South Florida Freight Advanced Traveler Information System

Demonstration Team Final Report

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16. Abstract

This Demonstration Team Final Report has been prepared to provide an overview of the conduct and qualitative findings of the South Florida FRATIS development and testing program. More specifically, this document provides:

- A description of the testing program;
- Information and lessons learned related to stakeholder/user engagement during the program;
- Information and lessons learned related to system testing during the program; and
- Recommendations concerning future FRATIS and freight connected vehicle programs.

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1.0 Introduction

This report provides summary-level information and lessons learned in the conduct of the Freight Advanced Traveler Information System (FRATIS) Small-Scale Testing Program in the South Florida region ("SFL FRATIS"), which was funded by the U.S. Department of Transportation's (DOT) Intelligent Transportation Systems (ITS) Joint Programs Office. The report has been prepared by key members of the SFL FRATIS Demonstration Team, including Cambridge Systematics (prime contractor), Productivity Apex (system integrator), and the University of Washington. Please note that quantitative findings regarding the performance of the SFL FRATIS test applications currently are being developed by an Independent Assessment (IA) contractor, and are expected to be published by the U.S. DOT later this year. In preparing this document, the reader is directed towards three previous documents, which provide both the full context and technical detail associated with this small-scale test.

- **Freight Advanced Traveler Information System Concept of Operations Final Report, August 2012, FHWA-JPO-12-065** (http://ntl.bts.gov/lib/54000/54100/54104/12-065.pdf). This document provides the technical basis for the FRATIS bundle of applications, and provides information on user needs, the conceptual framework, and example FRATIS operational scenarios. This document served as the blueprint for the development of the SFL FRATIS project.
- **South Florida Freight Advanced Traveler Information System: Architecture and Implementation Options Summary Report, July 19, 2013, FHWA-JPO-14-181** (http://ntl.bts.gov/lib/54000/54400/54479/Fratis_FHWA-JPO-14-181.pdf). This document provides the technical specification for the system design and architecture of the SFL FRATIS system.
- **South Florida Freight Advanced Traveler Information System: Demonstration Plan, October 25, 2013, FHWA-JPO-14-182** (http://ntl.bts.gov/lib/54000/54400/54485/Fratis_FHWA-JPO-14-182.pdf). This is the detailed planning document, which contains all of the necessary site, system, user, data, and other key information for the small-scale test to be implemented and operated.

The purpose of the SFL FRATIS project was to develop a prototype of the U.S. DOT's FRATIS bundle of applications—centered around two distinct components: 1) an optimization algorithm designed to improve the performance of local drayage fleet deliveries by eliminating wasted, nonrevenue generating moves (e.g., repositioning associated with empties, chassis, bobtails); and 2) an emergency management smart phone application to demonstrate the capability of facilitating emergency response efforts through more automated, integrated, and real-time data collection and data sharing. The first component is similar to the demonstration projects in Los Angeles and Dallas. The second component is unique to SFL FRATIS.

The region of South Florida was picked because it is home to more than 5 million residents, two of the State's largest seaports, one of the country's leading air cargo airports, a growing freight and passenger rail system, and an established ITS program. In addition, South Florida, given its susceptibility to major storm events and its comprehensive emergency response program, provided an opportunity to test the use of technologies to streamline post-event recovery activities involving the freight industry.

The following “near-term” performance goals for the SFL FRATIS tests were developed to be consistent with the successful conduct of previous analogous tests of FRATIS-like technologies in Memphis, Tennessee (Drayage Optimization) and Kansas City (U.S. DOT’s Cross-Town Improvement Program (C-TIP)):

- Reduce number of bobtail trips (i.e., empty-return loads) by 10 percent;
- Reduce travel time by 15 percent;
- Reduce fuel consumption by 5 percent;
- Reduce level of criteria pollutants and greenhouse gas (GHG) equivalent criteria pollutants by 5 percent; and
- Reduce GHG by 5 percent.

Using these goals as a yardstick, as mentioned previously, the IA Team currently is conducting a detailed evaluation of the quantitative performance of the SFL FRATIS.

Additionally, several qualitative goals were put forward by the SFL FRATIS Development Team, in consultation with the regional public and private stakeholders that participated in the test program:

- Leverage and integrate public- and private-sector data sources, and add the missing pieces;
- Test the benefits of added functionality—beyond what is readily available today;
- Support regional efforts to build trust and establish a new paradigm for cooperation within the intermodal freight industry—potentially leading to regionwide implementation;
- Build institutional support for freight-specific ITS applications; and
- Serve as an incubator for private industry—it is hoped that interested parties will further develop FRATIS functionalities and integrate them into their software offerings.

The lessons learned contained later in this report respond to these goals and provide additional qualitative findings in numerous areas relating to both stakeholder involvement and system testing.

The remainder of this document is organized as follows:

- **Test Overview (section 2.0).** This section provides a comprehensive overview of the elements of the SFL FRATIS Small-Scale Test Program.
- **Stakeholder Involvement Summary and Lessons Learned (section 3.0).** This section, after providing a description of all the key users and stakeholders involved in the SFL FRATIS test, presents key lessons learned regarding the user recruitment, user training, and user experience with the system.
- **System Testing Summary and Lessons Learned (section 4.0).** This section, after providing a summary of the testing areas and focus, presents key lessons learned regarding the design, content, and technical issues/opportunities with the SFL FRATIS deployed system.
- **Recommendations for Future FRATIS and Freight DMA Programs (section 5.0).** Based on a synthesis of the results of the lessons learned, this section provides recommendations that may be applicable to future FRATIS-like projects.

2.0 Test Overview

As discussed above, the SFL FRATIS demonstration project focused on two distinct demonstrations:

1. **Drayage Optimization.** A customized optimization algorithm was developed for a local drayage fleet; it was designed to optimize the drayage fleet deliveries and movements based on several key characteristics (e.g., time of day, predicted travel times between points on each truck's itinerary, appointment times, driver and equipment availability, and driver endorsements).
2. **Emergency Management.** A smart phone application was developed to help improve the data reporting and information dissemination capabilities of public-sector emergency management officials and key supply chain partners involved in the delivery of disaster relief following a major event (e.g., roadway conditions and closures, staging area locations and instructions, terminal status, business status).

These components addressed different aspects of the freight community: one focused on internal decision support tools (drayage optimization) designed to improve the efficiency of daily operations; and one focused on external information exchange tools (emergency management smart phone app) designed to facilitate information collection and dissemination during emergency conditions. Based on the purpose of each component and the way in which they were tested (daily use vs. scenario testing), they were not integrated as part of the demonstration project. Each of these components is discussed in more detail below.

2.1 Drayage Optimization

The SFL FRATIS drayage optimization component originally was designed to incorporate dynamic travel time planning and drayage optimization using web and in-vehicle technologies for a drayage fleet handling a mix of movement types (e.g., loaded, unloaded, empty, chassis only, bobtailing). This was the consistent expectation for all three demonstration projects. As the SFL FRATIS project advanced, the project definition evolved. For example, the original trucking partner decided not to participate following significant work by the SFL FRATIS Team. This partner had been selected because it demonstrated the type of characteristics this project was designed to address.

The replacement trucking partner (Florida East Coast Railway (FEC) Highway Services) did not share all the same characteristics, which required some modifications to the test parameters. For example, the types of dray moves were largely focused on outbound/inbound movements to FEC's intermodal rail yard; there was no significant repositioning of equipment and no opportunities to link trips to eliminate miles traveled. In addition, FEC drivers already had Qualcomm devices in their trucks, precluding the installation of the TomTom 7150s. As a result, it was decided by the U.S. DOT, in consultation with the SFL FRATIS Team and FEC, that this project scope would be modified to include a partial system integration component. This would eliminate the need for duplicate manual entry of loads. This met with FEC approval as duplicate data entry was not desired.

