Smart Roadside Initiative Gap Analysis

Trucking Technology Utilization

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16. Abstract

This technical memorandum synthesizes and summarizes the American Transportation Research Institute's (ATRI) findings for Subtask 2.3 of the Smart Roadside Initiative (SRI) Gap Analysis. As part of this task, ATRI:

1. completed a technical literature review;
2. generated a truck technology utilization report/searchable spreadsheet; and
3. conducted a webinar to validate those findings.

Section 1 includes summaries of each of the three deliverables and provides details on the methodology and findings.

Section 2 synthesizes and analyses the results of the first three deliverables and identifies current SRI-related technology utilization rates, gaps in technology functionality, future utilization trends and investment objectives.

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Technical Memorandum: Trucking Industry Technology Utilization Gaps and Trends

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Chapter 1: Deliverables Summary

Literature Review

ATRI reviewed a combination of peer reviewed articles, government-sponsored research publications, and literature from independent organizations that were relevant to SRI, intelligent transportation systems, motor carrier technology trends, and/or commercial vehicle technologies. Researchers searched a number of databases, including the Transportation Research Board's (TRB) Transport Research International Documentation (TRID) and EBSCO Information Services On-line. The search focused on technologies or systems that motor carriers would purchase, install, and maintain rather than on public sector initiatives. Based on feedback from the project team, ATRI focused this effort on the following technologies:

- Backroom Systems;
- Routing and Dispatch;
- Vehicle-based Systems;
- Asset Management; and
- Technology-based Programs.

Key Findings

- Motor carrier adoption of commercial vehicle technologies is dependent on the return-on-investment, ease of technology integration, and perceived benefits.
- Motor carrier operational characteristics (e.g., sector, size, etc.) are significant factors in technology adoption.
- Mainstream technologies currently deployed by carriers include communication systems (e.g., on-board/embedded systems, cellular/smartphones, etc.), preclearance transponders, routing and dispatching software, and navigation systems.

Truck Technology Utilization Report

Based on the literature review findings, ATRI proceeded to develop the "Truck Technology Utilization" report, a searchable spreadsheet that provides information on backroom systems, vehicle-based and asset management technologies, and routing and dispatch systems as well as several key industry programs/initiatives.

The Truck Technology Trends spreadsheet contains a brief introduction and Table of Technologies, the text of which is formatted as hypertext to allow the reader to click on a major heading of interest and jump to the sheet with more details on technologies under this heading. Several attributes are

described for each technology, including relative cost to a carrier, estimated market penetration and utilization trends.

"Trends in Trucking Technology Utilization" Webinar

ATRI proceeded to vet the draft findings of the literature review and truck technology utilization report through an industry webinar. Over 133 individuals participated in the January 23, 2014 event, with 33 of those representing motor carriers. During the webinar, ATRI provided a brief description of the technologies previously analyzed for the literature review and truck technology utilization report. Motor carriers were next provided with the draft "Gap Analysis" findings and asked to comment on the results through a series of poll questions. A copy of the presentation and recording of the webinar are available for download at www.freightmobility.com/Presentations.

Key Findings

- Embedded on-board communication device use is high among carriers, with the majority of poll respondents (83 percent) using this type of equipment on all of their trucks.
- More than 66 percent of the poll respondents use preclearance transponders on at least one of their trucks and the majority (90 percent) believed that transponder use will continue to increase.
- None of the responding carriers currently use 5.9 DSRC devices. Respondents were split on whether 5.9 Ghz dedicated short-range communications (DSRC) use will increase (55 percent) or remain limited (45 percent).
- Seventy-nine percent of the poll respondents use dispatching software.

