*	18% *(21%)*	**42%** ***(38%)***	7% *(13%)*	**56%** ***(55%)***	8% *(22%)*	30% (12%)	8% *(7%)*
Alternate Routes	19% *(20%)*	18% *(29%)*	24% *(23%)*	**53%** ***(37%)***	11% *(15%)*	**42%** ***(45%)***	8% *(23%)*	24% *(11%)*	5% *(6%)*
Truck Parking	13% *(17%)*	18% *(26%)*	18% *(20%)*	32% ***(34%)***	11% *(17%)*	**34%** ***(44%)***	10% *(21%)*	24% *(7%)*	2% *(7%)*

Insights:

- Reliance on CB Radio more than preferred
- High preference for receiving text messages
- Preference for truck parking info in GPS and routing applications
- Existing and preferred usage of message signs is high

NAVIGATION METHODS

FHWA-VDOT "Traveler Information for the Commercial Vehicle Operations Community", October 2019

Small vs. Large Fleets – Information Differences

Insights pertaining to the impact of fleet size on truck routing information:

- Small carriers
  - More leeway in tool selection
  - Less sophisticated tools
  - Less organizational support
- Large carriers
  - Preplanned routes
  - Company approved/given tools
  - More organizational support

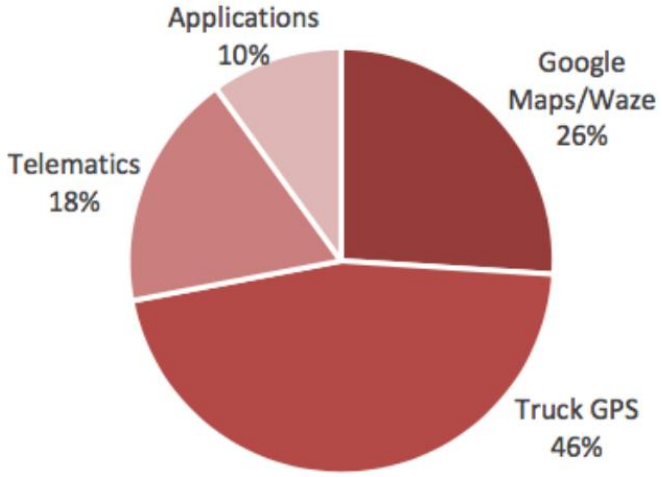
NAVIGATION METHODS

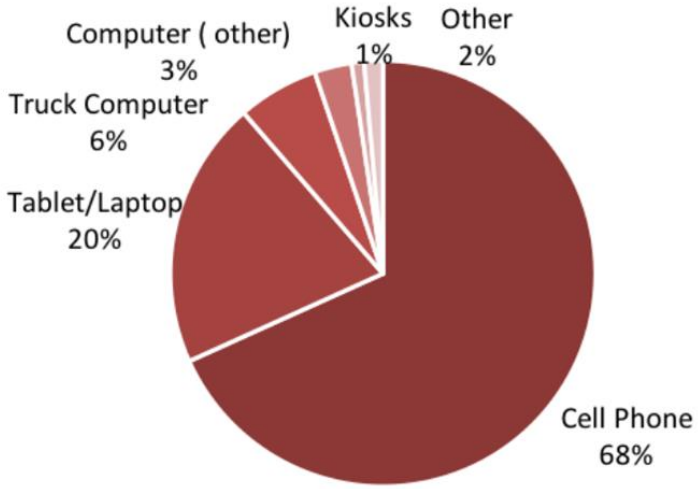
FHWA-VDOT "Traveler Information for the Commercial Vehicle Operations Community", October 2019

Common Navigational Tools

Insights pertaining to the impact of fleet size on truck routing information:

- Most Common
  - Omnitracs
  - PeopleNet
- Other Common
  - Verizon
  - Garmin
  - Telenav
  - TomTom
  - Traditional Road Atlas



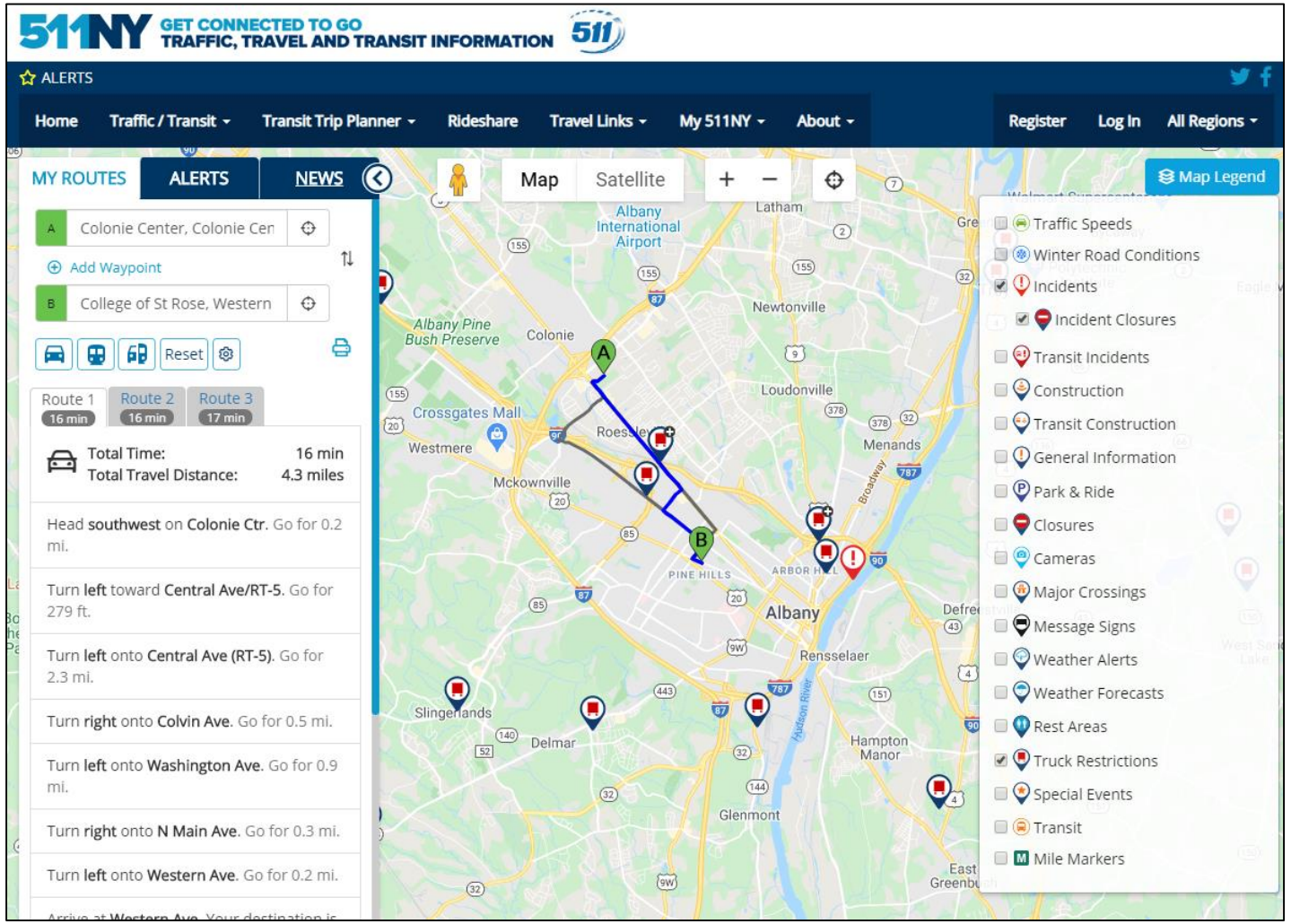


NAVIGATION METHODS

DOT Best Practices

New York 511

- Height/Weight Restrictions
- Routing Capability
- Additional Resources
  - https://www.dot.ny.gov/postedbridges – Posted Bridges
  - https://www.dot.ny.gov/gisapps/osowscreen - Permitted Load Routing



