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Multimodal Trip Planner System
Final Evaluation Report




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FINAL REPORT

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FOREWORD

This evaluation of the Multimodal Trip Planning System (MMTPS) is the culmination of a multi-year project evaluating the development and deployment of a multimodal trip planner in the Chicagoland area between 2004 and 2010. The report includes an overview of this project, the state of the current trip planning environment, and a discussion of technical and institutional issues. The primary purpose of this paper was gathering information to share with the transit community and other stakeholders on these technical and institutional issues including Intelligent Transportation System (ITS) standards, communication, marketing, and the technical feasibility of integrating single-mode trip planning. The report concludes with lessons learned and recommendations related to the development of a door-to-door, multimodal trip planner system.

The objective of this evaluation is to support FTA in its efforts to disseminate knowledge of advanced traveler information technologies within the transit community, in this case focusing on issues associated with multimodal trip planners.

NOTICE/DISCLAIMER

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ACRONYMS AND ABBREVIATIONS

APTA	American Public Transit Association
AVL	Automatic Vehicle Locator
CMAQ	Congestion Mitigation Air Quality
CO2	Carbon dioxide
COTS	Commercial off-the-shelf
DLLM	drive less. live more.
GCM	Gary-Chicago-Milwaukee
GTFS	General Transit Feed Specification
ITS	Intelligent Transportation System
MMTPS	Multimodal Trip Planner System
RFP	Request for Proposals
SAE	Society of Automotive Engineers
SEO	Search Engine Optimization
TCIP-SCH	Transit Communications Interface Profiles Scheduling Business Area
UIC	University of Illinois Chicago
XML	Extensible Markup Language

CHICAGO MULTIMODAL TRIP PLANNER

FINAL EVALUATION REPORT

EXECUTIVE SUMMARY

In 2004, the United States Department of Transportation (U.S. DOT) Intelligent Transportation Systems Joint Planning Office (ITS JPO) and the Federal Transit Administration (FTA) funded an effort to advance the state of the practice through the development of a door-to-door multimodal trip planning system (MMTPS) that integrated transit information with driving, parking, and bicycling information. Evaluating the MMTPS supports the FTA in disseminating knowledge of advanced traveler information technologies within the transit community. The findings, lessons learned, and recommendations related to the MMTPS project draw on interviews, surveys, and a review of project documentation and communications collected over the planning, development, and implementation phases of MMTPS, as well as a review of the current state of the trip planning environment.

The ITS JPO and FTA awarded the Regional Transportation Authority (RTA) of northeastern Illinois funding for an operational test to demonstrate the technical and institutional feasibility of an integrated MMTPS compliant with the Society of Automotive Engineers Advanced Traveler Information systems (ATIS) Standard (J2354) and the Transit Communications Interface Profiles scheduling (TCIP-SCH) standards. The project was to be managed by a systems engineering (SE) process and divided into three phases – core system development, feature expansion, and intercity bus and rail expansion – with the first phase scheduled to be complete by August 2006 and the second by December 2006. In 2007, due to schedule delays, the RTA incorporated work originally scheduled for Phase II into Phase I, eliminating the "go/no-go" decision gate scheduled to take place between phases.

The project experienced multiple delays, the largest of which was the preparation of an Alternatives Analysis, completed in the summer of 2006, covering seven development alternatives. With Federal approval, the RTA selected a commercial off-the-shelf (COTS) proprietary end-to-end traveler information solution, rather than develop a tool integrating local databases. After a series of stakeholder trials, the MMTPS, branded as "goroo," was made available to the public in April 2009. Developing the core system took more than two-and-a-half years longer than anticipated and did not include the ATIS or TCIP-SCH scheduling standards. Of the features expected to be included in Phase II, only environmental emissions data comparison has been implemented.

Both information technology and the trip planning environment have changed significantly since the early 2000s when FTA first conceived the MMTPS demonstration idea. The concept of a door-to-door multimodal trip planner incorporating seamless, comparative, multi-agency itineraries represented a significant innovation from what existed at the time. Then, the availability, sophistication, and quality of ATIS and the real-time transit and the traffic data that supported them were limited. Today, all large and many medium and small transit agencies either offer trip planning services through their own website or through Google Transit. One trend apparent in new trip planners is that they provide aggregated information from a number of different transit agencies. Multimodal trip planners that feature both driving and public transit appear to be more common internationally, particularly in Europe. Still, despite the vast

advances in the state of the practice, there is not yet a trip planner available in the United States that incorporates *all* of the original elements of MMTPS.

This evaluation examines the MMTPS within the context of the current trip planning environment and identifies institutional and technical lessons learned and recommendations. This summary covers a selection of those topics: changes in the provision of traveler information, changes in the roles of the federal, state/local, and private actors providing traveler information, and management practices for developing and deploying technical projects.

E1. Traveler Information Trends

While evaluating the MMTPS, the team indentified major trends in traveler information to understand the relationships between the introduction of the MMTPS and traveler behavior. For travelers, itinerary-planning is only one type of useful information. Real-time vehicle location, predictions, and disruption notifications are increasingly expected by travelers, particularly when en-route and on mobile devices.

Perhaps the most important change in traveler information is the increase in third-party providers; major search engine and mapping websites are eagerly accepting public feeds of static schedule data for integration in their trip-planning websites (including mobile access) and attract a large number of travelers. While Google, Microsoft, and other providers do not release data on their users, it is a reasonable assumption that their users are more multi-modal than those accessing transit websites, a market particularly of interest in the development of an MMTPS. The communication of transit schedules to third parties has become increasingly common with the proliferation of the General Transit Feed Specification (GTFS), originally developed by Google for their transit trip planner, but now open source and available to any interested entity. Though not competing directly feature-for-feature, GTFS has been substantially more widely-adopted than the TCIP-SCH standard developed by APTA and the FTA, largely due to its relative ease in describing, implementing, and maintaining the data feed.

However, what GTFS has in simplicity to implement, it lacks in rich features; it cannot transmit real-time information and does not integrate with the wider suite of ITS standards. Though the former problem will likely be resolved by the GTFS community, integration with other ITS-standards compliant services may remain an issue. Similarly, the near complete lack of agencies adopting TCIP-SCH presents a difficulty for the ITS standards program. This gap will have to be bridged, allowing agencies to reap the benefits of the work conducted to implement GTFS feeds and to be able to communicate with other ITS assets and partner agencies.

Key Findings

- Agencies currently developing or replacing trip planners still show a mix between open source systems and customized, individually ordered proprietary systems.
- A number of trip planners take expected traffic into account for a more realistic presentation of results. This additional accuracy may also promote transit use.
- It is difficult for transit agencies to implement standards before their software providers build such features into their systems.