Chapter 2: Truck Technology Utilization Gaps and Trends

In order to remain consistent with the broader SRI Gap Analysis research, a more focused list of SRI-related trucking industry technologies were identified based on the three operating scenarios and five functional areas being analyzed by the broader study. The operating scenarios include:

- Mainline Screening – use technology to improve the operational efficiency of fixed enforcement facilities.
- Virtual Weigh Stations (VWS) – are remote facilities that allow commercial vehicles to be identified, screened, and targeted for inspection in an area where there is no enforcement facility.
- Commercial Truck Parking Systems – are an emerging operational scenario focused on proving truck drivers and/or dispatchers with real-time or near real-time information regarding the location and availability of commercial vehicle parking.

The three operational scenarios were further segmented into five core functional elements:

1. Identify – accurately identify commercial vehicles, motor carriers, and/or drivers while the vehicle remains in motion.
2. Select, check, and verify – determines which commercial vehicles should be targeted for a roadside inspection within mainline screening and VWS scenarios. Within the truck parking scenario, this function determines the real-time availability of truck parking at a facility.
3. Control – managing the movement of commercial vehicles through a facility. In the case of truck parking, it refers to the method of directing truck drivers to the facility.
4. Collection and payment – electronically collecting payment of fees at a site.
5. Analysis – analyzing site operational data to modify site or enforcement operations.

Based on ATRI's research, motor carriers currently use the following technologies that could support SRI:

- On-board/Embedded Communication Systems;
- Mobile Communication Systems (Cellular and Smartphones);
- Preclearance Transponders;
- Connected Vehicle/5.9 GHz DSRC; and
- GPS-based Navigation Systems.

Table 2-1 documents which of the studied processes can be supported by these technologies. Mainline Screening and VWS technologies are described together due to the functional similarities. As seen in the table, the private-sector's technologies currently can support the Identify and Control processes of the Mainline Screening and VWS operational scenarios. Private-sector technologies currently do not support the Select/Check/Verify, Collect/Pay, or Analyze processes for Mainline

Screening or VWS. For Truck Parking, the currently deployed technologies support the Control and Collect/Pay processes.

Table 2-1. Operational Scenario and Functionality Currently Supported by Motor Carrier Technologies

	Identify	Select/ Check/ Verify	Control	Collect/ Pay	Analysis
Mainline Screening and Virtual Weigh Stations	*Preclearance transponders* – electronically verifies a truck's legal weight, safety rating and credentials *On-board/embedded communication systems* – wirelessly transmit information *Mobile communication systems (Cellular and smartphones*) – wirelessly transmit information *Connected vehicle/5.9 GHz DSRC* – emerging technology, wirelessly transmit information	N/A	*Preclearance transponders* – notify driver of inspection decision *On-board/embedded communication systems* – notify driver of inspection decision *Mobile communication systems (Cellular and smartphones)* – notify driver of inspection decision	N/A	N/A
Truck Parking	N/A	N/A	*On-board/embedded communication systems* – notify driver of parking availability *Mobile communication systems (Cellular and smartphones)* – notify driver of parking availability *GPS-based navigation systems* – notify driver of parking availability	*Mobile communication systems (Cellular and smartphones)* – emerging technology, reserve/pay for parking	N/A

Source: American Transportation Research Institute based on literature review.

Key Findings

Technology Usage

Communication systems (all types) and GPS-based navigation systems are currently used by the majority of carriers in the U.S. (see Table 2-2). Deployment rates vary by carrier operational characteristics, however, with large carriers more likely to use these systems than small carriers.[1] This is most likely due to large carriers having greater access to the capital necessary for purchasing/installing/maintaining these technologies as well as requiring increased connectivity between the terminals and trucks, which may be dispersed throughout the U.S. Carriers with larger fleets also may realize greater benefits associated with some of the technologies (e.g., preclearance transponders) because their larger operations increase the likelihood of them encountering an open inspection facility.

Table 2-1 shows the SRI-related truck technology utilization trends based on both the literature review and webinar findings. Mobile communication systems and applications top the list of technologies that carriers plan to deploy in the future.[2] The research indicates that due to changing industry regulations and the driver shortage, carriers have shifted their technology focus from company efficiency (e.g., transportation management software) to driver-centric approaches (e.g., communication and navigation).