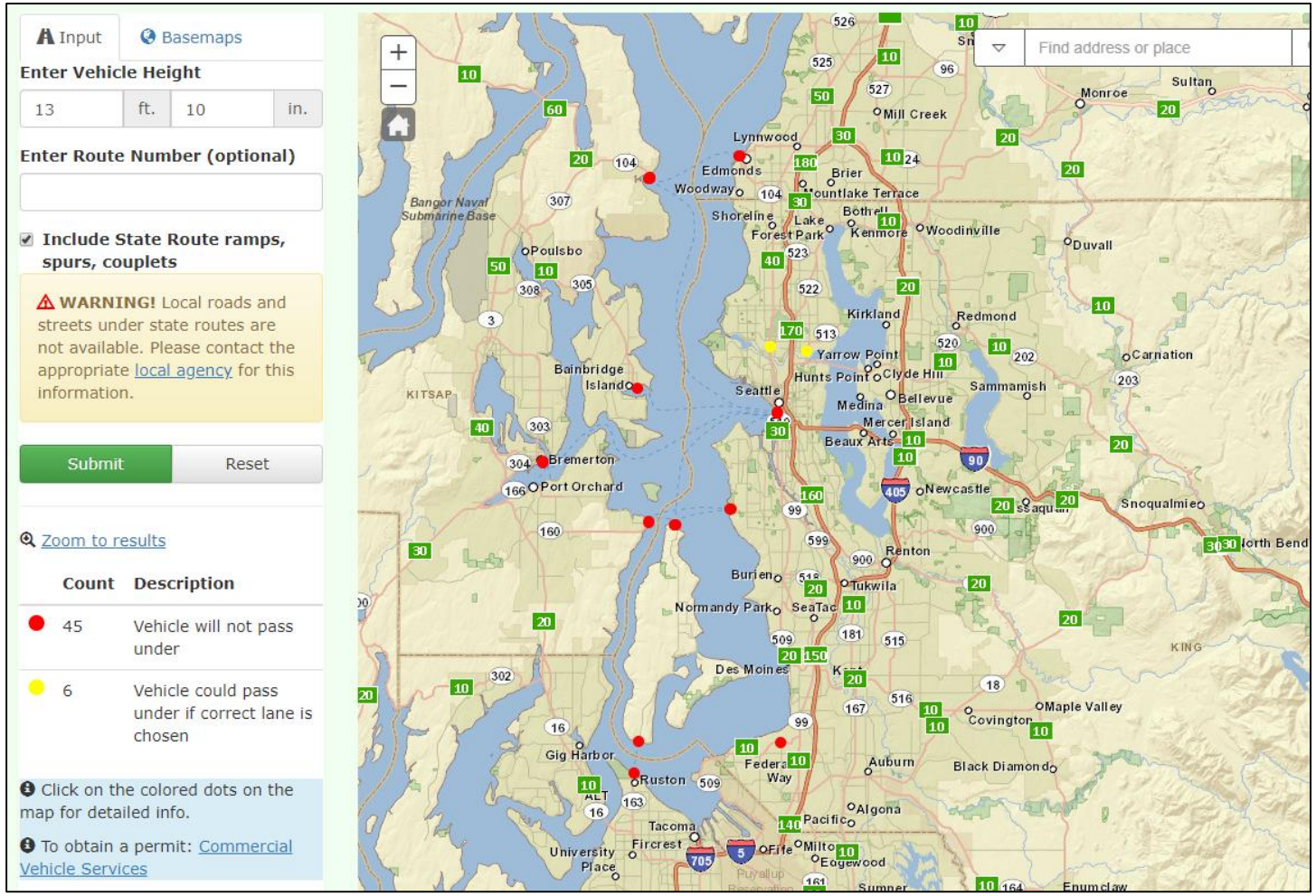
https://511ny.org/#:Alerts

NAVIGATION METHODS

DOT Best Practices

Washington 511

- Trip Planner
- User Height Input-based Routing
- Additional Resources
  - https://www.wsdot.wa.gov/commercialvehicle/restrictions/default.aspx?View=Main&refnum=321&action=1 – Oversize/Overweight Restrictions