- The lack of TCIP-SCH clarification for decision-makers has made it difficult to maintain momentum deploying compliant systems, particularly if it introduces additional costs.
- Agencies looking to apply TCIP-SCH may already use GTFS and will realistically have to understand how to convert data between the two.
- Given the emergence of GTFS and the difficulties experienced in building support for TCIP-SCH, it may be warranted to re-evaluate the state and strategy of the transit standards program. When technology is rapidly changing, longer demonstration projects may be less useful. A strategic decision should be made upfront on how to best move forward the technology. For the MMTPS, a smaller scale project may have enabled a proof of concept that provided valuable insight.

E2. Changing Roles

Data feeds containing both static and real-time information have been released to the software developer community at large, usually (but not exclusively) for inclusion in mobile phone "apps." This trend may be the first step in a changing role for transit agencies in the provision of traveler information, particularly in support of multimodal options to the public. That is, transit agencies' role in traveler information service provision may decline while their role in data provision and standardization grows, while the private sector and/or regional governments take on increased roles in providing multimodal traveler information. In this environment, the role of central governments may become to oversee the common referencing and standards/protocols and to facilitate implementation and deployment of products through information dissemination and knowledge transfer.

One of the goals of the MMTPS was to lower information dissemination costs. Before the above-mentioned third-party alternatives were available, each individual agency had to develop or procure a trip planner, requiring the agency to engage in web design and other related costly, resource-intensive activities. This approach limited the ability of smaller or budget-restricted agencies to offer trip planners. Difficulties in developing the MMTPS along the original plan (of "knitted together" databases) in a timely manner, however, negated some of the expected reduction of costs. Additionally, the advent of alternatives such as Google Transit, Bing Maps, and OpenTripPlanner lowered costs of information provision, allowing agencies to offer trip planning services without having to procure a full trip planner. As these alternatives to the traditional trip planning model develop, it may be politically difficult for transit agencies and state or regional authorities to continue investing in proprietary trip planning products when other, less expensive options are available. However, many large and some medium agencies continue to see benefit in maintaining their own trip planners as they can provide amenities or features third-parties do not. Moreover, while such alternatives have reduced the cost of providing trip planning services, transit agencies and regional transit authorities still incur costs to develop and maintain agency and regional data feeds.

Key Findings

- The future role of transit agencies in traveler information service provision may decline in lieu of providing standardized data feeds to third parties and developers.

- Because of the tension between the goal of promoting transit use and providing multimodal information, multimodal trip planners may be best suited for agencies, organizations, or unique collaborative partnerships whose missions are more multimodal.
- The cost of developing a trip planner depends heavily on existing data quality at an agency. Agencies with consolidated, standardized databases will face much lower costs.

E3. Management Practice

Like an increasing number of transportation projects, the MMTPS followed a SE process to guide project progress. The SE process is built on ensuring that all project components support and are traceable to a user need, and that each component is testable. This process requires diligence in early stages to ensure that user needs are well defined and translated clearly into a Concept of Operations and System Requirements. Consequently, after design and build of the project, testing procedures can ensure that not just design specifications have been met, but that necessary operational concepts are fulfilled, and most importantly, that user needs are satisfied.

However, engineering projects often have difficulty maintaining the effort and energy to continue the SE process through to completion. In the case of the MMTPS, federal oversight lessened once the System Requirements phase passed and a contractor was brought on board at the RTA. Not only was there less useful communication and feedback about the final design, diligence in developing the various test plans faded as well. Consequently, while Chicago RTA had a well designed acceptance plan at the design level (e.g., verifying the various buttons function as intended), and some specific system requirements were tested, an integrated System Verification plan tied to user needs was not developed, making it difficult for the project team and federal managers to determine when the site had met criteria for a public launch. This resulted in at least two failed soft launches and a reversion to “beta” after the official launch happened.

Similarly, the decision to go with a COTS software provider changed the proposed development plan, combining Phases I and II and removing the only go/no-go decision gate. While the improvement in development speed was then welcomed, the project later faced increasing delays as well as new pressures introduced by technological innovation elsewhere. Neither the federal team nor the RTA had a clear, established method to communicate openly and honestly about the value of continuing the project on its current path, adjusting the project plan to better meet the situation, or even considering ending the project. It is difficult to say retrospectively if the project would or should have been aborted, but a frank conversation about project and demonstration goals would likely have served the project well at multiple, regular points throughout.

The MMTPS project was also intended to reach new markets for transit. However, rather than market the MMTPS independently, the RTA opted to leverage existing resources through a

cross-promotion with their drive less. live more campaign, which may have reduced the market expansion originally anticipated for the project.

In support of the MMTPS demonstration, the FTA convened a peer advisory panel of a cross-section of members of the transit community to provide insight and feedback during the course of the project. The panel was also expected to facilitate the transfer of the technology to other metropolitan agencies by involving transportation staff from agencies with a potential to develop an MMTPS. Because the final MMTPS was developed with a COTS solution, the anticipated transferability was not a result of the panel. The peer panel, however, did lead to increased collaboration between members and also with the RTA as their agencies pursued trip planning projects.

Key Findings

- Project Management
- The standard, multi-year operational test and evaluation model used for the MMTPS project may not be most appropriate in areas of rapid technological change. A different model that is designed specifically to address the challenges of testing and evaluating rapidly changing technology may be necessary.
- In the face of changes in the technical, institutional, or external environment, project teams should determine how the plan and objectives will have to be revised.
- A conversation about the benefit to continuing the project would have focused stakeholders on the value of remaining project activities, unmet user needs, and demonstration goals.
- To determine how much risk a project can tolerate, careful balancing of usefulness/novelty of a demonstration and the likelihood of producing a useable product must take place.
- The project team must set out criteria for understanding when a project has crossed a risk threshold for project failure, and a clear timetable for when such decisions should happen.
- The federal team should ensure decision points and “go/no-go” decisions are built into project management plans and schedules.
- The “go/no-go” decision should not be a substitute for vigilance in keeping project goals and objectives.
- Although changes may require decision gates to be rescheduled, they must not be eliminated altogether.
- A decision to end a project does not necessarily represent a failure of the research and/or demonstration program, and this should be made clear to stakeholders.
- Some well-conceived ideas will not come to fruition, but even if called off, can likely provide significant feedback about the usefulness of an idea or process.
- All levels of management and a project team should create an organizational culture that reinforces this concept as new ideas move forward.
- Ensure that project partners share the same goals, and that cumulative small decisions do not move the project away from one partner’s goals.
- Decisions to leverage other internal resources should be examined carefully and critically. The potential benefits should be weighed against additional risks introduced.