[1] Gartner. (2006). In-Vehicle Commercial Vehicle Technology Use Survey Results: 2005 Update. American Transportation Research Institute.

[2] Garner, H. (2012). 2012 Truck IT Report: A Brief Analysis of eyefortransport's Recent Survey. eyefortransport. Available on-line: http://events.eyefortransport.com/truckIT/pdf/TruckITReport12012.pdf

Table 2-2. Current and Estimated Future Private-Sector Technology Deployment

Technology	Current Utilization Rates	Future Utilization Trend
On-Board/Embedded Communication Systems	Thirty-three to 74 percent of carriers use cellular- or satellite-based on-board communication devices.[a,b,c]	Significant increase
Mobile Communication Systems (Cellular and Smartphones)	Sixty-seven to 94 percent of drivers use a cellular or smartphone as part of their job.[d,e,f,g]	Moderate to significant increase
Preclearance Transponders	Ten percent of the nation's interstate and intrastate commercial vehicles.[h]	Significant increase
Connected Vehicle/ 5.9 GHz DSRC	Anecdotal reports indicated that DSRC has limited market penetration in the trucking industry.[i]	Limited to moderate increase

[a] Gartner. (2006). In-Vehicle Commercial Vehicle Technology Use Survey Results: 2005 Update. American Transportation Research Institute.

[b] Stock, D., Jensen, M., Carter, M., Wik, E., Louisell, C., & Mitchell, C. (2004). Hazardous Materials Safety and Security Field Operation Test Evaluation Final Report. United States Department of Transportation, Federal Motor Carrier Safety Administration. Available on-line: http://www.fmcsa.dot.gov/documents/hazmat/fot/HMFOT-Final-Report.pdf.

[c] Knipling, R.R., & Bergoffen, G. (2011). Potential Safety Benefits of Motor Carrier Operational Efficiencies. *Commercial Truck and Bus Safety Synthesis Program, 20.* Washington, DC: Transportation Research Board. Available on-line: http://onlinepubs.trb.org/onlinepubs/ctbssp/ctbssp_syn_20.pdf.

[d] Fleet Leaders Embracing Mobility Technology Potential. (2012). GreenRoad.

[e] Stock, D., Jensen, M., Carter, M., Wik, K., Louisell, C., & Mitchell, C. (2004). Hazardous Materials Safety and Security Field Operation Test Evaluation Final Report. United States Department of Transportation, Federal Motor Carrier Safety Administration. Available on-line: http://www.fmcsa.dot.gov/documents/hazmat/fot/HMFOT-Final-Report.pdf.

[f] Corsi, T.M., Cantor, D.E., Grimm, C.M., Sienicki, D.M. (2007). Factors Underlying the Adoption of New Safety Technologies by U.S. Commercial Carriers. United States Department of Transportation, Federal Motor Carrier Safety Administration.

[g] Knipling, R.R., & Bergoffen, G. (2011). Potential Safety Benefits of Motor Carrier Operational Efficiencies. *Commercial Truck and Bus Safety Synthesis Program, 20.* Washington, DC: Transportation Research Board. Available on-line: http://onlinepubs.trb.org/onlinepubs/ctbssp/ctbssp_syn_20.pdf.

[h] Battelle Memorial Institute, *Universal Electronic Identification System for Commercial Motor Vehicles Concept of Operations*, March 2011.

[i] Traffic Technology International. (2011). Commercial Break. http://www.kapsch.net/ktc/its-solutions/Commercial-Vehicle-Operations/Documents/TTi_AprMay2011?lang=en-U.S.