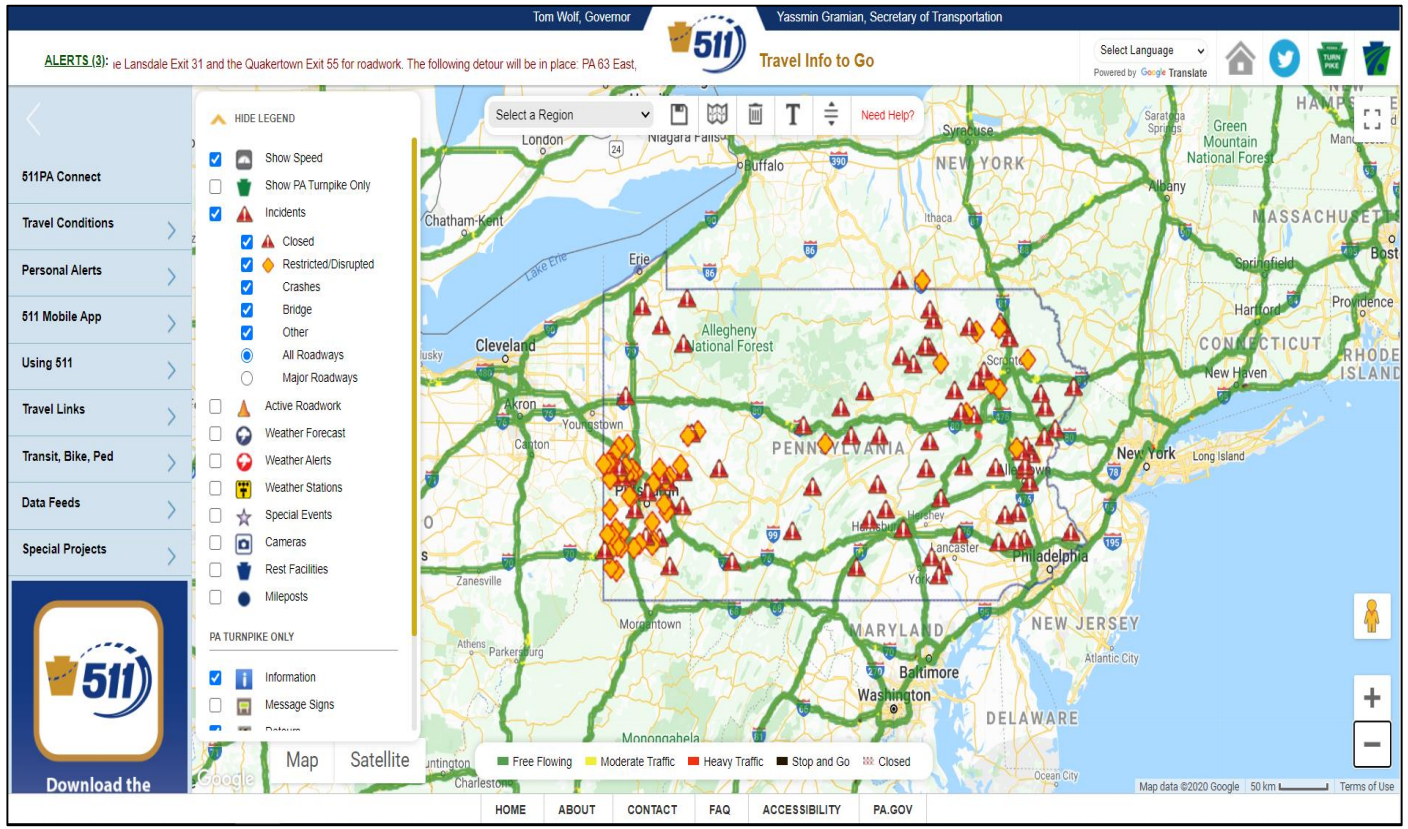


https://www.wsdot.wa.gov/data/tools/bridgeclearance/

NAVIGATION METHODS

Pennsylvania Practice

- PennDOT 511 system
  - ➢Not truck driver specific, but offer options
  - ➢Extended coverage to New Jersey and West Virginia

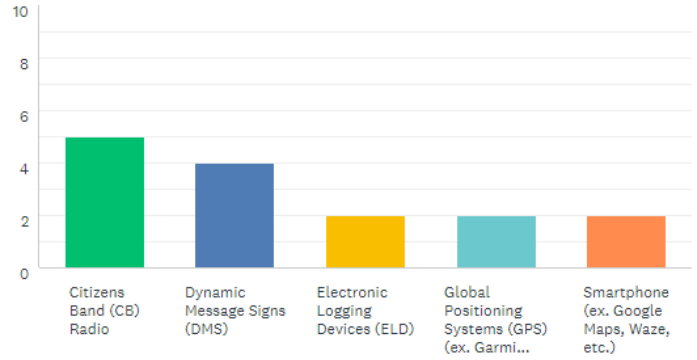


NAVIGATION METHODS

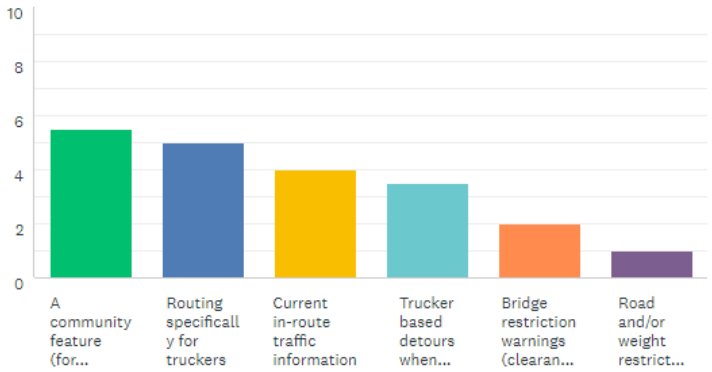
PMTA Survey Results

- Demographics
- Topics
- Tools
- 511PA

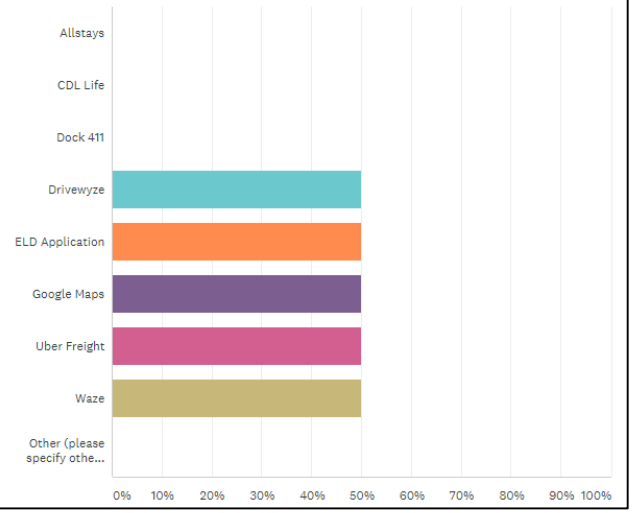
What are PMTA members using to inform their in-route decision making, whether related to navigation and/or prevailing traffic conditions? Rank in order of importance, with 1 being most important:



Please rank the most important features provided by a smartphone travel application.



What applications do your members use? Check all that apply:



NAVIGATION METHODS

Gaps/Issues

1. Truck route restrictions
2. Work zones, incidents, and traffic congestion
3. Truck parking
4. Alternate truck routes
5. Access to information and research
6. Regional integration

NAVIGATION METHODS

Truck Route Restrictions

- Not every truck has a truck GPS navigational tool
- Google, Waze do not contain truck route restriction information
- Restrictions not clearly identified; signs placed when there is no possible corrective action
- Route restriction length information is a static map
- Bridge height information is not available
- No integrated length, weight, and height restriction map
- No information included in 511 system
- Violation locations and reasons not recorded

NAVIGATION METHODS

Work Zones, Incidents, and Traffic Congestion

- Limited truck awareness that they will encounter a work zone or incident zone
- Lack of information on the impact of the delay
- Not all telematics provide the incident information on the in-cab communication device

NAVIGATION METHODS

Alternate Truck Routes

- Alternate routes not defined with trucks in mind
- Guidance signs very far from one another
- No specific guidance posted on most telematics

NAVIGATION METHODS

Access to Information and Research

- The information was in some cases difficult to find
- Outreach improvement
- Third party data providers not aware of all data available
- There is no formal procedure to reach developers of existing applications

ENGAGING PA TRUCKERS

Trucking Community Outreach Plan

- Informed by literature review
- Informed by PMTA Meeting
- Differentiates between the various forms of trucking entities/groups/sectors
- Target audiences

Size	National	Regional	Owner Operator
Small		X	X
Medium		X	
Large	X	X	

ENGAGING PA TRUCKERS

Trucking Community Outreach Plan

- Outreach Approach Options:
  - Remote invitation-based meetings
  - Survey
  - Combination meetings and surveys
- Survey Results
  - Surveys would be the best way to engage the trucking community
  - The trucking community would be receptive to engaging in this project

Enclosure B
PMTA Survey Results

Q1 What is the ratio of owner operators to company drivers within PMTA?

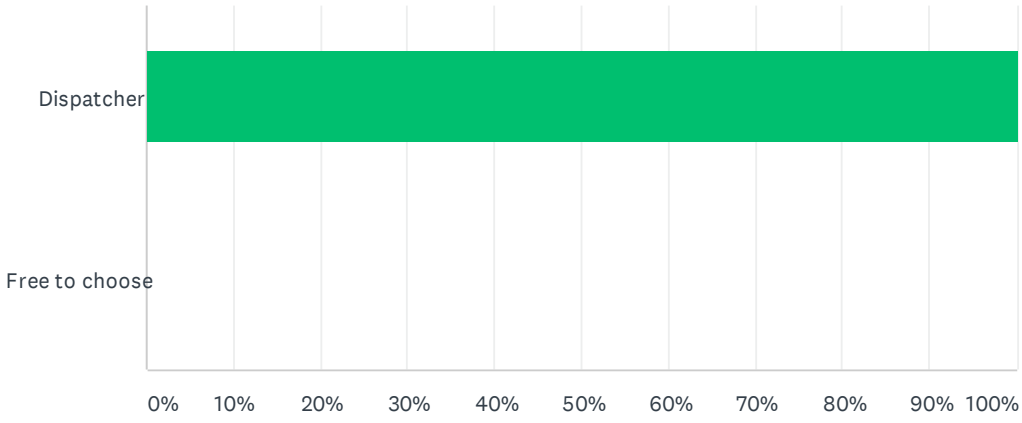
Answered: 2 Skipped: 0

Q2 What is the ratio of long to short haul drivers within PMTA?