Based on these changes, the project advanced focusing on a web-based drayage optimization tool that provided integrated load matching and freight information exchange to maximize the efficiency of daily load assignments. About 50 TomTom devices (Link 510) were installed on partner trucks with a corresponding WebFleet subscription. These devices supported pretest data collection. Figure 1 illustrates the Link 510. The drayage optimization tool was web based. Load data was provided three times a day through a dedicated, encrypted FTP server. The necessary data elements were mapped to the optimization tool. FEC Dispatch staff were then able to log in through a web-based interface and select loads for optimization.

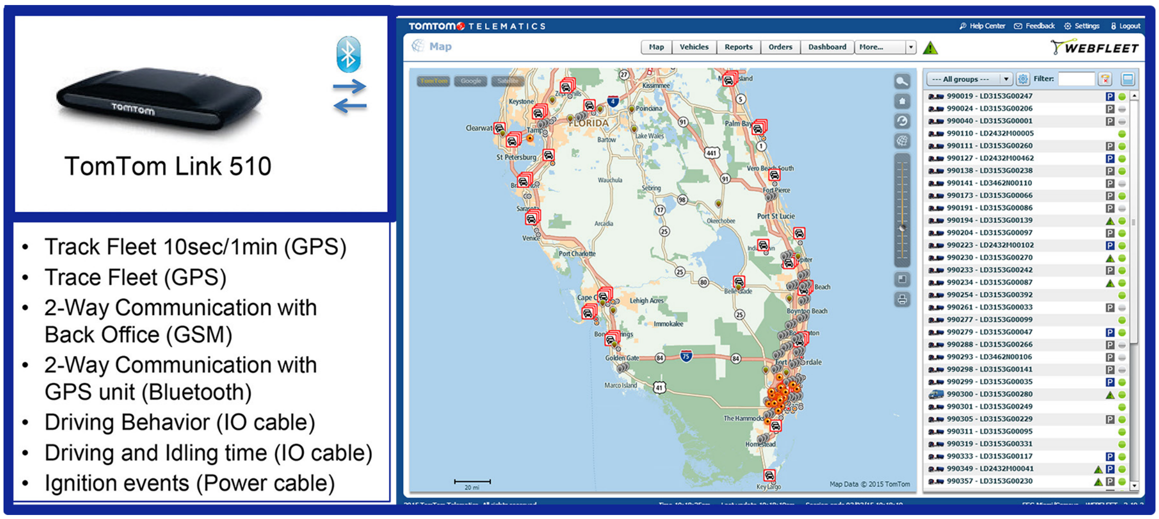

Figure 1. TomTom Link 510 Tracking
(Source: Productivity Apex Inc. and WebFleet, Inc.)

Prior to the use of the FRATIS optimization tool to assign loads to drivers in the FEC legacy system, this tool was tested over a three-month period. This was done in order to ensure that the tool accounted for specific business parameters, such as average delivery time and driver qualifications (hazardous materials (Hazmat), flatbed, etc.). During this time period, close to 95 percent of "Day" loads for the following day were optimized. This volume would range from as low as 60 per day upwards to more than 100 per day. More than 3,500 loads were optimized during the testing phase. This testing period was then followed by the actual use of the system to assign and deploy drivers over a three-week period. For this period, slightly fewer loads were assigned using the tool, roughly 85 to 90 percent of the total, due to additional knowledge that the dispatcher had about operations and driver preferences. In addition, some loads were not selected since they had specific drivers who have to deliver them, and the optimization tool did not account for this. On average, 90 loads were assigned each day over this testing period with daily volumes ranging from the low 60s to more than 100. Almost 1,000 loads were optimized and assigned to drivers during this period.

The drayage optimization component used an optimization algorithm, developed by Productivity Apex (PAI), which determined the most efficient assignment of loads to the available drivers for the following day. This algorithm had to be customized for FEC's operation based on typical operating characteristics, regional geography, and special rules.

The characteristics that the Drayage Optimization Algorithm is designed to optimize and assign daily loads based on include delivery location; appointment time; stop time; equipment type (e.g., flatbed); commodity type (e.g., Hazmat); driver availability (day/night, endorsements, hours of service); and route travel time/traffic information.

The tool was developed and finalized using four main iterations. Before each iteration, planning meetings were held to lay out the development process. During each iteration, specific parts of the system were developed and tested, to be later validated in a demonstration and review meeting at the end of the iteration. For the development process, user stories (requirements) were captured from the different stakeholders participating in the project, from which the development team extracted a series of features to implement into the system in order to satisfy those requirements.

The SFL FRATIS drayage optimization tool had to be capable of accepting a data feed from FEC Highway Services' legacy system. In order to do that, as discussed above, significant time was spent with FEC staff to identify the necessary data fields, map those fields to the optimization tool, review and validate the results, test the data feed, and establish an automated process to transmit data daily—all within an encrypted and secure venue.

The final tool received the data file three times per day from FEC via a one-way data push through an encrypted FTP server. Through this integration, FEC staff entered orders as they do now. Order data that was required for the algorithm was then pulled from the system into a flat file as an input to the algorithm. Once the file was generated, it uploaded to the PAI server to be imported into the optimization tool. FEC dispatch staff then logged in via a web interface, selected the loads and drivers to optimize, and submitted the request. An optimized plan would be generated and sent back to FEC for review and implementation. Loads were optimized based on minimizing idle time; miles traveled; driving time; stop time; and total time (as the summation of idle time, driving time, and stop time). Key data input necessary to run the tool included travel time by time of day; distance; appointment times; delivery location; stop/wait time; type of movement (e.g., live unload, drop and pick); driver hours of service; equipment type; and driver endorsements.

The algorithm provided an optimized plan based on the best available data for the loads selected. FEC dispatch staff had the ability to override the algorithm to respond to changing business needs and any constraints or requirements not able to be addressed by the tool. Load assignments were then manually entered into the legacy system, and drivers were notified by phone or at the dispatch window. Note, that while the drivers were all equipped with Qualcomm units, the SFL FRATIS demonstration was not able to use these units as part of the test. This was, in part, due to the service package purchased by FEC, as well as the fact that upgraded units were purchased and installed during the testing, making coordination impossible.

Drayage Optimization Development Lessons Learned

A critical component of any pilot program is identifying and documenting the key lessons learned during the project. The purpose of this is two-fold: first, it helps to provide the project sponsor with a comprehensive understanding of the results of the pilot program by identifying opportunities, successes, challenges, and roadblocks; and second, and most importantly, understanding these opportunities and challenges helps provide the insight needed to positively impact future deployments and related follow-on efforts. As such, the project team documented key lessons learned throughout the life of the project in order to ensure successful completion of the pilot program and to help ensure the success of follow-on efforts.

One of the most important aspects for the development of the optimization tool was access to the necessary data. The SFL FRATIS project focused on integrating the drayage optimization tool with FEC's legacy system in order to avoid double data entry. To do this, the load data was transmitted electronically through a secure FTP server by FEC. Table 1 provides an overview of the lessons learned related to data access.