Systems Engineering

- A diminished focus on the SE process resulted in a system acceptance and verification plan focused more on technical functionality rather than user needs.
- In order for user needs to be an effective guide throughout the systems engineering process, the SE documentation should articulate them clearly and concisely.

E4. Conclusions

The MMTPS provides an opportunity to understand some of the common issues that can be encountered during a technology demonstration project. Project management and oversight, both at the federal and grantee level are paramount to achieving a successful demonstration. Regular, honest communication about project progress and satisfying user needs keeps the stakeholder team focused on achieving demonstration goals, including, at times, terminating a project early and compiling the lessons learned up to that point. Recognizing the nature of technology demonstrations and creating a culture where making appropriate decisions, even if that decision is to terminate a project, will help encourage optimal investment of agency funds. Project plans must also be calibrated to the technology environment. When projects take place in rapidly changing fields, shorter duration projects of individual components may be more appropriate than the traditional multi-year implementation and demonstration. Research plans and oversight techniques should be updated to reflect this type of research project.

Specifically ATIS projects, uncertainty about the ITS standards process remains. Some resolution on the relationship between GTFS and TCIP-SCH will be necessary to allow agencies to benefit from existing investments, support the growing third-party developer community, and facilitate integration with other ITS assets.

Overall, the MMTPS project has provided a useful look into the rapidly changing and exciting world of traveler information, highlighting opportunities for new products, new features, and identifying management and development practices that can help insure the traveling public reaps the benefits of new technology.

1. INTRODUCTION

Over the past decade, transit agencies in the United States have expanded the availability of traveler information available to riders through a number of channels. During this period, transit trip planners went from being a feature offered by fewer than three dozen agencies to a tool offered in some manner by most large and medium transit agencies. The development of the Multimodal Trip Planner System (MMTPS) was an early effort by the Federal Transit Administration (FTA) to advance the state of the practice through the development of a door-to-door multimodal trip planner that integrated transit information with information on driving, parking, and bicycling.

The MMTPS was envisioned as a planning tool designed to generate separate travel itineraries for driving only, transit only, and drive-to-transit, taking into account user preferences regarding the trip and highlighting the comparative cost and travel time associated with each of the itineraries.[1] The ultimate goal of the project was to enable individuals to make smarter travel decisions, which, in turn, would result in system-wide benefits, including increased transit ridership, decreased traffic congestion, and cleaner air. MMTPS was also intended to serve as a model deployment for other regions considering multimodal trip planners, particularly with respect to the applicability of Intelligent Transportation System (ITS) standards.

In 2004, the United States Department of Transportation's (U.S. DOT) Intelligent Transportation Systems Joint Program Office (ITS JPO) and the Federal Transit Administration (FTA) awarded the Regional Transportation Authority (RTA) of northeastern Illinois funding to develop the MMTPS after a competitive process.

Figure 1: Six-County RTA Region Map

The Regional Transportation Authority of northeastern Illinois (RTA) is responsible for the financial and budget oversight of the Chicago Transit Authority Metra commuter rail and Pace Bus, as well as regional transit planning issues. In 2009 there were 639.5 unlinked passenger trips on the RTA system. The new system developed through this agreement provides regional coverage throughout the six-county RTA region, including the City of Chicago and Cook, DuPage, Lake, McHenry, Kane, and Will Counties.

[1] The decision to add functionality for comparing the environmental impact across trips was made later in the project.

Ultimately, due to a combination of technical and institutional issues, the schedule and final product of this new system diverged from the initial product envisioned. A proprietary end-to-end traveler information solution was procured rather than developing a tool integrating information from local databases, and this product was not developed to be ITS standards compliant. Additionally, because of the long delays in developing the MMTPS software, the trip planning environment has changed significantly from when the project was conceived, which affects the context within which the MMTPS is evaluated.

The objective of this evaluation is to support FTA in its efforts to disseminate knowledge of advanced traveler information technologies within the transit community, in this case focusing on issues associated with multimodal trip planners. This report examines the MMTPS within the context of the current trip planning environment and identifies institutional and technical "lessons learned" from the development process taking the changes described above into consideration. The evaluation findings may be of particular use for transportation agencies, both transit and multimodal, considering providing multimodal trip planning services.

2. METHODOLOGY

The section presents the approach used to generate the findings for this evaluation of the MMTPS project. It contains an overview of how the methodology and focus of the evaluation shifted as the MMTPS project diverged from plans in a way that was no longer compatible with the evaluation plan finalized in February 2006.

The evaluation of the MMTPS project was initially designed to address different aspects of the basic question of whether or not the system provided additional benefits beyond a single mode information system. A total of 25 hypotheses, some quantitative, some qualitative, were developed to address various facets of this question, and methods of evaluation and data sources were specified for each. The five areas of analysis supported by these hypotheses were:

- Identify characteristics and needs of door-to-door multimodal trip planner users to understand what types of travelers use the system
- Identify the types of trips for which a multimodal trip planner is used in contrast to trips planned through the existing transit trip planner
- Assess the effect on transit ridership and mode choice, and factors that influenced or could influence users in their choices
- Evaluate system costs and effects on other agency costs, such as customer service
- Identify technical, standards, and institutional issues and possible solutions, as well as other impacts of the system

The original evaluation goals described above draw heavily on quantitative analysis on site users and rider characteristics to investigate these hypotheses. However, long delays in developing the MMTPS software have led to two major departures from the original assumptions that drove the MMTPS original evaluation plan.

- **Goroo (the product name for the MMTPS website) became a replacement for the RTA's previous trip planner, TripsWeb.** The original evaluation plan called for the two to run simultaneously, with different markets accessing each site. Hypotheses related to user characteristics, user needs, and types of trips for which MMTPS is used largely relied on the comparison between the two.
- **The trip planning environment has changed significantly since the plan was created.** Chicago Transit Authority (CTA) and Metra provide a General Transit Feed Specification (GTFS)-compliant feed to Google, Microsoft Bing Maps, and MapQuest (as well as application developers) for third-party trip-planning services, some of which can be accessed directly from the CTA website. NextBus, a real-time bus arrival information service, is available for the entire CTA network. A number of other traveler information applications for mobile devices are also available. These changes affect the ability to test hypotheses that rely on call center and trip-log information, particularly those on system costs and effects on ridership, as customer information requests now come from a variety of sources outside RTA control/operation.

Additionally, two major design decisions made by the Chicago RTA reduced the usefulness of the project as a demonstration and test of the open, multimodal trip planner concept and the ITS standards.