Answered: 2 Skipped: 0

Q3 Do company drivers receive specific routes from the dispatcher or are they free to choose their own?

Answered: 2 Skipped: 0



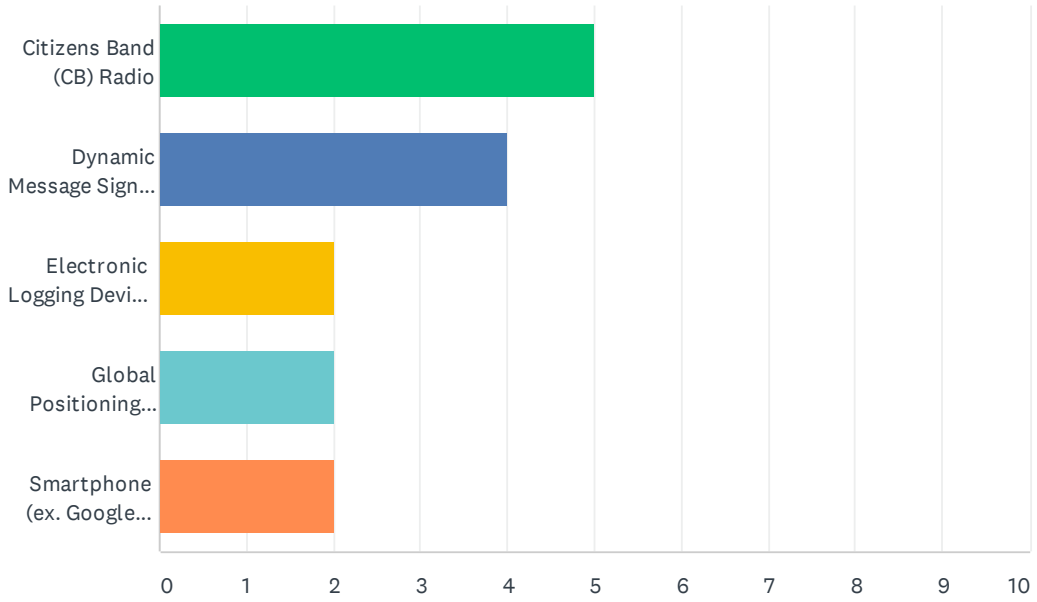
ANSWER CHOICES	RESPONSES	
Dispatcher	100.00%	2
Free to choose	0.00%	0
TOTAL		2

Q4 How do drivers or dispatchers generally select a route?

Answered: 2 Skipped: 0

Q5 What are PMTA members using to inform their in-route decision making, whether related to navigation and/or prevailing traffic conditions? Rank in order of importance, with 1 being most important:

Answered: 2 Skipped: 0



	1	2	3	4	5	TOTAL	SCORE
Citizens Band (CB) Radio	100.00% 2	0.00% 0	0.00% 0	0.00% 0	0.00% 0	2	5.00
Dynamic Message Signs (DMS)	0.00% 0	100.00% 2	0.00% 0	0.00% 0	0.00% 0	2	4.00
Electronic Logging Devices (ELD)	0.00% 0	0.00% 0	50.00% 1	0.00% 0	50.00% 1	2	2.00
Global Positioning Systems (GPS) (ex. Garmin, TomTom, etc.)	0.00% 0	0.00% 0	0.00% 0	100.00% 2	0.00% 0	2	2.00
Smartphone (ex. Google Maps, Waze, etc.)	0.00% 0	0.00% 0	50.00% 1	0.00% 0	50.00% 1	2	2.00

Q6 Are there any devices, tools, or aids you wish your members were utilizing?

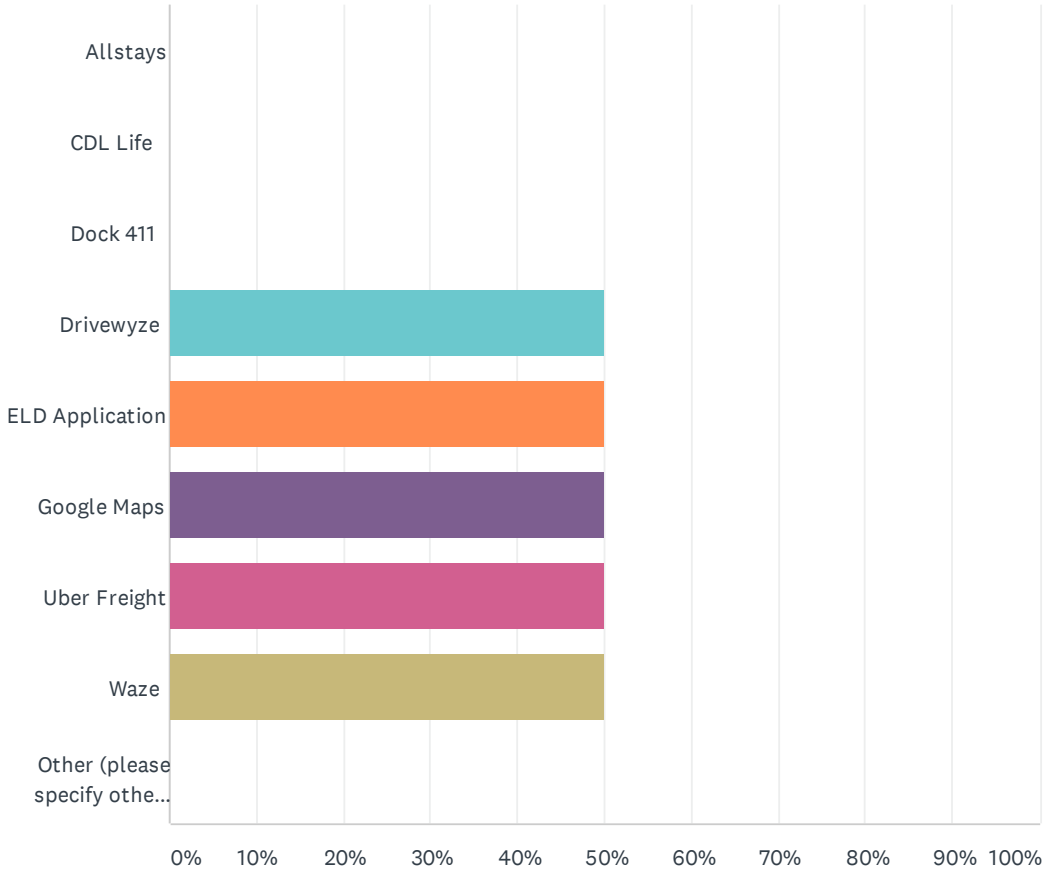
Answered: 2 Skipped: 0

Q7 Are there any specific devices, tools, or aids that PMTA or your members do not prefer? If so, why?