Table 1. Key Lessons Learned: Data Accessibility

Is necessary data available?	Load data must be accessible electronically; data feeds must be real time, reliable, and accurate.
• Inability to access all necessary data fields restricted the flexibility of the algorithm solutions. For example, regarding appointment windows, the selected data fields only provided the later time of a delivery window, rather than the from/to window. This did not allow for the drivers to be assigned an earlier time for these orders, limiting the flexibility of the system due to an improper calculation of idle times and driver availability. • Load data transmitted for use was not always accurate or complete. FEC customer service staff did not always provide complete or accurate records. Load data was, therefore, transmitted to the system with errors. Customer service, in some cases, provided updates to the records/loads; however, these were not accounted for in the optimization tool as the data feed was static (not real time). FEC Dispatch had to correct these errors or omissions while optimizing loads. This required significant time to correct that the dispatchers did not always have. • Failures and temporary outages of established data exchange protocols and the web server during key testing activities impacted use of the system and user satisfaction. FTP data feeds failed during live testing due to expiration of FEC's security certificate, resulting in loss of testing days; and, at other times, the optimization web server was unavailable or nonresponsive.	
Success of the Project	
Access to necessary data without requiring duplicative data entry is critical to long-term success. The South Florida test introduced the concept of data integration to address this need. While FEC was unwilling to commit to true system integration, as part of a short-term pilot, they did commit to a partial integration defined as a one-way data feed from their system daily. While there were some data mapping challenges, data quality issues, and data exchange failures, overall the project demonstrated the ability to map a legacy system to the tool and populate load data repeatedly.	

Source: Cambridge Systematics, Inc.

While the data typically was received in a consistent manner and contained a majority of the necessary information, several key pieces of information were missing. Specifically, loads that had an appointment window, instead of a specific time, did not have the beginning of the time frame associated with the order. Due to this, the algorithm was not as flexible as it might have been, had this data field been captured. This prevented drivers from being assigned loads consistent with the start of the appointment window. Some loads had the flexibility to be delivered anytime in a 12-hour period. The algorithm assigned the load so that it was delivered at the end of the 12-hour window. This caused the idle time statistics to be skewed. Based on this knowledge, the development team needs to be sure of all data fields required to receive the best solution.

Other times, transmitted data had inaccurate records due to entry error by customer service staff. Errors included transmittal of orders that were not handled by FEC Miami, orders not handled by Highway Services, incorrect appointment times, missing appointment times, and missing required credentials (such as Hazmat or flatbed). This resulted in solutions which were unable to be implemented, requiring the dispatcher to modify the solution; this could not be done until after having already accepted the original modified solution. Common errors of this type need to be identified early in the development process so that they can be addressed, either by the customer service staff or by the development team, to lessen the impact these errors have on the solution.

Data transfer also was a key issue during this pilot test. Not only was it difficult to initially get the data, but data transfers failed at key points during testing due to server performance in some cases, and the expiration of security certificates in others. The inability to transmit updated load data prevented dispatch from using the tool to assign loads on certain days. This was a key concern because it affected FEC's perception of the tool, and it impacted the number of days the tool was used. Due to these failures, it is recommended that all security licenses and their expiration dates be tracked through the course of future projects.

Once the correct data was acquired, additional problems arose. As this pilot project worked to integrate with an existing system, but only partially, the data feed did not allow for a real-time, reactive environment. Table 2 summarizes key lessons learned related to use of the data.

Table 2. Key Lessons Learned: Use of Data

How does the data fit with the system?	Data must be formatted and mapped to feed the drayage optimization tool in order to support load assignment decisions.
• Partial system integration does not provide a real-time, reactive environment. While the data mapping and daily data feed eliminated the need for manual data entry, the system was unable to reflect changes to orders from time of load planning to time of dispatch. When changes did occur, they had to be identified and corrected manually during the dispatch process. • Onboard devices used by FEC were not linked to the optimization tool. FEC uses Qualcomm devices. These were replaced/upgraded during the demonstration project. They were linked to the legacy load management system. TomTom Link 510s were installed and collected data via WebFleet for assessment purposes. • Customization of the established drayage optimization tool was not a simple process. The established tool had to be modified to reflect FEC's operation; and more importantly, be modified to receive a daily data feed from FEC's legacy system. This data feed represented a one-way static push multiple times per day. Development of special rules complicated the algorithm and compromised its stability. • Driver qualifications, endorsements, and preferences were not all accurately represented in the tool. Data feeds from FEC did not always contain the endorsements required to deliver a load. For example, some Hazmat requirements were added by customer service after the tool has received and processed the data feed. In other instances, the tool was unable to interpret these endorsements due to data integrity issues.	
Success of the Project	
Identifying and packaging the data for use by the tool is a critical and complex challenge, particularly when doing it through data integration. Previous tests had relied on data entry—so the tool had exactly what it needed to optimize. This version had to rely on and be restricted to the agreed-upon data feed and data mapping exercise. FEC was able to work with us to define the data needs and develop the data push protocols. In doing so, there was ongoing input from FEC operations staff requesting modifications during the test process. While not all requests could be accommodated, FEC's data was successfully imported into the tool and used to optimize loads.	

Source: Cambridge Systematics, Inc.

The partial integration eliminated the manual data feed aspect, which saved time for customer service, but dispatch had to correct orders that were not able to be correctly mapped. In addition, as the data was a static feed, sometimes order appointment times would change and would not be captured by the optimization tool. When dispatch went to assign these loads, the new appointment times would conflict with other loads assigned to those drivers, and the solution would need to be modified manually. The static data feed does not work in a real-time environment; and without a consistent live feed, the optimization tool requires significantly more time for load planning. The development team should work to ensure that a live data feed is possible to ensure buy-in from the dispatch staff.

Other issues that caused significant time requirements for the dispatchers and should be addressed during the development stage include ensuring that driver qualifications, endorsements, and preferences can be accommodated by the tool, or at least be easily modified by the dispatch staff as part of a load and driver screening and selection process. Since FEC's fleet is all owner-operators, drivers have the ability to reject orders that they do not want to complete. Typically, these are consistent from day to day. Driver preferences can include any combination of the following: 1) not wanting to deliver outside of a certain mile radius, 2) not wanting to deliver to a particular customer, 3) not wanting to deliver at a certain time of day, 4) not wanting to deliver multiple loads in a day, 5) not wanting to complete flatbed deliveries, 6) not wanting to complete multiple flatbed deliveries in a day, and 7) customers that can only be served by specific drivers. These preferences caused dispatch to have to make significant changes to the proposed solution; in addition, attempts to hard code these types of rules caused the algorithm to become less stable. The development team needs to be aware of such preferences prior to developing the tool to reduce the instability of the algorithm and provide a solution which is more reflective of actual operating conditions.

2.2 Emergency Management

The Emergency Management aspect of the SFL FRATIS demonstration was focused on the development of an Android smart phone app. This relied on the communication between devices used by test participants for both submitting and disseminating information and the emergency management server itself. As highlighted below in figure 2, the mobile reporting platform allows for information to be distributed, as required, to a wider user community to provide near real-time dissemination of important disaster recovery updates.

The mobile app allows for emergency management staff to replace current paper-based reporting methods with real-time mobile reporting of infrastructure damage and other information. Other users (such as truck drivers and key businesses) are able to supplement this information by reporting on business openings, relief supply availability, road status, and other features. This also incorporates real-time traffic conditions from Google, while tracking and mapping user locations and speeds to enable better road closure information reporting and distribution.