- **A proprietary end-to-end traveler information solution was procured** rather than building a customized tool to integrate single-mode information from various local databases.
- Advanced Traveler Information System (ATIS) and Transit Communications Interface Profiles Scheduling (TCIP-SCH) standards were used neither in pulling information from data providers nor in providing it to the public. While most data providers do not currently submit standards-compliant data, the site, at present, contains no framework or ability to accept standards-compliant data in the future.

In response to the delays, divergences from the original implementation plan, and changes in the trip planning environment, the evaluation team revised the plan to focus primarily on the fifth evaluation requirement, institutional and technical issues. Additional information about each of the hypotheses, the data collection type, and reasons for any changes can be found in Appendix A. The revised evaluation plan was submitted to the FTA and approved in July 2010. Based on the changes in the trip planning environment noted above, the scope was also expanded to include an assessment of the current trip planning environment and the idea of multimodal trip planners as a tool to influence travel behavior. The revised methodology supports a more qualitative evaluation of the project, primarily drawing from interviews with project staff, staff at supporting and partner agencies, and members of the peer advisory panel. When possible, these descriptions are supported by quantitative analysis, making use of the data gathered for the original evaluation plan.

In 2007, the evaluation team prepared an interim evaluation report to provide an update of project progress during the long development period. The report included some initial data analysis, discussed initial lessons learned, and findings relating to the institutional and technical issues encountered in the design and ongoing development of MMTPS, including the challenges experienced in applying relevant ITS standards. The findings from the interim evaluation informed the interviews and document reviews for this evaluation. A number of them were also expanded and updated in this report.

2.1. Documentation Reviews and Interviews

This evaluation draws substantially on a review of project documentation and communications collected over the planning, development, and implementation phases of the MMTPS. This documentation includes minutes from biweekly status meetings between RTA and the lead developer, peer advisory panel meetings, and correspondence from the duration of the project. Inferences drawn from the other technical assessments, such as the *ITS Standards & Multi-Modal Trip Planner System Draft White Paper* prepared by the RTA, were used in conjunction with these data sources to guide the end-of-project interviews and to enrich the conclusions. Key sources are described in more detail below.

2.1.1. Peer Panel

In support of the operational test of the MMTPS, the evaluation team coordinated the recruitment and participation of a peer advisory panel. The panel, separate from the development process and managed by the Volpe Center, was organized to provide insight and feedback during the course of the project and to facilitate transfer of the technology to other cities. The panel was composed of members representing a cross-section of the international, federal, state, and local transportation communities. A list of peer panel member organizations is available in Appendix B.

During the course of the MMTPS project, there have been eight meetings of the peer advisory panel. Each meeting was held at a project milestone, and for each there was a specific set of topics and a clear agenda to encourage focus on specific issues. The kickoff meeting was in Portland, Oregon in October 2005. The subsequent meetings were held via telephone with the last one held in December 2008. The evaluation team considered a final meeting prior to the report, but a decision was made instead to contact members of the peer panel for individual feedback in conjunction with the final round of interviews to obtain additional information on communication, coordination, and the current trip planning environment.

2.1.2. Interviews

For the evaluation, the team conducted three formal rounds of qualitative interviews: an initial round from December 2005-January 2006, a second round starting in August 2007, and a final round in late 2009/early 2010. Interview questions addressed technical issues, schedule, ITS standards, communication, marketing, and the trip-planning environment. The long duration of the project and changing or discontinued roles of partner agencies made it difficult to maintain contacts and collect relevant, useful information. The evaluation team also encountered difficulty scheduling certain interviews – in particular, final interviews could not be conducted with as many members of the development team as desired. Overall, the responses provided useful project information, insight, and feedback. Table 1: Evaluation Interviews by Round, below, presents the sources interviewed by interview round.

Table 1: Evaluation Interviews by Round

	Initial Round	Second Round	Final Round
RTA	X	X	X
Lead developer (contractor)	X	X	X
Rideshare Services, Chicago Area Transportation Study	X		
Illinois DOT (IDOT)	X	X	X
Center for Neighborhood Technology	X	X	
Subcontractor to lead developer		X	
Standard Parking		X	X
External standards consultant		X	X
Peer advisory panel			X

2.2. User Survey

In 2004, the RTA conducted research on its then-current trip planner, TripsWeb. The survey was also available on the Illinois Department of Transportation (IDOT)'s traveler information website; however, this evaluation uses only those data collected from TripsWeb. This research served as the baseline for analyzing survey data from the MMTPS. A web-based user survey was developed in 2009 to collect detailed information on the needs and characteristics of MMTPS users. The survey was announced on goroo.com on November 19, 2009 and ran through December 14, 2009. In order to intercept users, a graphic appeared on each of the results pages provided by goroo.com.[2] The survey graphic was posted on the results pages in order to ensure that the target population, those planning a trip on goroo.com, was being intercepted (i.e., as opposed to intercepting users who were only obtaining transit schedule information).

The survey was designed to gather feedback from goroo.com users on three key evaluation areas:

- The characteristics and needs of door-to-door multimodal trip planner users to understand what types of travelers use the system
- The types of trips for which a multimodal trip planner is used
- The effect on transit ridership and mode choice and factors that influenced or could influence users in their choices

To address these evaluation topics, questions were designed to provide useful data on the socio-demographic characteristics of users, their patterns of use regarding the website, and trip specific information (e.g., information sought for this trip, expected mode(s) of travel for this trip). In addition to the main survey, a follow-up (Phase II) survey was administered to a subset of the respondents. The purpose of the Phase II survey was to determine whether customers used the itinerary information presented on MMTPS, and if so, whether the tool had an effect on mode choice. Users were also asked to assess the quality of the information they received from the website (based on their experience using the itinerary information on their trip). Both the Phase I and Phase II surveys can be found in Appendix C.

Overall, the survey received 424 responses, and after data cleaning, the final sample size included 406 respondents. The Phase II survey was sent to 252 respondents who indicated their willingness to complete a follow-up survey. The Phase II survey received 121 responses. In this evaluation, the results of the survey mainly inform findings related to the role of multimodal trip planners as a tool to influence travel behavior.

[2] Using a tabular format, goroo provides an average of five to six itineraries (based on different modes), with each itinerary presented on a separate results page. The survey graphic appeared on each of these results pages.

2.3. System Costs

A major driver for the creation of the MMTPS was a desire to lower information dissemination costs (per user and potentially overall) and/or provide greater value for each information dissemination dollar. Over the course of the project, the evaluation team collected information on the cost of developing and operating MMTPS. With the data collected, the evaluation team produced three cost datasets, each at the monthly level, consisting of the average cost per information request to TripsWeb, goroo, and the RTA traveler information call center. These data were calculated based on the following data elements provided by RTA:

- Number of visits to the trip planners
- Call center call volumes
- RTA contracts
- Other miscellaneous cost data

The TripsWeb and call center data date from June 2007 to December 2009 and the goroo data span from May 2009 (month deployed) to December 2009.