Answered: 2 Skipped: 0

Q8 What applications do your members use? Check all that apply:

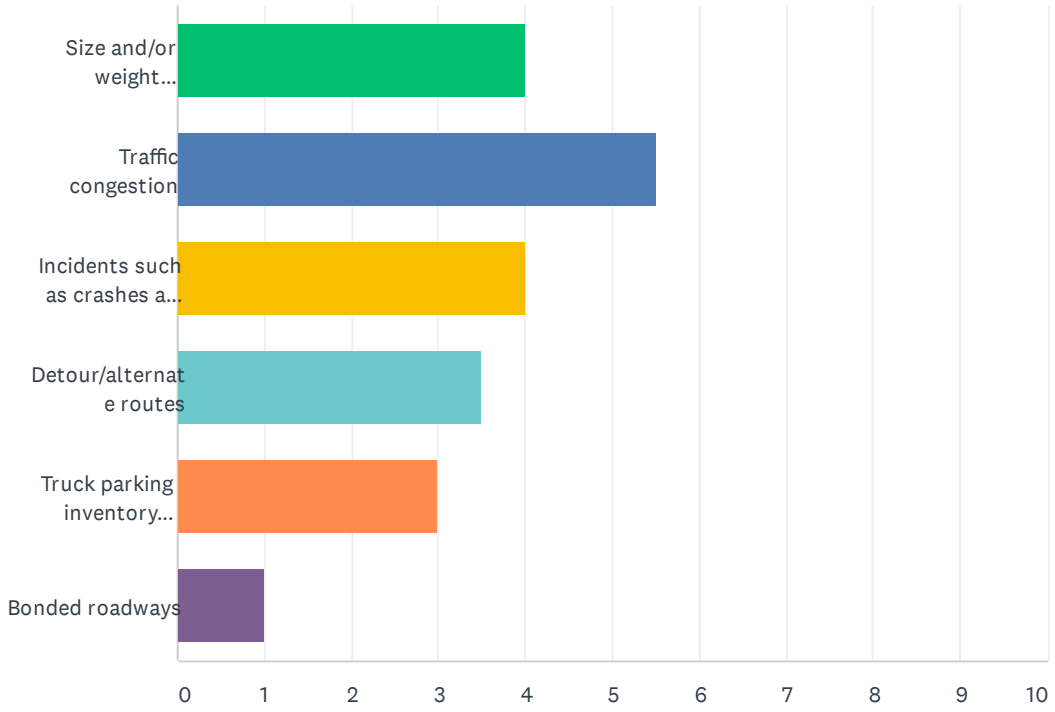
Answered: 2 Skipped: 0



ANSWER CHOICES	RESPONSES	
Allstays	0.00%	0
CDL Life	0.00%	0
Dock 411	0.00%	0
Drivewyze	50.00%	1
ELD Application	50.00%	1
Google Maps	50.00%	1
Uber Freight	50.00%	1
Waze	50.00%	1
Other (please specify other application and/or ELD application)	0.00%	0
Total Respondents: 2		

Q9 What in-route travel information are your members most interested in? Rank in priority order:

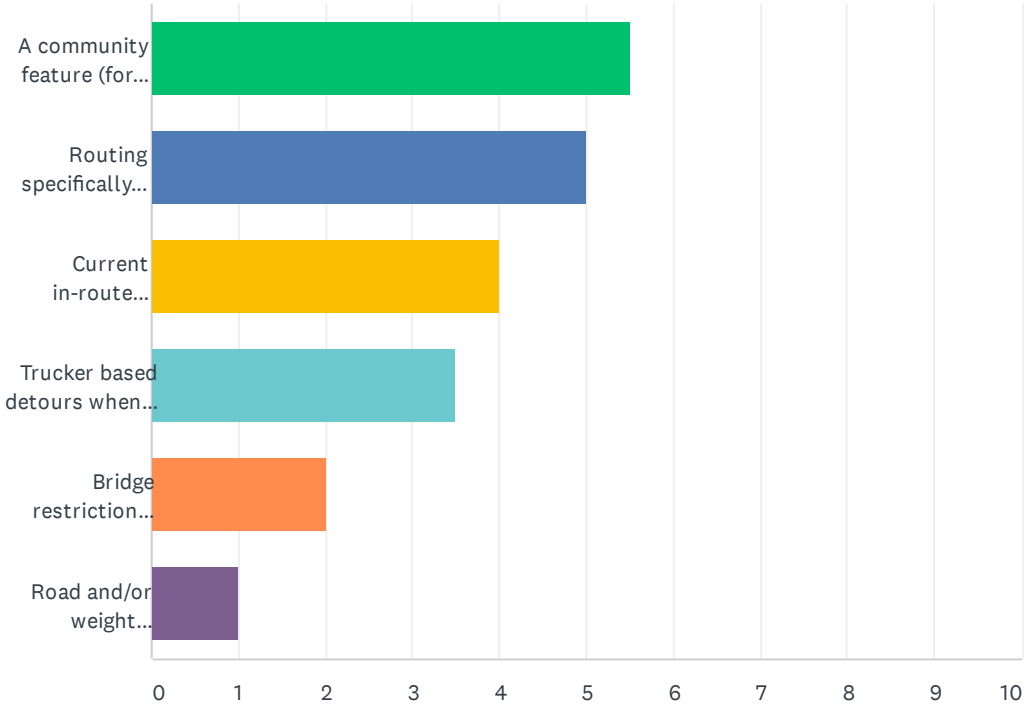
Answered: 2 Skipped: 0



	1	2	3	4	5	6	TOTAL	SCORE
Size and/or weight restrictions (bridges and roadways)	50.00% 1	0.00% 0	0.00% 0	0.00% 0	50.00% 1	0.00% 0	2	4.00
Traffic congestion	50.00% 1	50.00% 1	0.00% 0	0.00% 0	0.00% 0	0.00% 0	2	5.50
Incidents such as crashes and other roadway hazards	0.00% 0	50.00% 1	0.00% 0	50.00% 1	0.00% 0	0.00% 0	2	4.00
Detour/alternate routes	0.00% 0	0.00% 0	50.00% 1	50.00% 1	0.00% 0	0.00% 0	2	3.50
Truck parking inventory (commercial or rest areas)	0.00% 0	0.00% 0	50.00% 1	0.00% 0	50.00% 1	0.00% 0	2	3.00
Bonded roadways	0.00% 0	0.00% 0	0.00% 0	0.00% 0	0.00% 0	100.00% 2	2	1.00

Q10 Please rank the most important features provided by a smartphone travel application.