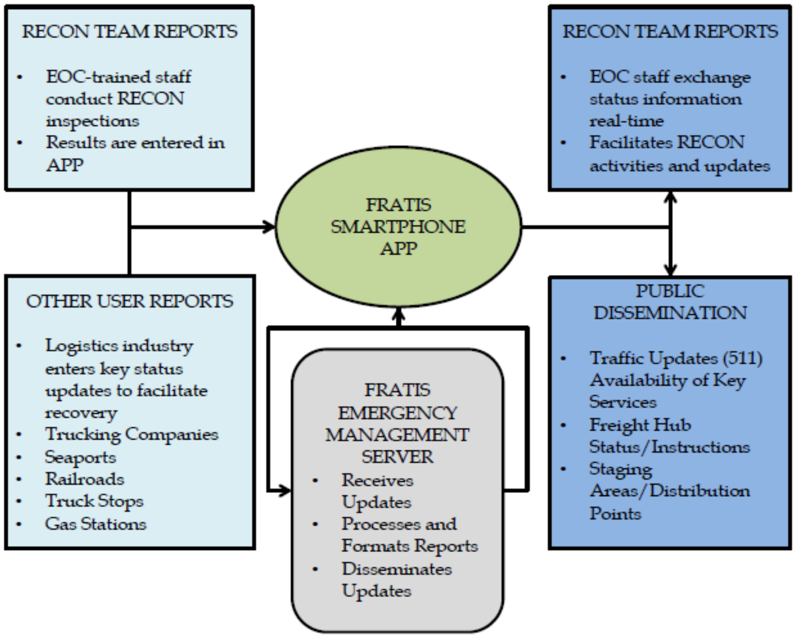

Figure 2. Overview of FRATIS Smart Phone Application
(Source: Cambridge Systematics, Inc.)

App Development Lessons Learned

Similar to the drayage optimization piece, lessons were learned throughout the app development and testing process, which can be utilized for future deployments of the FRATIS program. For app development, lessons were learned both throughout the initial development process, as well as during the testing phase, which could be utilized for development. Both of these types of lessons are discussed in this section.

Design of the system had to take into consideration the key characteristics necessary for the app to add value to the existing emergency management procedures. In addition, recognition of user sophistication, platform stability, and volume of data transactions all were critical. Table 3 summarizes key lessons learned related to app development.

Table 3. Key Lessons Learned: Development of the App

How should the App be developed?	Software should be developed at the most common level in order to limit conflicts with operating systems and devices.
• **App was developed using freely available software.** This allowed the use of Google API's (maps, geocoding, location, and directions) with minimal development. They are simple to use and greatly enhanced the framework for prototyping. • **Rapid prototyping was a good choice for development of the app.** Rapid prototyping allowed for users to get a good sense of how the app might work and, therefore, also gave insight into how they wanted such a system to work. This makes writing software for full development much easier and less costly. • **An increase in data entries caused the system to slow down significantly.** As the scenario testing progressed, more data points were available on the map which slowed down the functions of the app. Modifying the main page of the app to an options menu, rather than the map interface, may increase functionalities. • **Additional features will need to be developed for a full deployment of the app.** Features such as an administrator interface (user management of passwords, permissions, etc.) were not created as part of this demonstration test in order to encourage as many participants as possible. Additional enhancements to features, such as the map source, map engine, reporting features, routing, and Google Play Services, also would be necessary to enhance the functionality.	
Success of the Project	
The app developed for this demonstration project showed interested stakeholders the type of functionality that would be available with a full deployment of this app. **The development process yielded a working app that met this goal, but further enhancements would be necessary in order to create a robust app that is reliable in the event of an emergency.**	

Source: Cambridge Systematics, Inc.

One of the most useful aspects of the development of the emergency management app was using freely available software. Google Application Program Interfaces (API), such as maps, geocoding, and location information, are fairly simple to use and do not require the developer to create these functions on their own. Another good method used for development was rapid prototyping. This allowed users to get a good sense of how the app might work, and also provided insight about how users would want a system to work. This will make development for a full deployment much easier and less costly. Both Google APIs and rapid prototyping are recommended for use in future pilot programs.

An issue that was encountered during the testing phase was that an increase in the number of data entries caused the system to slow down significantly. This is critical because a full deployment of this app in an emergency situation would have significantly higher usage than was seen during testing. The app must be robust enough to handle and display a large volume of information. For future app development, how this data is displayed and processed should be considered so that users do not experience delays during use.

Additional aspects would need to be developed, should this app be fully deployed. For instance, an administrator interface to manage usernames, passwords, permissions, and the like was not developed as part of this test in order to encourage as many participants as possible to test the app. Other features that require additional development include Google Play Services, the map source, map engine, and reporting features. Most significantly, routing was identified as a key enhancement to the app to guide users around reported conditions. These enhancements should be considered for future apps of a similar nature.

Other lessons learned during the development of the emergency management app focus on where data comes from, how it can be used, and how it is shared. Table 4 summarizes key lessons learned related to data collection and dissemination.

Table 4. Key Lessons Learned: Data Collection and Dissemination

Where does our data come from and how do we share it?	Data must be delivered in a timely manner and be able to be easily validated.
• **Data was primarily provided by users.** While Google Traffic and Google Businesses were included as part of the system, all additional data displayed in the app were entered by test participants. With users spread throughout South Florida, this limited the ability to provide “updated” information on prior reports. • **Different types of devices create different experiences.** While the app was developed on a single platform, several different types of devices were utilized. However, each device had slightly different features, which impacted the functionalities of the app. Additional testing is necessary to ensure that the app works on a wide variety of devices. • **Integration with existing systems will enhance the information exchange.** Given that this demonstration test consisted of scenario testing over several days, there was no integration with existing systems. Future enhancements/expansion of the system should focus on integration with user systems to improve data collection and dissemination activities. • **User volumes can increase exponentially.** As most information is user provided, the amount available is solely dependent on the number of users. As more users begin to use the app, more data are then available. As more data is available, additional users will be drawn to the app as it becomes more useful. • **Participants who were given an Android phone to use for testing were unfamiliar with the mobile platform.** Phones were given to participants who did not own an Android device so that they could participate in the simulation test. However, as these users are unfamiliar with the Android operating system, their issues with the app functionality were exasperated.	
Success of the Project	
It is important to have a large quantity of data post-event in order to understand existing conditions. **Data collection and system integration was limited for this test; however, the value of the data provided was understood by users and demonstrates the type of capabilities possible with further development.**	

Source: Cambridge Systematics, Inc.

For this test, some data was provided by Google Traffic and Google Businesses; however, the majority of data is provided by users. Given that this was a limited test, a limited number of test participants were providing data. The usefulness of this app is solely dependent on the number of users. The more who begin to use the app, the more data is made available. As more data is available, more users will be drawn to it as it becomes more useful. It is important to acknowledge that not all data are treated the same. RECON data collected by first responders must be uploaded and go through verification and screening process before it can be released to the public. Data collected and provided by the private sector and/or general public can be shared immediately consistent with other crowd sourcing protocols.

For future development of this app, it is recommended that it be integrated with existing systems, such as 511, which already provide some information to supplement the user inputs. Integration was not done as part of this demonstration due to the limited nature of the pilot test, as well as a relatively decentralized emergency management operation; that is, each agency has its own system; integration is done verbally in a joint emergency operations center during the event. The full benefits of an app like this would require a centralized server or, at a minimum, system integration for each set of users. This would limit the need for double data entry, as well as provide the ability to see all available information in one location.

There also is a need to consider the types of devices and users who will be using the app. Different types of devices, while operating on the same Android platform, resulted in different user experiences. Each device had slightly different features and technological sophistication, which impacted the functionality of the app, as did the versions of Android firmware. For future testing of how useful an app can be, it is recommended that all test participants use the same device in order to reduce the number of issues that must be addressed as part of the initial testing. Once the core system has been perfected, it also is recommended that the app be coded for additional platforms as soon as reasonable. Significant feedback from users reflected a strong desire to test the app on the chosen platform (iPhone users did not want to even try and learn how to use an Android device). Additional testing prior to deployment also would be useful to ensure that the most major issues affecting the largest number of users are corrected.

Tied into the types of devices used also is how familiar users are with an operating platform. Several test participants only had access to Apple phones and, in order to encourage their participation, were given prepaid Android phones. While these participants were given training on the emergency management app and how to use it within the Android operating system, their general unfamiliarity with the Android operating system limited their ability and interest in testing the functionality. As noted above, there can be a real resistance in convincing users of one system to learn another. It is recommended that these participants receive more robust training on the basic use of an operating system if they are unfamiliar with it, but as noted above, providing the app in multiple platforms also should be a short-term objective.