Although a benchmarking of project costs was not a primary focus of the evaluation, the evaluation team also sought to collect information on costs incurred by other demonstration projects or peer group members in improving their agencies' traveler information systems. Similarly, as the peer group includes agencies that have joined Google Transit, the evaluation team gathered information from several large and medium-sized transit agencies and regional aggregators on the resources required to provide information through their hosted services and the factors that may influence the level of resources required.

2.4. Trip Log Data Collection

During the course of the evaluation period under the original evaluation plan, the Volpe Center team collected a large quantity of data on the way the public has interacted with RTA trip planning tools. One of the resources collected was the logs on goroo usage that were collected during a study period spanning 6.5 months. (Though the website itself had no logging capability, a subcontractor of RTA's developer was able to recreate the logs by re-running all trip plans – which had been stored by the subcontractor – during overnight downtime.)

The resulting dataset is a rich source of information on how the public interacted with the MMTPS and it can provide valuable useful insight into many questions that are of interest to transit agencies and other transportation researchers. Data elements include:

- Date and time of query
- Date and time of requested trip
- Origin and destination requested
- Modes, routes, and stops recommended in trip planner output

Additionally, the data for the new trip planner capture travel preferences supplied by the user, most notably mode preferences and route optimization method (least time, least cost, etc.).

Due to the changing nature of the evaluation, rather than carry out the analysis envisioned in the original Evaluation Plan for this project the evaluation team produced a technical white paper on the data from the MMTPS logs.

The white paper submitted to FTA is a guide to the MMTPS logs, covering the following topics:

- Design of the MMTPS
- Data structure
- Potential research applications
- Limitations
- Data idiosyncrasies that may affect the importing process
- Privacy concerns associated with publication of the data

As multimodal trip planners become more common, there will be increasing demand for information that agencies can draw on to help inform design and marketing decisions. The MMTPS logs can be a valuable resource for these agencies, as well as others engaged in related research. Furthermore, from the U.S. DOT's perspective, the release of the data will help advance FTA's goal of disseminating knowledge of advanced traveler information technologies within the transit community, which was a major motivation for the MMTPS demonstration project. Releasing this type of data in an open format also aligns with one of the data release and visualization activities under the U.S. DOT's Open Government Initiative.[3]

[3] U.S. Department of Transportation, *Open Government Plan: April 2010 – April 2012*, June 2010, (available at http://www.dot.gov/open/pdf/DOT_Open_Gov_Plan_V1.2_06252010.pdf)

3. MMTPS PROJECT BACKGROUND

In May 2004, the FTA issued a request for proposals (RFP) for an operational test to demonstrate the "technical and institutional feasibility of an integrated, multimodal door-to-door trip planner" that would "demonstrate the integration of existing single mode trip planning through the use of Extensible Markup Language (XML) based on the Society of Automotive Engineers (SAE) Advanced Traveler Information systems (ATIS) Standard (J2354) and the Transit Communications Interface Profiles (TCIP) standards.[4]" The concept behind the system was the integration of transit trip itineraries, driving directions, real-time roadway and transit information into a single, aggregated trip planning tool. The tool was also expected to provide comparative cost and travel time information associated with each itinerary. The MMTPS was also intended to serve as a model deployment for other regions considering multimodal trip planners, particularly with respect to the applicability of the ITS standards. For a variety of reasons, the project diverged from the original development and implementation plan in ways that greatly compromised its usefulness as a demonstration and test of the ITS standards and reusable multimodal trip planner concept. This section provides a brief overview of the project background. A project timeline is available in Appendix D of this report.

The FTA and U.S. DOT ITS JPO selected the RTA and in May 2004 awarded the funding to develop and implement a multimodal trip planner. In October 2004, the RTA and the FTA signed a cooperative agreement for the MMTPS operational test and evaluation. The total project cost was to be $1.35 million with a federal share of 80 percent and an RTA match of 20 percent.

The development of MMTPS was to be divided into three phases:

- Phase 1: Develop core system, with implementation scheduled to be complete by August 2006.
- Phase 2: Expand the MMTPS to include real-time transit information, emissions data, and information on parking conditions. Implementation of phase II was initially scheduled to begin in March 2006, and the system was expected to be operational by December 2006.
- Phase 3: Expand the MMTPS to include data on intercity bus and rail (Greyhound/Amtrak), the Milwaukee County Transit and Northern Indiana Commuter Train District.

At the project inception, the RTA made a commitment to using the Systems Engineering (SE) process to manage the technical development of the project. The SE process flows from broader conceptual issues to more detailed technical considerations and is designed to ensure that all system functions are mapped to, and are necessary to accomplish, a user need.

In 2005, the RTA conducted baseline user research demonstrating the importance of consolidating traveler information. In accordance with the SE process, the RTA then developed

[4] Though not specified in the RFP, this section is referring to the TCIP-SCH

a concept of operations (ConOps) building on this user research. This document was developed in-house by the RTA and provides information on potential users, concept design, proposed interfaces, and conformity to the national ITS Architecture and ITS Standards. The ConOps identified problems that "may impact the feasibility of the proposed approach" to the routing engine. After completion of the ConOps, the next step in the SE process was to develop system requirements. The final Technical Requirements Document (TRD) was delivered in 2006, delayed for two months due to contracting issues related to finding a developer. The MMTPS described in both the ConOps and TRD reflects the system as originally envisioned and as described in the RFP, RTA proposal, and cooperative agreement.

In the next stage of the project, the RTA formally evaluated and compared seven development alternatives that could meet the technical requirements and achieve the business objectives in an objective Alternatives Analysis process to determine the ideal MMTPS solution. The seven alternatives evaluated were:

- Alternative 1: Existing Systems Integration
- Alternative 2: Enhanced Systems Integration
- Alternative 3: Open Source Development
- Alternative 4: Customize Existing Open Source Efforts
- Alternative 5a: Commercial Off-the-shelf (COTS) – HAFAS Itinerary Trip Planner
- Alternative 5b: Commercial Off-the-shelf (COTS) – MENTZ Intermodal Journey Planner
- Alternative 6: Combination

During the summer of 2006, the RTA presented the results of the Alternatives Analysis to stakeholders for review and discussion. The preparation of the alternatives analysis took longer than expected and was one of the biggest single delays setting back the project schedule. This delay was a result of the time it took to gather information from the technical vendors and develop a methodology to evaluate the alternatives while addressing the concerns of a large stakeholder group. Initially the RTA did not anticipate the need to identify a new engine and thought that the trip planner could be integrated with the RTA's Itinerary Planning System (TripsWeb) and Pace's Ridematch 21 System; however, this approach proved not to be a viable solution in the face of the MMTPS technical requirements and fell short of other solutions when alternatives were explored. The alternatives were evaluated based on: capability for meeting trip planning functionality requirements as defined in the TRD; development and deployment schedule; and development, deployment, and maintenance costs.