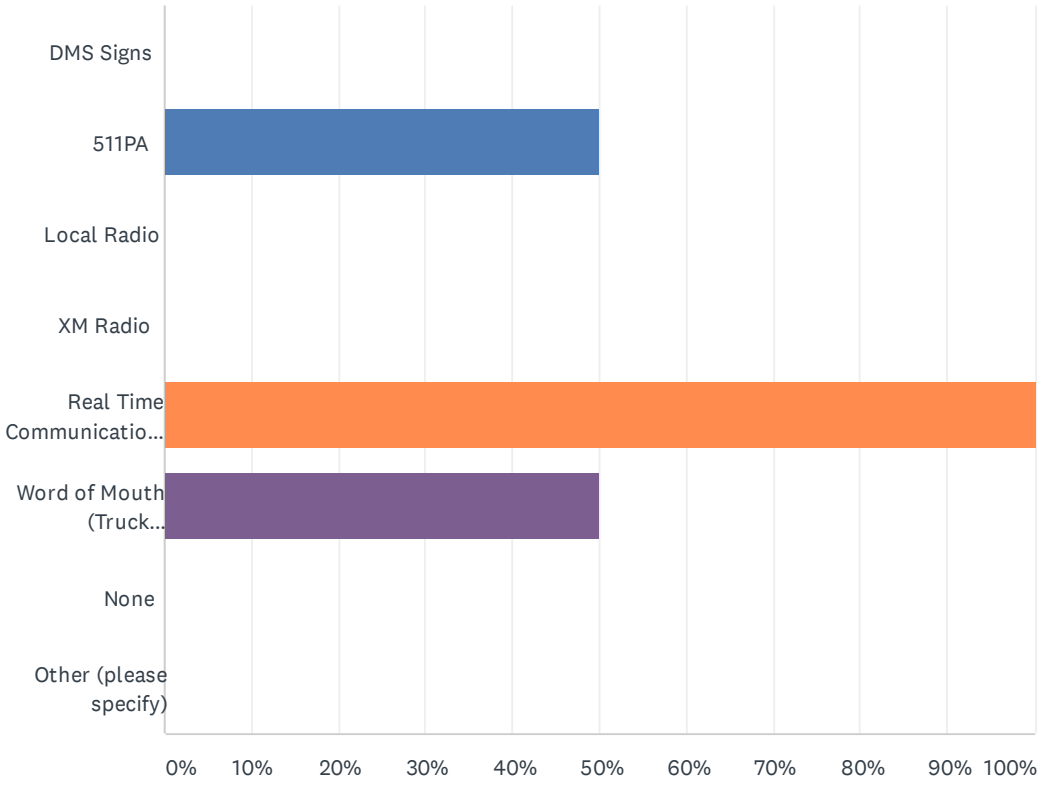
Answered: 2 Skipped: 0



	1	2	3	4	5	6	TOTAL	SCORE
A community feature (for finding parking or truck stop vacancies)	50.00% 1	50.00% 1	0.00% 0	0.00% 0	0.00% 0	0.00% 0	2	5.50
Routing specifically for truckers	50.00% 1	0.00% 0	50.00% 1	0.00% 0	0.00% 0	0.00% 0	2	5.00
Current in-route traffic information	0.00% 0	50.00% 1	0.00% 0	50.00% 1	0.00% 0	0.00% 0	2	4.00
Trucker based detours when re-routing	0.00% 0	0.00% 0	50.00% 1	50.00% 1	0.00% 0	0.00% 0	2	3.50
Bridge restriction warnings (clearance and weight)	0.00% 0	0.00% 0	0.00% 0	0.00% 0	100.00% 2	0.00% 0	2	2.00
Road and/or weight restricted roadways	0.00% 0	0.00% 0	0.00% 0	0.00% 0	0.00% 0	100.00% 2	2	1.00

Q11 Have you or your members found additional resources, outside of smartphones, that are useful for travel and traffic information? Check all that apply:

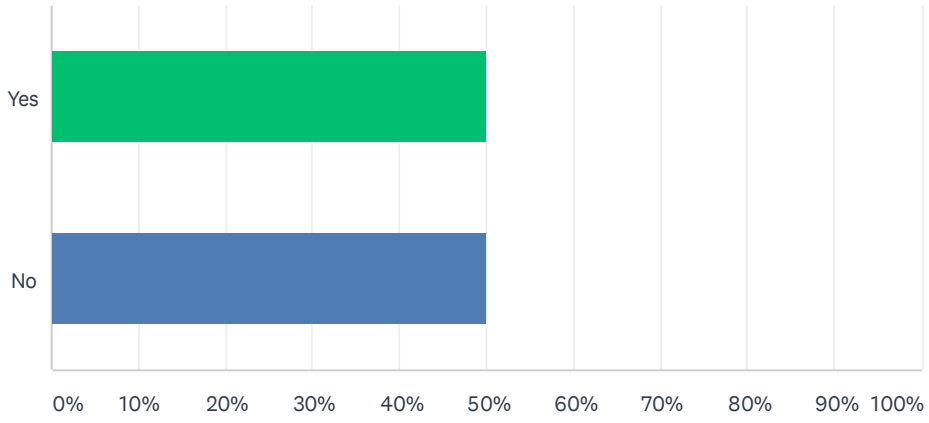
Answered: 2 Skipped: 0



ANSWER CHOICES	RESPONSES	
DMS Signs	0.00%	0
511PA	50.00%	1
Local Radio	0.00%	0
XM Radio	0.00%	0
Real Time Communications (CB Radio/Dispatcher)	100.00%	2
Word of Mouth (Truck Stops/Phone)	50.00%	1
None	0.00%	0
Other (please specify)	0.00%	0
Total Respondents: 2		

Q12 Do you think your members use 511PA or other State 511 traveler information systems?

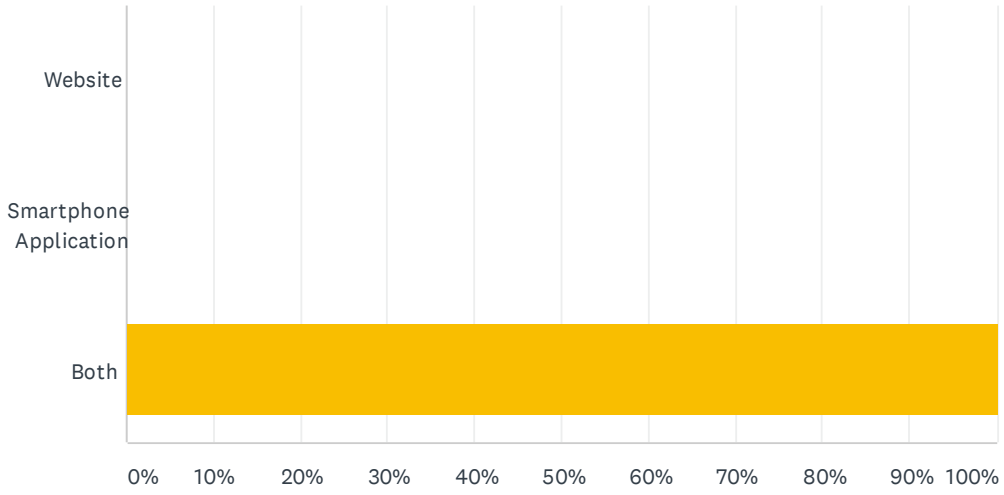
Answered: 2 Skipped: 0



ANSWER CHOICES	RESPONSES	
Yes	50.00%	1
No	50.00%	1
TOTAL		2

Q13 If members use 511PA or other State 511 traveler information systems, which platform is most useful?

Answered: 1 Skipped: 1



ANSWER CHOICES	RESPONSES	
Website	0.00%	0
Smartphone Application	0.00%	0
Both	100.00%	1
TOTAL		1

Q14 If PennDOT were to update the 511PA System to include a trucker-specific interface, what data would be of most interest to your members?

Answered: 2 Skipped: 0

Q15 How do drivers check for the following information?

Answered: 2 Skipped: 0

ANSWER CHOICES	RESPONSES	
Bridge Restrictions - Clearance	100.00%	2
Bridge Restrictions - Weight	100.00%	2
Detour is Truck-Safe	100.00%	2
Restricted Roads	100.00%	2

Q16 Do you have any concerns with industry regulations pertaining to the use of technology in commercial vehicles?

Answered: 2 Skipped: 0

Q17 What is the best way to engage PMTA's membership in regards to this subject matter? (i.e. surveys, virtual open houses, focus groups by sector, etc.)