3.0 Stakeholder Involvement Summary and Lessons Learned

The key participants in the SFL FRATIS demonstration test are summarized below. Of note here, key Federal Highway Administration (FHWA) staff, including Ms. Coral Torres (current U.S. DOT FRATIS Technical Manager) and Mr. Randy Butler (former U.S. DOT Technical Manager), also were involved as key Federal-level stakeholders in this effort.

3.1 Drayage Optimization Demonstration

Participants and Roles

Intermodal Freight Industry Test Participants

- **FEC** is a Class II regional railroad operating between Miami and Jacksonville, and providing all intermodal rail service in South Florida. FEC Highway Services (a division of FEC) operates a fleet of about 100 trucks in the region, including the Broward and Hialeah intermodal ramps. FEC also has trucks operating at its other facilities in Florida, but Cambridge Systematics focused on the South Florida fleet for purposes of this test. FEC agreed to outfit 50 of their trucks operating primarily in South Florida with TomTom tracking devices (Link 510) to facilitate baseline data collection to support development of the drayage optimization component of FRATIS. The drayage optimization algorithm was customized for their operation and implemented using a web-based interface and an electronic data push from FEC's legacy load management system to the optimization tool. FEC Highway Services participated in testing of the system from August 2014 through early March 2015.
- **Florida Customs Brokers and Forwarders Association, Inc. (FCBF)** is a statewide trade and logistics association based in Miami, Florida. FCBF helped engage the industry in the SFL FRATIS project, and also provided ongoing logistical support and input.
- **PortMiami** is one of the largest container ports in Florida handling almost 1 million twenty-foot equivalent units (TEU). Planning staff were engaged in the development of the project providing industry input and access to its marine terminal operators.
- **Port Everglades** also is one of the largest container ports in Florida handling almost 1 million TEUs. Planning staff were engaged in the development of the project providing industry input and access to its marine terminal operators.

Public-Sector Test Participants/Stakeholders

- **Florida Department of Transportation (FDOT) (Central Office, District 4, District 6)** is a public-sector data user who can use the freight performance data outputs from FRATIS to help with goods movement planning and investment decision-making. FDOT District 4 also was instrumental in establishing the technical basis for a Virtual Freight Network (VFN) in

South Florida. FDOT also can supply key ITS data feeds, as needed, such as SunGuide roadway conditions and traffic data for the region. FDOT staff also provided logistics support and technical expertise.

- **Broward MPO** is the Metropolitan Planning Organization (MPO) for the Greater Fort Lauderdale area. Staff provided logistics support, and provided technical input related to regional freight planning efforts.
- **Miami-Dade MPO** is the MPO for the Greater Miami area. Staff provided technical input related to regional freight planning efforts.

Development Team Participants

- **Cambridge Systematics, Inc.** was the prototype demonstration contractor lead, responsible for overall task management and project coordination and ensuring that all data requirements to facilitate the impact assessment were met.
- **Productivity Apex, Inc.** was the software development and systems engineering lead, responsible for all Agile software development and testing.
- **TomTom** provided the fleet tracking and fleet management suite to support the drayage optimization feature of FRATIS, including predeployment data collection.

Stakeholder Involvement Lessons Learned

A critical component of any pilot program is identifying the appropriate stakeholders to participate. Stakeholders are critical to ensuring the success of the project, as well as giving an appropriate representation of how the pilot could be utilized in the future. This section describes some of the key lessons learned related to the SFL FRATIS stakeholder involvement activities for drayage optimization.

The most important element of this drayage optimization aspect is having a company to test the optimization. Table 5 summarizes key lessons learned related to partner selection.

Table 5. Key Lessons Learned: Partner Selection

What type of company should be recruited?	The operational characteristics of a motor carrier include types of movements (TL, LTL, live unload, drop and pick) and type of services (Hazmat, flatbed).
• **Original trucking partner represented a full set of drayage movements necessary to properly test the drayage optimization tool.** The original trucking partner representing the Miami drayage community serves a variety of customers. After many months of working with this company, management made a business decision to terminate participation. This decision was based on concerns about data security (confidential load data) and fleet control (its fleet consisted of owner operators, and there was concern over their ability to dictate installation of new technologies on the trucks). While a nondisclosure agreement was offered to help mitigate data security concerns, and offers to work with drivers to gain support were proposed, management was unwilling to continue. • **FEC's existing operations do not allow for a significant amount of optimization.** Movements primarily consist of the delivery of loaded container/trailers from the FEC Miami Ramp to the final destination and the movement of empty or reloaded containers/trailers back to the FEC Miami Ramp. • **FEC's existing driver fleet is not flexible to changes in dispatch operations.** The FEC fleet consists of owner operators able to influence their load assignments based on driver preference. • **FEC's dispatch staff found use of the system to be time consuming and disruptive.** Dispatch staff received a lot of complaints from drivers during the test period due to an unwillingness by drivers to see a change in load assignment protocols. In addition, due to lack of full system integration, dispatch staff experienced a significant increase in time necessary to assign loads using the tool. • **FEC's willingness to engage in system integration activities was limited by company investments in technology and ongoing system upgrades.** FEC undertook several system upgrades (dispatch, Qualcomm) during the demonstration project that limited installation of additional FRATIS technology (TomTom devices).	
Success of the Project	
It is important to identify trucking companies that provide the best mix of operations to help fully test the effectiveness of the drayage optimization tool. **However, in looking at a company like FEC, who did not have a full set of movements, other operational improvement opportunities were identified, such as better driver utilization.**	

Source: Cambridge Systematics, Inc.

Since the tool is working to reduce empty/wasted movements, an ideal company would have a variety of movement types (e.g., empties, equipment relocation, bobtailing), which would benefit from the optimization. While the original trucking partner selected for this pilot program did have the appropriate mix of movements, they chose not to participate after initial development/ implementation efforts were completed. FEC Highway Services then agreed to be the key partner for this test. FEC's operation differed from the original participate, in that, most of the loads consisted of deliveries from the FEC Miami Ramp to the customer and back to the FEC Ramp. This type of operation has little to no bobtail movements, which could be eliminated through this tool. In addition, there was little to no chassis or equipment repositioning, further reducing the opportunities for optimization. What FEC Highway Services did have was a manual load assignment process based on a rolling list; this process assigned a driver's first load the day before, and all other loads were done real time. This provided an opportunity for improved efficiencies. With that said, it is important to effectively screen companies and select participants best able to test the full functionality of the optimization tool.

In addition to the types of movements FEC handles, other aspects of the company were not ideal for this pilot test. As discussed previously, FEC's fleet consists entirely of owner operators who can choose to not deliver a load assigned to them. In doing so, this alters the proposed optimal solution and reduces the possible benefits of the tool. An ideal partner would be one that does not allow drivers to alter their assigned scheduled, which is more likely possible with a nonowner operator fleet. FEC also was in the process of upgrading its Qualcomm units and, as such, was not willing to have drivers use an additional onboard device (TomTom units), which would have enhanced the features used during this test, such as dynamic routing and real-time traffic information. In addition to the onboard devices, FEC also implemented upgrades to its legacy load management system during the development phase of the SFL FRATIS project, which delayed and complicated the development of the system integration/data feed functionality.

Upon selection of an appropriate company with which to conduct this test, it also is critical to get buy-in from key participants within the company. Table 6 summarizes key lessons learned related to stakeholder commitment and engagement.