The alternative selected by the RTA and the federal team was Alternative 5b: COTS- MENTZ Intermodal Journey Planner because it had the highest relative closeness to the ideal solution. Under this alternative, the RTA would procure a proprietary multimodal end-to-end traveler information solution rather than build a tool designed to integrate information from various local databases, as originally envisioned. Because of this outcome, the FTA continued to emphasize the importance of using ITS standards as one of the major goals for this demonstration.

These changes caused the RTA to push back the launch to October 2007. By this point in the development, it appeared that the bulk of the work originally scheduled for Phase II could actually be incorporated into Phase I, and the plan was modified accordingly. The elimination of the "go/no-go" decision that had been scheduled to take place upon completion of Phase I was approved.

Over the course of the project, a number of other organizations were expected to contribute or contributed to the development of the system, including IDOT, the Gary-Chicago-Milwaukee (GCM) Corridor Coalition, the Chicago Area Transportation Study (CATS), University of Illinois – Artificial Intelligence Lab (UIC), and the Center for Neighborhood Technology (CNT). The role of a number of these local supporting and partner agencies was decreased or eliminated when the decision was made to use a COTS product rather than integrating single-mode systems. A list of contributors to the final MMTPS product is available in Appendix E.

In April 2007, the RTA delivered the Detailed Design Plan. At this point, some broad concerns were raised regarding transferability and overall compliance with original project requirements and goals, including the ITS standards. As development progressed, there was a growing concern that the standards were not being used. In February 2008 it became clear that the MMTPS was not standards compliant. The RTA agreed to try to resolve this and in April 2008 outlined the broad steps that would be necessary to integrate the TCIP-SCH and ATIS standards into the MMTPS. These steps were not carried out as a consensus on roles, responsibilities, and who would bear the costs was not reached between the FTA, the RTA, and other project partners. The decision not to use ITS standards will figure centrally in the findings that follow. In September 2010, the RTA submitted a report detailing some problems they identified early in the standards implementation process.

As technical development progressed, there was also an ongoing marketing planning process at the RTA. An early draft marketing plan anticipated an independent marketing campaign for the MMTPS. Rather than market the MMTPS independently, the RTA eventually opted to leverage existing resources through a cross promotion campaign with the RTA's "drive less. live more" (DLLM) effort and contract. In January 2008, the RTA MMTPS team began working with a marketing and publicity consultant the agency had procured to work on DLLM. The RTA selected the name "goroo" for the MMTPS product and worked with the consultant to develop a brand, logo, and identity.

In May 2008, after a one-day soft-launch for stakeholders, it was determined that further testing would be necessary, and the public launch was again delayed. Around this time Google Transit was introduced in Chicago, initially including only CTA routes. A second round of stakeholder testing began in September 2008, and it was determined that additional work would be necessary. In February 2009, the system was again opened to stakeholder review and received mixed feedback. One notable criticism at this point was that the trip planner did not produce results that were favorable enough to transit; however, the intention of the project was not to create results favorable to transit, but to create a mode-neutral product. The RTA remained admirably faithful to modal neutrality both in system development and branding. In April 2009, goroo was made available to the public, but was not officially publicized until the

goroo launch media event in May 2009. The public launch received coverage from the Chicago Tribune, Metro Magazine, and other media.[5]

In the end, development of the core system took more than two-and-a-half years longer than anticipated. The original plan was to expand the system to include real-time transit and highway incident and diversion information, emissions data, and real-time information on parking conditions. These additional features were expected to be operational by December 2006; with the exception of emissions data, which was included in the initial roll-out, none have been implemented to date. Incident information is available as a feed on the goroo home page, but is not integrated with the trip planning functionality. The public parking data module is still on the development roadmap, but due to resource constraints and feature prioritization, the RTA has not pursued this feature. Screenshots of the MMTPS user interface are provided in Appendix F.

[5] Hilkevitch, John, "RTA hopes travelers go along with Goroo", *Chicago Tribune*, May 15, 2009. and "Chicago RTA launches multi-modal trip planner", *Metro Magazine*, July 2009.

4. TRIP PLANNING STATE OF THE PRACTICE

This section provides an overview of changes to the advanced traveler information and trip planning environment during the period when MMTPS was being developed, and seeks to place this project in the context of other past and future trip planning projects. This section provides an overview of the current and evolving trip planning environment through a review of other recent multimodal trip planning developments. The section then highlights three particular changes that have drastically affected how information is provided: real-time information, Google Transit and the GTFS, and mobile traveler information. As we look at these changes, it is also useful to compare system costs for different approaches. This section provides some initial insights on system costs. This report is not an evaluation of these trends, but it is important to note that the availability of these resources has changed users' expectations and values when it comes to trip planning. Despite the vast advances in the state of the practice, however, it is noteworthy that there is not yet a trip planner available in the United States that incorporates all of the elements the MMTPS was envisioned to include.

4.1. The Evolving Trip Planning Environment

Both information technology and the trip planning environment have changed significantly since the early 2000s when the FTA first conceived the idea for an MMTPS demonstration. In 2002, there were approximately 30 existing transit web-based trip planners in the United States – and at least a dozen more in planning or development stages. Of the existing trip planners at the time, eight served multiple agencies.[6] None of these trip planners were multimodal and none incorporated real-time information. The concept of a door-to-door multimodal trip planner that incorporated seamless, comparative, and multi-agency itineraries represented a significant departure and innovation from what existed at project conception. The novelty of the project earned it coverage from media, such as the *Chicago Tribune* and *The Urban Transportation Monitor* at the time of its announcement,[7] At that time, the availability, sophistication, and quality of ATIS and the real-time transit and traffic data that supported them were limited.

Today, all large transit agencies and many medium and even small transit agencies offer trip planning services either through their own website or third-party providers, such as Google Transit, Microsoft Bing Maps, or MapQuest. Google Transit, which was the first of these services, is a service integrated into the mapping products offered by Google, Inc. that provides transit itineraries for participating agencies to users seeking direction between two points. Google Transit was introduced in Chicago for CTA routes in 2007 and now provides multi-

[6] Radin, Sari et al., Trip Planning State of the Practice, Federal Transit Administration, July 2002.