Answered: 2 Skipped: 0

Q18 Do you think your membership would be receptive to engaging in this project?

Answered: 2 Skipped: 0

#1

COMPLETE

Collector:	Web Link 1 (Web Link)
Started:	Friday, July 17, 2020 2:10:21 PM
Last Modified:	Friday, July 17, 2020 2:25:22 PM
Time Spent:	00:15:01
IP Address:	216.164.244.110

Page 1

Q1

What is the ratio of owner operators to company drivers within PMTA?

0

Page 2

Q2

What is the ratio of long to short haul drivers within PMTA?

2

Page 3

Q3

Do company drivers receive specific routes from the dispatcher or are they free to choose their own?

Dispatcher

Page 4

Q4

How do drivers or dispatchers generally select a route?

y

Page 5

Q5

What are PMTA members using to inform their in-route decision making, whether related to navigation and/or prevailing traffic conditions? Rank in order of importance, with 1 being most important:

Citizens Band (CB) Radio	**1**
Dynamic Message Signs (DMS)	**2**
Electronic Logging Devices (ELD)	**3**
Global Positioning Systems (GPS) (ex. Garmin, TomTom, etc.)	**4**
Smartphone (ex. Google Maps, Waze, etc.)	**5**

Page 6

Q6

Are there any devices, tools, or aids you wish your members were utilizing?

0

Page 7

Q7

Are there any specific devices, tools, or aids that PMTA or your members do not prefer? If so, why?

0

Page 8

Q8

What applications do your members use? Check all that apply:

Uber Freight

Page 9

Q9

What in-route travel information are your members most interested in? Rank in priority order:

Size and/or weight restrictions (bridges and roadways)	**1**
Traffic congestion	**2**
Incidents such as crashes and other roadway hazards	**4**
Detour/alternate routes	**3**
Truck parking inventory (commercial or rest areas)	**5**
Bonded roadways	**6**

Page 10

Q10

Please rank the most important features provided by a smartphone travel application.

A community feature (for finding parking or truck stop vacancies)	**1**
Routing specifically for truckers	**3**
Current in-route traffic information	**2**
Trucker based detours when re-routing	**4**
Bridge restriction warnings (clearance and weight)	**5**
Road and/or weight restricted roadways	**6**

Page 11

Q11

Have you or your members found additional resources, outside of smartphones, that are useful for travel and traffic information? Check all that apply:

Real Time Communications (CB Radio/Dispatcher)

Page 12

Q12

Do you think your members use 511PA or other State 511 traveler information systems?

No

Page 13

Q13

If members use 511PA or other State 511 traveler information systems, which platform is most useful?

Respondent skipped this question

Page 14

Q14

If PennDOT were to update the 511PA System to include a trucker-specific interface, what data would be of most interest to your members?

0

Page 15

Q15

How do drivers check for the following information?

Bridge Restrictions - Clearance	**1**
Bridge Restrictions - Weight	**1**
Detour is Truck-Safe	**1**
Restricted Roads	**1**

Page 16

Q16

Do you have any concerns with industry regulations pertaining to the use of technology in commercial vehicles?

1

Page 17

Q17

What is the best way to engage PMTA's membership in regards to this subject matter? (i.e. surveys, virtual open houses, focus groups by sector, etc.)

1

Page 18

Q18

Do you think your membership would be receptive to engaging in this project?

1

#2

COMPLETE

Collector:	Web Link 1 (Web Link)
Started:	Friday, July 17, 2020 4:04:40 PM
Last Modified:	Friday, July 17, 2020 4:41:50 PM
Time Spent:	00:37:10
IP Address:	73.230.132.48

Page 1

Q1

What is the ratio of owner operators to company drivers within PMTA?

We don't track owner operators separately.

Page 2

Q2

What is the ratio of long to short haul drivers within PMTA?

We don't track that either

Page 3

Q3

Do company drivers receive specific routes from the dispatcher or are they free to choose their own?

Dispatcher

Page 4

Q4

How do drivers or dispatchers generally select a route?

Route that will take the least amount of time without incurring tolls.

Page 5

Q5

What are PMTA members using to inform their in-route decision making, whether related to navigation and/or prevailing traffic conditions? Rank in order of importance, with 1 being most important:

Citizens Band (CB) Radio	**1**
Dynamic Message Signs (DMS)	**2**
Electronic Logging Devices (ELD)	**5**
Global Positioning Systems (GPS) (ex. Garmin, TomTom, etc.)	**4**
Smartphone (ex. Google Maps, Waze, etc.)	**3**

Page 6

Q6

Are there any devices, tools, or aids you wish your members were utilizing?

CB radios are still the most popular for the driver while PA511 for the dispatchers.

Page 7

Q7

Are there any specific devices, tools, or aids that PMTA or your members do not prefer? If so, why?

Our members will try to obtain information from any source

Page 8

Q8

What applications do your members use? Check all that apply:

Drivewyze,

ELD Application,

Google Maps,

Waze

Page 9

Q9

What in-route travel information are your members most interested in? Rank in priority order:

Size and/or weight restrictions (bridges and roadways)	**5**
Traffic congestion	**1**
Incidents such as crashes and other roadway hazards	**2**
Detour/alternate routes	**4**
Truck parking inventory (commercial or rest areas)	**3**
Bonded roadways	**6**

Page 10

Q10

Please rank the most important features provided by a smartphone travel application.

A community feature (for finding parking or truck stop vacancies)	**2**
Routing specifically for truckers	**1**
Current in-route traffic information	**4**
Trucker based detours when re-routing	**3**
Bridge restriction warnings (clearance and weight)	**5**
Road and/or weight restricted roadways	**6**

Page 11

Q11

Have you or your members found additional resources, outside of smartphones, that are useful for travel and traffic information? Check all that apply:

511PA,

Real Time Communications (CB Radio/Dispatcher),

Word of Mouth (Truck Stops/Phone)

Page 12

Q12

Do you think your members use 511PA or other State 511 traveler information systems?

Yes

Page 13

Q13

If members use 511PA or other State 511 traveler information systems, which platform is most useful?

Both

Page 14

Q14

If PennDOT were to update the 511PA System to include a trucker-specific interface, what data would be of most interest to your members?

Dynamic notifications of traffic accidents or road closures direct to all truckers cell phones in the area of the closure with detour instructions. Truck parking availability

Page 15

Q15

How do drivers check for the following information?

Bridge Restrictions - Clearance	**Experience or shipper**
Bridge Restrictions - Weight	**Experience or shipper**
Detour is Truck-Safe	**When forced to detour off major highway, they can go where directed by police**
Restricted Roads	**Signage**

Page 16

Q16

Do you have any concerns with industry regulations pertaining to the use of technology in commercial vehicles?

Yes. Hand held devices are prohibited for commercial drivers.

Page 17

Q17

What is the best way to engage PMTA's membership in regards to this subject matter? (i.e. surveys, virtual open houses, focus groups by sector, etc.)

Surveys might be best which we can send this same survey , with modifications to our members as I believe that might provide the most benefit

Page 18

Q18

Do you think your membership would be receptive to engaging in this project?