Table 6. Key Lessons Learned: Stakeholder Commitment and Engagement

Who within the company needs to be onboard?	**Participants should include senior management, IT support, and dispatch. Participants must be accessible and committed to the project.**
• **FEC's senior management committed the firm to the project.** FEC recognized the importance of supporting U.S. DOT's demonstration project to improve the reliability of South Florida's logistics system. • **FEC's Highway Services management was committed, but experienced turnover.** A vacant position was filled and almost immediately, upon building support with this individual, he moved on and the project team had to start over with his replacement. • **FEC's Highway Services Dispatch management was committed, but had limited time to provide input to the project.** The manager was excited for the potential utility FRATIS could provide her operation; however, her ability to provide critical operational information in a timely manner significantly delayed the project. • **FEC's Highway Services IT Support was responsive to the project, but with significant delay.** The IT staff assigned to support this project was overloaded with multiple assignments and could not commit to the timely delivery of necessary system information and data required for the data mapping/partial system integration process. Access to this material compromised system development and testing. • **FEC's Highway Services Dispatcher/staff supported management's commitment, but had limited time to dedicate to the project.** Two dispatch staff made themselves available to help test the tool in an iterative process that lasted a few months, followed by a few months of live testing. This required a significant time commitment on the part of the project team to accommodate their real-time operational setting.	
Success of the Project	
It is critical to have the support and commitment of senior management at the onset to communicate to the organization that participation is supported and expected. As the project progresses, the personal commitment of the daily operations staff becomes most important. Commitment was there from all levels, but significant delay was introduced due to their inability to commit the time necessary to advance the project at critical times. **In the end, their commitment came through**.	

Source: Cambridge Systematics, Inc.

To make this test successful, support is needed at all levels. FEC's senior management first committed the firm to the project. They recognized the importance of supporting U.S. DOT's demonstration project and helped the project team get in touch with the Highway Services staff. The Highway Services management also was committed to this project, but experienced turnover throughout the course of testing. This resulted in a need to start over with replacement staff. The remainder of staff who provided the most support to this project, including dispatch management, IT support, and dispatchers, were all committed to the project, but unfortunately had limited time to dedicate. This limited availability resulted in significant delays throughout the entire project, from the original inquiries about available data all the way through final testing of the use of the system. One recommendation to help alleviate this problem was to provide incentives to the employees of the company participating as compensation for the significant amounts of time contributed to this pilot test or provide staff resources.

3.2 Emergency Management Demonstration

Participants and Roles

Intermodal Freight Industry Test Participants

- **PortMiami** is one of the largest container ports in Florida handling almost 1 million TEUs. Planning staff were engaged in the development of the project providing industry input and access to its marine terminal operators.
- **Port Everglades** also is one of the largest container ports in Florida handling almost 1 million TEUs. Planning staff were engaged in the development of the project providing industry input and access to its marine terminal operators, and participated in the simulation test.
- **Crowley** is a terminal operator at Port Everglades and was a participant for the emergency management smart phone app and participated in the simulation test.
- **South Florida Container Terminal** is a terminal operator at PortMiami and provided input to the development of the emergency management smart phone app.
- **FCBF** is a statewide trade and logistics association based in Miami, Florida. FCBF helped engage the industry in the SFL FRATIS project, and also provided ongoing logistical support and input.
- **FEC Highway Services** (a division of FEC Railway) operates a fleet of about 100 trucks in the region. In addition to serving as the drayage optimization trucking partner, FEC Highway Services staff participated in the development and testing of the emergency management smart phone app.

Public-Sector Test Participants/Stakeholders

- **FDOT (Central Office, District 4, District 6)** is a public-sector data user that can use the freight performance data outputs from FRATIS to help with goods movement planning and investment decision-making. FDOT District 4 also was instrumental in establishing the technical basis for a VFN in South Florida. FDOT also can supply key ITS data feeds, as needed, such as SunGuide roadway conditions and traffic data for the region. Officials from FDOT Districts 4 and 6 emergency operations also supported the emergency management application testing. FDOT staff also provided logistics support and technical expertise.

- **Broward and Miami-Dade County Emergency Management** staff provided technical input and expertise during the development phase and participated in simulation testing of the emergency management Android app.
- **Florida Division of Emergency Management** was an expert advisor on the emergency management Android app development and observed simulation testing to help develop key performance metrics and lessons learned.
- **Broward MPO** is the MPO for the Greater Fort Lauderdale area. Staff provided logistics support, and provided technical input related to regional freight planning efforts.
- **Miami-Dade MPO** is the MPO for the Greater Miami area. Staff provided technical input related to regional freight planning efforts.

Development Team Participants

- **Cambridge Systematics, Inc.** was the prototype demonstration contractor lead, responsible for overall task management and project coordination and ensuring that all data requirements to facilitate the impact assessment were met.
- **The University of Washington (UW)** was the developer of the emergency management Android app as a student capstone project through the University's Information School.

Stakeholder Involvement Lessons Learned

Similar to the drayage optimization piece, the emergency management app development and testing had a variety of stakeholder participation. Table 7 summarizes key lessons learned related to system users.

Table 7. Key Lessons Learned: System Users

Who are the appropriate system users?	Participants should include each of the targeted user groups to get input from all perspectives.
• **Public entities are responsible for managing reconnaissance activities, public safety, and recovery activities.** These agencies were interested in the capabilities the app provided to collect and disseminate data. The public entities involved throughout the app development were interested in the functionality of the app and how it would serve their RECON efforts. However, issues with testing and phone compatibility limited their participation during the scenario testing. • Private businesses, including freight hubs (ports, railroads, trucking companies), are responsible for communicating status of operations, including special instructions. The role of private businesses was played by Port Everglades, Crowley, FEC Railway, and the development team and other test participants who were willing to take on multiple roles. A better tie-in to private businesses would allow for additional input for app development related to suppliers and gasoline distributors, as well as insight into the likelihood of a business using this technology.	
Success of the Project	
It is important to have a wide variety of system users and testers in order to garner different levels of input. **For this test, participants represented a wide range of technology capabilities, which aided in identifying software bugs, as well as providing insight into how intuitive using the app is.**	

Source: Cambridge Systematics, Inc.

The key stakeholders involved in this effort covered both the public sector and the private sector. This is necessary as emergency management activities require the coordination between these two groups. Public entities are responsible for reconnaissance activities post-event, and participants saw a value in the app's capabilities of automating the current manual processes. However, issues with testing and phone compatibility limited some participation by these stakeholders.

Private businesses for this pilot test predominately included the local ports, railroads, and shipping partners. A better tie-in to private businesses would allow for additional information to be disseminated through the app. The SFL FRATIS Team interviewed key industry coalition representatives, and the local emergency management agencies reached out to their industry contacts during the testing activities, but a more direct involvement would be necessary to ensure the app is useful to the private business community moving forward. As part of the simulation testing, this functionality was tested by a mix of participants taking the role of a private business. As previously discussed, with more data available, more users will be encouraged to use the app. This will allow additional feedback as to the usefulness of the app and how such technology fits with current operations and information dissemination.

4.0 System Testing Summary and Lessons Learned

Development of the SFL FRATIS included a comprehensive process to develop specific user needs, map those needs to system requirements, and then to develop the software solutions (and hardware integration) that delivered on the promise to meet the user needs. To facilitate this process, Cambridge Systematics, Productivity Apex, and University of Washington staff implemented a comprehensive Agile Process for system development. A key feature of this process was the involvement of key user groups—including FEC and emergency management staff—at key phases of the system development process. Readers that may be interested in more of the details in this process are referred to the following documentation:

- **South Florida Freight Advanced Traveler Information System: Architecture and Implementation Options Summary Report, July 19, 2013, FHWA-JPO-14-181** (http://ntl.bts.gov/lib/54000/54400/54479/Fratis_FHWA-JPO-14-181.pdf). This document provides the technical specification for the system design and architecture of the SFL FRATIS system.