Functionality Gaps

Several gaps where functionality for SRI-related technologies may be insufficient or absent were identified. For example, carriers are unfamiliar with Connected Vehicle/5.9 GHz DSRC technology and none of the carriers that participated in the January 23 "Trends in Trucking Technology Utilization" webinar currently use the technology. Findings from the literature review suggest that the industry has several concerns about DSRC, including:

- The occurrence of interrupted or false messages;
- The cost of equipping tractors and trailers with 5.9 GHz DSRC devices;
- Accuracy of position estimates between two vehicles;
- Data broadcast security; and
- The relationship between message latency and vehicle speed.[3]

Research findings further suggest that the trucking industry lacks support, enthusiasm, and experts on 5.9 GHz DSRC, which will make it more difficult to implement.[4] In addition, suppliers and original equipment manufacturers noted that the decision to provide or equip vehicles with 5.9 GHz DSRC-capable devices would be dependent upon customer demand, return-on-investment, regulatory policies, and standardization of systems.

Previous studies also have indicated that several general user needs or user requirements must be addressed for SRI-related technologies to be successfully implemented by the industry. These include:

- Technology must be able to uniquely identify each truck, trailer, and driver;
- Capable of bidirectional data transmittal between the device and external systems;
- Capable of integrating and analyzing multiple data sources in one consolidated dataset;
- Capable of data exchange between the truck and technology while vehicle is in motion; and
- Capable of data transmittal in a timely manner.[5]

[3] LeBlanc, D., & Belzowski, B. (2012). Interoperability Issues for Commercial Vehicle Safety Applications. Report No.: DOT HS 811 674, United States Department of Transportation, National Highway Traffic Safety Administration. Available on-line: http://www.nhtsa.gov/DOT/NHTSA/NVS/Crash%20Avoidance/Technical%20Publications/2012/811674.pdf.

[4] Ibid.

[5] Black, C., Cassady, J., Le, S., Veile, A., & Schaefer, R. (2013). System Design Document (SDD) for Smart Roadside Initiative—Draft. Report No.: Not Provided. United States Department of Transportation, Federal Highway Administration.

Investment Objectives

When considering how to address existing gaps in technology deployments/usage, it is important to remember that motor carriers operate on extremely thin profit margins. As such, the initial purchase price, maintenance cost, projected return-on-investment (ROI) and other financial concerns are typically the most important factors for investing in technology. According to an eyefortransport report, for example, "lowering costs" was ranked the number one driver for investing in technology.[6]

A survey by ATRI and Gartner G2 found that the most important benefit was "improving operational effectiveness" by using new technologies to minimize costs associated with operating and maintaining commercial vehicles and, in turn, improving the carrier's profit margin.[7] A TRB-sponsored report found that the top five motivators for on-board safety system adoption by small carriers were:

- Tax credits/breaks;
- Good warranty;
- Carrier/peer feedback;
- Reduced insurance; and
- Return-on-investment.[8]

Another important issue is the ability to integrate new technologies with existing systems. Truck technologies often require a significant investment and carriers have limited resources to research, test, install and maintain multiple systems. As a result, carriers are increasingly demanding more functionality and interoperability from new and existing systems.

These factors will be considered by the study team when determining how potential gaps in private-sector technology usage can be addressed.

[6] Garner, H. (2012). 2012 Truck IT Report: A Brief Analysis of eyefortransport's Recent Survey. eyefortransport. Available on-line: http://events.eyefortransport.com/truckIT/pdf/TruckITReport12012.pdf.

[7] Koslowski, T. (2006). In-Vehicle Technologies Provide Differentiation Opportunities for U.S. Commercial Vehicle Manufacturers – Summary. Report No.: G00141361 Gartner. Available on-line: https://www.gartner.com/doc/493288/invehicle-technologies-provide-differentiation-opportunities.

[8] Pickett, R.L., Murray, D., & Flanigan, C. (2010). On-board Safety System (OSS) Deployment Research: A Synthesis of Research on the Costs, Benefits and User Requirements Associated with Motor Carrier Safety Technologies. Transportation Research Board Annual Meeting, 2010.

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