Yes. We always want to know about delays caused by traffic

Appendix C

Task 2.3 - Commercial Vehicle Community Outreach Plan

E04695 - Commercial Vehicle Navigation Research

Task 2.3 – Commercial Vehicle Company and Individual Commercial Vehicle Outreach

September 8, 2020

COMMERCIAL VEHICLE COMMUNITY OUTREACH PLAN

Prepared for:

Pennsylvania Department of Transportation
Bureau of Planning and Research
Keystone Building
400 North Street
Harrisburg, PA 17120
(717) 412-5300
www.penndot.gov

By:

Michael Baker International, Inc.
4431 N. Front Street, 2nd Floor
Harrisburg, PA 17110
(717) 213-2900

PURPOSE

The purpose of this *Commercial Vehicle Community Outreach Plan* (Outreach Plan) is to articulate the research team's intended approach to engage with and solicit feedback from the commercial vehicle community regarding ways to improve the dissemination and use of commercial vehicle navigation information. This Outreach Plan is informed by our findings from the project's literature review task, Task 2.1, and the Pennsylvania Motor Truck Association (PMTA) Meeting task, Task 2.2, conducted on July 22nd, 2020 via WebEx. The Outreach Plan is an early action component of project Task 2.3 – Commercial Vehicle Company and Individual Commercial Vehicle Outreach. Upon review and approval of the Outreach Plan, it will be deployed as the framework to conduct outreach.

OUTREACH FORMATS

Two outreach methods will be deployed in parallel to engage the Pennsylvania commercial vehicle community and garner their input:

1. An online survey for commercial vehicles traveling on Pennsylvania roads
2. A virtual town hall meeting

Stakeholders

The following organization and associations will be contacted to inquire about their willingness to distribute both the survey and town hall meeting outreach opportunities.

- Associated Pennsylvania Constructors (APC)
- Owner-Operator Independent Drivers Association (OOIDA)
- Pennsylvania Aggregates and Concrete Association (PACA)
- Pennsylvania Asphalt Pavement Association (PAPA)
- Pennsylvania Bus Association (PBA)
- Pennsylvania Moving & Storage Associates (PMSA) – moving and storage vehicles
- Pennsylvania Motor Truck Association (PMTA) – Primary engagement audience
- Recreation Vehicle Industry Association (RVIA) – recreational vehicles (RVs)

Survey Questionnaire

An online survey will be used to collect the input of commercial vehicle drivers traveling on Pennsylvania roads. The purpose of the survey will be to determine what tools are regularly used to navigate Pennsylvania roadways and any improvements that can be done to make navigating easier and safer. The survey link will be sent out to all participating organizations, those stakeholders agreeable to include their membership, along with the town hall meeting invitation. The survey will be open for a three-week period prior to the virtual town hall meeting. Responses to the survey questionnaire will be used to help guide the town hall meeting discussion. Upon completion of the town hall meeting, the survey will remain open for a two-week period to give meeting attendees the opportunity to pass along any additional information not imparted during the meeting.

The following questions are proposed to be included in the online survey:

Q1: How would you identify yourself as a driver? Please select one or more.

a) National Corporation Driver
b) Regional Company Driver
c) Local Company Driver
d) Over the Road Driver
e) Dedicated Route Driver
f) Independent Contractor Driver
g) Other, please specify

Q2: How are routes usually selected? Please select one or more.

a) Dispatcher chooses routes
b) I choose my own routes: 511 System
c) I choose my own routes: Phone Apps; ex. Google, Waze, etc.
d) I choose my own routes: Road Atlas
e) I choose my own routes: GPS; ex. Garmin, TomTom, Rand McNally
f) Depends on daily assignment, etc.
g) Other, please specify

Q3: Which methods do you use to make in-route decision making about navigation and/or traffic conditions? Please rank in order of importance, with 1 being most important.

a) Real-time communication (Citizens Band (CB) Radio/Dispatcher)
b) Dynamic Message Signs (DMS)
c) Electronic Logging Devices (ELD)
d) Global Positioning Systems (GPS); ex. Garmin, TomTom, etc.
e) Smartphone Applications; ex. Google Maps, Waze, etc.
f) State 511 System
g) Local Radio
h) XM Radio
i) Word of Mouth (truck stops/phone)

Q4: What smartphone applications, if any, do you use throughout your day? (check all that apply)

a) Allstays Truck & Travel
b) CDL Life
c) Dock 411
d) Drivewyze
e) ELD Application
f) Google Maps
g) State 511 Application
h) Uber Freight
i) Waze
j) No Smartphone Apps Used on Route

k) Other, please specify

Q5: What features are most important to you in a smartphone travel application? Please rank in order of importance, with 1 being most important.

a) A community feature (for finding parking or truck stop vacancies)
b) Commercial vehicle-specific routing
c) Current in-route traffic information; ex. crashes on route, slowdowns, etc.
d) Determining fastest route
e) Commercial vehicle-based detours when re-routing
f) Bridge Restriction warnings (clearance and weight)
g) Road and/or weight restricted roadways
h) Identifying routes with tolls

Q6: Have you ever used 511PA or any other State 511 traveler information system?

a) Yes
b) No

Q7: How might you improve one of the traveler information tools?

[Open-end answer without character limit]

Q8: What in-route travel information are you most interested in receiving? Rank in order of importance to you, with 1 being most important.

a) Size and/or weight restrictions on bridges and roadways
b) Traffic congestion
c) Incidents such as crashes and other roadway hazards
d) Detour/alternate routes
e) Truck parking inventory (commercial or rest areas)
f) Bonded roadways
g) Weigh-In Stations

Q9: How do you currently lookup the following information?

a) Bridge restrictions- clearance (short answer)
b) Bridge restriction – weight (short answer)
c) Detour is truck-safe (short answer)
d) Restricted Roads (short answer)
e) Vacant parking/truck stops (short answer)

Q10: Do the industry regulations pertaining to the use of technology in commercial vehicles affect the way you get information while on route?

a) No
b) Yes, write them here

Q11: Are there any additional comments you would like voiced about how information is conveyed to commercial vehicles?

a) No
b) Yes, please specify *[without character limit]*

Virtual Town Hall Meeting

The consultant team will host and facilitate a 1-hour virtual town hall meeting to engage the commercial vehicle community regarding navigation issues. The topics for discussion will be informed by the results of the survey questionnaire previous distributed prior to the meeting. The following agenda is proposed for the town hall meeting:

Agenda
1. Purpose and Intended Outcomes
2. Project Team Introductions & Meeting Format
3. PA Commercial Vehicle Navigation Needs
4. Navigation Tool Options – Limitations & Issues
5. Adjournment

The meeting will be tentatively held the week of October 5th, 2020, three weeks following the distribution of the online survey questionnaire. The final date and time of the meeting will be determined by the consultant team and PennDOT.

MEETING OUTCOMES & NEXT STEPS

The primary outcome from the meeting will be the commercial vehicle community outreach survey along with any additional issues that were brought up for discussion. The survey results will be analyzed and compiled into a more comprehensible format that can be reported to the project stakeholders and used to further identify gaps/issues related to commercial vehicle navigation.

Once the information from the meetings is compiled a more thorough needs assessment can be completed. Significant gaps and issues in commercial vehicle navigation will be used to help plan future improvements to existing logistics, information processing, and technology associated to CV navigation.

Upon approval of this Outreach Plan by both PennDOT and PMTA, the consultant team will begin communication with the targeted outreach organizations as previously outlined. A brief project synopsis will be discussed with the user group and then a time for the town hall meeting will be agreed upon.

Following the town hall meeting and closure of the survey questionnaire a technical memorandum will be developed that summarizes the outreach activities and their findings. The Task 2.3 Technical Memorandum deliverable will be submitted by October 30, 2020.