Additionally, all SFL FRATIS software developed for the small-scale test, including the Optimization Algorithm and Emergency Management app, have been uploaded to the U.S. DOT's Open Source Applications Development Portal and can be accessed directly at: www.itsforge.net.

4.1 Drayage Optimization Testing Summary

The drayage optimization test required significant development, customization, training, and ongoing support and enhancements to fully evaluate the usefulness of the tool. Over the course of the SFL FRATIS demonstration, significant resources were spent working with FEC to build a rapport, gain support and trust, and develop a system with the potential to improve their operation.

The actual testing of the tool consisted of FEC dispatchers utilizing the FRATIS web interface and optimization algorithm to assign orders to their drivers. Extensive testing and input were conducted over the course of several months to modify the existing algorithm to more closely mirror expected solutions based on current operating conditions at FEC. During the beta-testing period, FEC dispatch staff used the tool daily to generate solutions. These solutions were reviewed, modified, and commented on by the staff in discussions with the SFL FRATIS Team to identify modifications required for the solutions to be used. This culminated in an intensive three-week period, during which the dispatchers used the tool to generate solutions to assign orders to their drivers.

Table 8 below provides a summary of the focus of which elements of FRATIS were tested, and relates these to the expected benefits hypotheses that were developed early on based on user needs and expected benefits to the user. The IA Team currently is assessing the results of the SFL FRATIS in relation to these hypotheses, and it is expected that the U.S. DOT will publish the IA Team's evaluation final report later this year.

Table 8. Drayage Optimization Test Hypothesis

System	Elements	Test Hypothesis
Drayage Optimization	Order entry—Integrated file transfer from FEC's existing system, or manual entry through a web portal.	The drayage optimization algorithm will provide an optimized plan for the day's moves that will accomplish all required moves in the most efficient manner possible, accounting for the business constraints—This will result in reduced miles traveled, reduced trips, fewer bobtails, less bobtail miles, and corresponding reductions in emissions.
	Optimization algorithm—Runs on PAI server and provides a daily plan that will maximize productive moves and minimize nonproductive ones, accounting for historical traffic and other factors.	
	Dispatch—FEC dispatchers can accept or reject algorithm recommended moves based on business needs; they will communicate instructions as they do now or using TomTom devices.	The traveler information web portal will provide dispatchers with better travel data, which will improve drayage trip planning.
	Traveler information web site "one-stop shop" with real-time traffic information for dispatchers.	Public agencies will use data generated by FRATIS to assist in freight planning and investment decision-making.
	Public-sector freight performance monitoring—web site with freight movement data compiled throughout the test.	

Source: Cambridge Systematics, Inc.

System Testing Lessons Learned

Many of the key lessons learned during testing also were lessons for the development of the drayage optimization system. These have already been discussed in an earlier section. As such, this section focuses more so on how useful the company found the system to perform. Table 9 summarizes the key lessons learned related to the usefulness of the system to FEC.

Table 9. Key Lessons Learned: Usefulness of the System

How useful was the system to the company?	Real-world conditions do not always match ideal solutions; however, there must be a measurable benefit.
• **System allows better use of dispatcher time.** Currently, dispatch only assigns the first load for a driver the day before, and then assigns all other loads real time. The tool allows dispatch to assign all loads the day before, and then focus their real-time efforts on exceptions/changes/same day loads. In addition, it can position FEC for growth by improving driver management. • **System does not capture load updates or changes.** Daily assignments are based on static data. The data push was timed to capture the greatest percentage of loads; however, changes or updates are not reflected in the tool. The dispatcher had to correct where possible during the load planning and real-time operations. • **Web-based interface had some performance issues.** FEC had a slow Internet connection and older computers. Internet Explorer (IE) did not work well. Google Chrome was more reliable. On days with a large number of loads, the tool periodically timed out during the optimization process. In addition, the steps to complete certain tasks required a large number of clicks, and drag/drop actions were difficult when the loads did not all fit on one screen. While FEC was able to upgrade its computers during the testing phase to achieve some improvement in performance, additional involvement in the development process would have been beneficial to ensure the interface itself was as streamlined as possible.	
Success of Project	
While the independent assessment will provide final input on usefulness of the system, **this experience indicates there is potential to improve the overall dispatching process**; however, additional system enhancements and performance improvements would be necessary to recruit/engage FEC operations staff.	

Source: Cambridge Systematics, Inc.

Under an ideal development scenario (full integration, live data feeds, etc.), this system would allow for a better use of the dispatcher's time. At present, FEC's dispatchers only assign the first load for a driver the day before; the remainder of the loads must be assigned in real time. This tool allows the dispatcher to assign all loads for the next day. This saved the dispatcher some time the following morning as they only needed to focus on orders which changed from when the initial assignment was made. However, as the system was developed for this test, making assignments using the drayage optimization tool actually required the dispatcher to spend more time developing the load plan than they normally do. This was due to a combination of issues that included the use of a static data feed for a live operating environment, slow Internet connections, assignment of orders to drivers with improper credentials, and the existing method of assigning orders in the legacy system. These obstacles would need to be overcome in order for FEC to find the tool useful for their operating environment.

4.2 Emergency Management Testing Summary

The emergency management smart phone application was tested with the participation of the key stakeholders previously identified. These stakeholders represented a variety of user types to illustrate how the app would be used by trained RECON staff, freight terminals, private businesses, and truck drivers. Training was provided to all users via in-person meetings, web meetings, and one-on-one meetings. Much of this training began with initial discussions and demonstrations of the app and its functionality. As not all users had access to Android smart phones, several "pay as you go" phones were purchased for their use. In addition, several users used web browsers on their personal non-Android smart phones, tablets, or office computers. The application was tested over the course of three separate days, in which users were given three separate hurricane scenarios to simulate. As the test progressed, each scenario represented more severe events (i.e., a Category 3 storm versus a Category 1 storm); and users were expected to adjust the severity of the conditions reported accordingly.

Table 10 below provides a summary of the focus of which elements of FRATIS were tested, and relates these to the expected benefits hypotheses that were developed early on based on user needs and expected benefits to the user. The IA Team currently is assessing the results of the SFL FRATIS in relation to these hypotheses, and it is expected that the U.S. DOT will publish the IA Team's evaluation final report later this year.

Table 10. Emergency Management Test Hypothesis

Hypothesis	Data Needed to Test	Source(s)
The app will allow emergency management officials to conduct more timely RECON reporting and information dissemination.	Reports entered by emergency management officials in the app during a simulation exercise.	• Android app • User interviews
The app will allow drivers to enter critical post-event recovery information, including gas status openings/fuel availability, and openings of key businesses that sell relief supplies.	Reports entered by drivers and business owners/managers in the app during a simulation exercise.	• Android app • User interviews
The app will allow ports and intermodal terminals to report on their status after an event and note any special conditions or instructions.	Reports entered by ports and intermodal terminals in the app during a simulation exercise.	• Android app • User interviews
Users will have better road opening/ closure information through position reporting, pings, and real-time traffic.	Maps generated by the app during simulations.	• Android app • User interviews

Source: Cambridge Systematics, Inc.

System Testing Lessons Learned

As described in the discussion of the drayage optimization system testing, a critical component of any pilot program is identifying and documenting the key lessons learned during the project. Table 11 summarizes the key lessons learned that are related to the SFL FRATIS emergency management app testing program.