[7] Groark, Virginia, "Trip-planning help en route", *Chicago Tribune*, June 9, 2005. and "Chicago's RTA, IDOT to Develop First Web-Based Multimodal Trip Planner in U.S.", *Urban Transportation Monitor*, June 24, 2005.

agency transit directions for the CTA and Metra (but not Pace Bus), as well as bicycle directions; however, it does not plan drive-to-transit or bike-to-transit trips. On the CTA website a traveler can opt to either plan a trip through Google Transit or goroo. This trend has been augmented by both the growth of "smartphones" (approximately one-third of U.S. mobile subscribers own smartphones that run full operating systems[8]) and the growing number of transit agencies that provide real-time and static data feeds for use by third-party developers to create web and mobile applications. Regardless of the approach, there is a premium on accurate, timely, well-structured data and common data and interface standards and protocols.

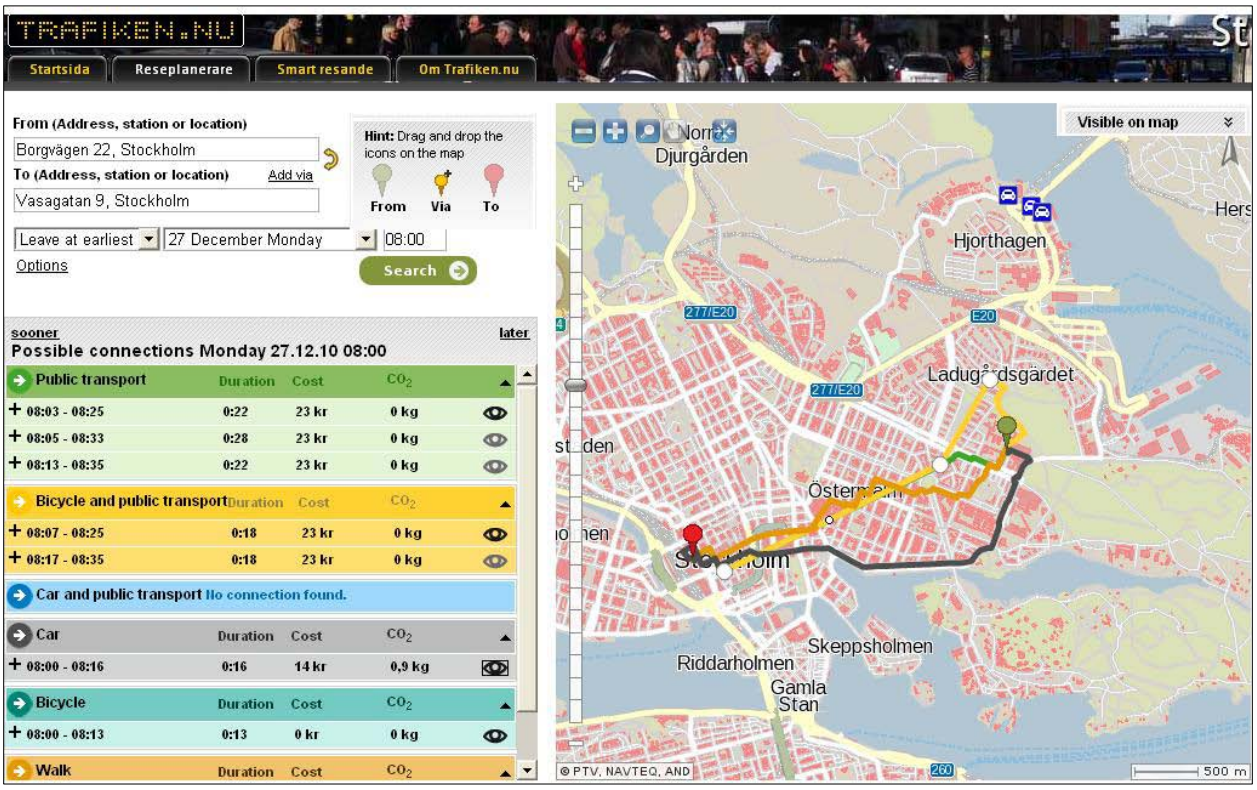
One trend apparent in new trip planners is that they provide aggregated information from a number of different transit agencies. For example, the Metropolitan Transportation Commission (MTC) 511 trip planner provides information from 35 transit agencies within the San Francisco Bay Area region. Large metropolitan areas with multiple transit agencies and modes may want to offer a more customized product that provides extra features beyond what may be possible through either individual agency development or a service like Google Transit. In these cases, regional, multimodal transportation coordinating bodies or a collaborative partnership among a number of regional entities may be in the best position and have more resources to create a seamless, region-wide trip planner.

Stockholm's journey planner, a collaboration between the City of Stockholm, Stockholm Public Transport, and the Swedish Road Administration,[9] allows users to plan and compare the time, cost, and environmental impact of trips for transit, car, bike, and walking, as well as combinations of those modes such as bike to transit or drive to transit. The planner also gives users the options to plan trips for departure or arrival at a specified time, and also provides a "plan commute" option. Rejseplanen, the Danish multimodal trip planner, also includes a map with the number of spots and average occupancy of park-and-ride locations.

[8] "U.S. Smartphone Battle Heats Up: Which is the 'Most Desired' Operating System?" Nielsen News, December 1, 2010. Accessed December 7, 2010. http://blog.nielsen.com/nielsenwire/online_mobile/us-smartphone-battle-heats-up/

[9] Available at http://reseplanerare.trafiken.nu/bin/query.exe/en?

Figure 2: Screenshot of Trafiken.nu Journey Planner



Multimodal trip planners that feature both driving and public transit appear to be more common internationally, particularly in Europe. In the United Kingdom, Transport Direct's Journey Planner provides customizable user preference options and allows comparison of time, cost, and carbon dioxide (CO_2) emissions for public transportation and automobile trips.[10] A separate feature allows users to plan bicycle trips in certain locations within the United Kingdom. Advanced options are available and users can customize this feature by "quietest," "quickest," or "most recreational."

Another recent European traveler information and trip planning project is the Intermodal and Interoperable Travel Management System for European Cities (In-Time), a three-year demonstration project with 22 partners, coordinated by AustriaTech. In-Time held a launch event in January 2011 in Vienna, Austria to present project information and achievements, as well as models for the six pilot cities. The goal of the project is the implementation of a standardized, interoperable, real-time traveler information system across Europe. The three components of the project are pre-trip information, mid-trip information, and traffic management and operation. The pre-trip component will provide web-based interoperable information on a number of modes and itineraries.