Table 11. Key Lessons Learned: Benefits of the Smart Phone App

How would users benefit/gain from the app?	App must create some benefit for the user so that they are willing to use it.
• **App functionality creates a centralized data repository.** At present, those seeking information would need to use a variety of resources to obtain information post-event. For instance, Port Everglades sends information out to their users via email, Publix posts store status on their web site, and the roadway conditions are available through FloridaDisaster.org. This app allows for all information to be found in one location to allow a user to make the most informed decision possible. • **App allows for the faster reporting of data.** The app eliminates the need to fill out paper forms, which are only entered into the emergency management system once RECON teams have returned from their shift. An automatic upload of this information allows for conditions to be reported in near-real time and can allow for repairs and debris removal to begin sooner. • **Manual process of RECON reporting is digitalized.** By digitizing the manual RECON process, fewer resources are needed by emergency management officials to process the data. RECON teams can go out in the field without worrying about having enough paper forms. In addition, it reduces the effort required at the central command center to enter the information when crews return. • **Better data is available through the app.** The app allows users to attach pictures with each report. This is possible with current RECON procedures; however, the image is not attached to the report and must be done manually when the report is entered into the system. • **Lower resource usage for information management.** Post-event conditions are a state of “controlled chaos” with limited personnel resources. The app will reduce the amount of time needed to enter and process the data from RECON reports, freeing up personnel time for other tasks. • **Better resource allotment.** The app can tell users which stores are open that have the supplies they need. This reduces the amount of supplies the State must provide as supplies must be available, but they do not need to be free. In addition, updated business statuses can indicate to emergency management officials where points of distribution are most needed.	
Success of Project	
While not all benefits were fully realized during the course of the scenario testing, **significant benefits are possible, should the app be developed further.** However, the app must be robust enough to handle a multitude of users, as well as be reliable enough for use in the case that an emergency event does occur.	

Source: Cambridge Systematics, Inc.

Many of the lessons learned during testing would have been pertinent information for the development phase. These lessons have already been highlighted in an earlier section. Namely, these issues are due to the prototype nature of the app, which did not necessarily allow for smooth use of the system. The majority of other concerns stemmed from uncertainty of the mobile network following a storm. Cell phone providers have fortified their networks since the last major hurricane to hit South Florida, in addition to providing mobile cell towers, should the need for additional service arise. As such, there is a high likelihood of the relevancy of this app during future events.

Barring any concerns with the development stage and cell phone coverage, test participants saw value in the further development of this phone app. In fact, subsequent meetings with key partners, including FDOT, suggest that there is interest in identifying and pursuing a follow-on project to build off of the existing smart phone app to, at a minimum, develop a closed loop system for a specific agency.

5.0 Recommendations for Future FRATIS and Freight DMA Programs

Based on the lessons learned as part of the SFL FRATIS demonstration project, the following recommendations are provided to the U.S. DOT and regional public-private partnerships that are interested in developing, testing, and deploying future FRATIS and Freight Connected Vehicle applications.

5.1 Drayage

1. **Optimization Tool must be real-time and reactive.** The SFL FRATIS test relied on a one-way, static data feed for optimization purposes. This method, while reducing time required for the double-entry of orders, did not lend itself to the real-time trucking environment. Changing the time of a single order could require the shuffling of multiple orders among multiple drivers, thus, significantly changing the entire optimization solution. Future FRATIS optimization-related applications need to ensure that systems are able to accommodate the real-time nature of this industry.
2. **Economic incentives may improve level of participation.** The SFL FRATIS project required significant amounts of time to develop and test and deploy both for the demonstration team, as well as the test participants. At times, the ability and willingness of the participants were limited due to the perceived benefit and other daily responsibilities. Also, the test participants were committed by their management; not their personal choice. At times during the development and testing periods, it was difficult to get their attention, which delayed the project. Future implementations of the FRATIS optimization tool should consider incorporating an economic incentive in the form of staff compensation and/or consultant resources to help alleviate the amount of extra work required, and ultimately increase the level of commitment to the project.
3. **Drayage partner must have appropriate operational characteristics.** One limiting factor of the SFL FRATIS drayage optimization project was the operational characteristics of the partner trucking firm; the fact that the operation did not include all types of movements prevented the full use or demonstration of this tool. Without a variety of movement types, minimal benefits could be determined from the optimization. Future projects should include substantial time for the screening and recruitment of an appropriate company before proceeding with a testing program. Doing so will ensure the appropriate testing metrics can be measured in order to determine whether or not the technology makes a difference.
4. **Technologies must be flexible and able to be modified.** The technologies used for the SFL FRATIS optimization tool need to be implemented in a flexible manner that accommodates the needs of a user. This applies to both participant and developer systems as it relates to data sharing, data mapping, system integration, system stability, and system customization regarding carrier-specific requirements. This will help ensure the system produces useful solutions, which will result in buy-in from the users. Issues such as a slow

server, lack of roadside information, exclusion of some driver characteristics and constraints, and the lack of the ability to share data real time limited the effectiveness of the system. While in a perfect world all drivers can handle all orders, this often times is not the case. Future FRATIS drayage optimization deployments need to ensure technologies can be integrated and modified jointly by the developer and by the participant.

5. **Driver commitment is critical.** Some of the main metrics for this SFL FRATIS demonstration project included reduced mileage, reduced fuel consumption, and an increase in the number of orders. While this has been proven to be the case in some prior deployments of FRATIS, the long-term benefits were not realized by drivers during the short implementation of this test. Many drivers were unwilling to accept certain loads, and their rejection of an order compromised the ability to measure the benefits of the tool. Future FRATIS deployments should ensure that drivers understand the purpose of the project and long-term benefits, and are willing to participate. Tying back to the recommendation of recruiting an appropriate company, a test partner with a private fleet, instead of owner-operators, may be more suitable so that drivers cannot influence which orders they are willing to accept.

5.2 Emergency Management

1. **System integration is necessary to demonstrate the benefits of data sharing.** A key element in a real life emergency scenario is the sharing of information in order to minimize duplication of efforts and increase the speed of dissemination. Given that the SFL FRATIS emergency management smart phone app was a demonstration test, system integration was not incorporated. Involved stakeholders identified integration as a key enhancement that would be required if the system was to be fully deployed. Further development of this mobile app should begin to integrate with existing systems in order to facilitate the sharing of this information across multiple agencies.
2. **Minimize the level of effort.** As with the drayage optimization piece of this demonstration project, a key component of the success of these technologies is providing a product which does not require additional time or resources on the part of participants. Many of the involved stakeholders have existing methods for disseminating information to interested parties and do not want to have to repeat this process. While system integration will solve some of these concerns, the app and web interface need to be simple and straightforward processes, which do not require significant amounts of time to utilize and/or could be structured to import data from established protocols.
3. **Increased private business engagement is required.** As part of this demonstration, private businesses were predominately demonstrated through public stakeholder participation. While several key freight terminals were involved, such as Port Everglades and Crowley, businesses such as gas stations and grocery stores were not fully represented in this demonstration. Further outreach to these types of stakeholders should be conducted as part of future deployments of this technology in order to gain their feedback on the system and incorporate any enhancements they deem pivotal to the success and use of this technology.
4. **Technology development and functionality should be balanced.** The emergency management smart phone app was only developed on the Android platform for this SFL FRATIS deployment. This caused some issues for stakeholders who did not have access to or experience with an Android phone. In addition, several different types of Android devices were used. Further enhancements to the app should work to strike a balance between developing the mobile app on multiple platforms and focusing on a single platform/identical

devices. One approach engages users in their preferred environment, while the other provides a more ideal testing and development environment.

5. **Technology must be fast, robust, and responsive.** One of the main concerns about developing a smart phone app for emergency management purposes is the availability of the wireless network post-event, particularly for hurricane scenarios. While the network has been significantly enhanced since the last major storm event in Southeast Florida, it has not been tested in this situation, which leaves some uncertainty about the reliability of the system. In addition, limited use of the system during the testing scenarios showed a slowing of the system as traffic/users increased. Further development of the app needs to ensure that it is robust enough to handle surges in demand, as well as be flexible to the certain needs of users.

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