[10] Available at http://www.transportdirect.info/Web2/Home.aspx?repeatingloop=Y

In the United States, a few transportation agencies, including the MTC in the San Francisco Bay area and TriMet in the Portland, Oregon region, are actively developing their own multimodal trip planners. The MTC plans to add turn-by-turn trip plans and directions, as well as cost comparisons, to the extent possible, for transit, driving, and drive-to-transit. Phase I, as of the finalization of this evaluation, expected to be completed in summer 2011, will include static transit schedule information, historic average speeds for certain road segments, and cost comparison. The MTC also plans to make available map layers, such as traffic condition displays from 511, regional rail line stations and ferry and bus terminal locations, and parking locations applicable to drive-to-transit trips. The plan for parking information is to include static information on park and ride and transit agency lots, as well as larger parking structures within a half-mile walking radius of transit stations. The ability to provide further information is limited by the large number of parking lots in the region and the lack of comprehensive updated electronic pricing information. The MTC discussed this approach with the RTA, who confirmed this was likely the only feasible approach. A year after Phase I, the MTC plans to incorporate CO_2 emissions, as well as some degree of real-time traffic and transit information, and a small amount of real time parking information for drive-to-transit trips, into the trip planning.

Although there may be movement towards a more open trip planning environment, agencies currently developing or replacing trip planners still show a mix between open source systems and customized, individually ordered proprietary systems. For its new system, the MTC made the decision to not develop a whole new product, but rather to build on its existing 511 trip planner with more focus on map interactivity. For the mapping portion, the MTC explored external mapping application programming interfaces (APIs) including open source mapping applications, but decided to continue using their current ArcGIS/TeleAtlas system, because there is already institutional experience. A number of agencies or regions provide multiple services. Fresno's main transit system, FAX, is on Google Transit, but to go beyond functions available through Google Transit, the agency is also using COTS software to develop a regional trip planning service that includes interactive voice recognition and real-time bus arrival system. The development of a replicable, multimodal, regionally integrated trip planner, initially envisioned for the MMTPS, is now being used by TriMet in Portland, Oregon through OpenTripPlanner, an open source multimodal trip planner.[11]

4.1.1. Real-Time Data

During the development and implementation of the MMTPS, the provision of traveler information experienced rapid change and growth, particularly with respect to real-time information. Transportation professionals hope that providing travelers with information, such as congestion levels, parking availability, next bus or train arrival, or hazardous condition

[11] The TriMet OpenTripPlanner demonstration page is available at http://maps5.trimet.org/otp/. A public beta is scheduled for spring 2011. Although the functionality is available, the alpha demonstration does not include does not include driving directions.

warnings will encourage them to make more informed and interactive travel decisions with respect to mode and route choice. The expected benefits include avoided waiting time for delays, reduced travel time unreliability from allowing travelers to make informed decisions, and faster travel time based on the ability to take alternative routes.

A major change in real-time transit information that occurred during the project was the development and expansion of the use of a global positioning system (GPS) to provide customers with locations and estimated arrival times of buses. Products such as NextBus and WebWatch now provide this service for dozens of transit agencies and university transportation systems. In Chicago, the CTA Bus Tracker service now provides information for all of its routes. Other large metropolitan transit agencies that provide system-wide real-time bus arrival information include the Massachusetts Bay Transportation Authority (Boston), Washington Metropolitan Area Transit Authority (Washington DC), and Muni (San Francisco). Large transit agencies, such as the Southeastern Pennsylvania Transportation Authority (Philadelphia) and the Metropolitan Transportation Authority (New York), are working towards implementation. For highways, data increasingly available include real-time traffic data for both highways and urban arterials. Other applications in which real-time data are used, though less widely, include variable message signs, ramp meters, adaptive signal controls, and automated vehicle location/computer-aided dispatch systems.

Although advances have been made in the provision of real-time information for transit, there are still technical and financial limitations. In order to realize the benefits of real-time information, it needs to be available, accurate, reliable, consistent, timely, and easily accessible. Achieving a high level of data quality remains particularly difficult and expensive for urban arterials.

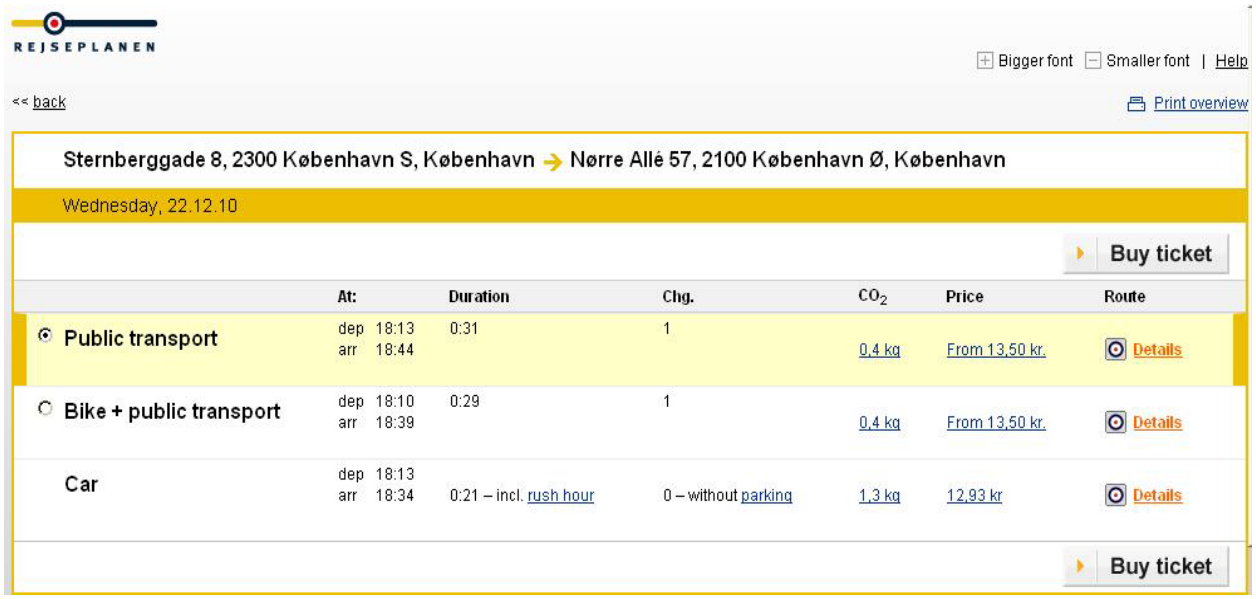
Neither real-time traffic nor transit information was ultimately incorporated into the MMTPS trip planning functionality as initially anticipated. Real-time transit incidents, traffic incidents, and special event/emergency data are available only as a feed on the home page. The RTA was not able to form a partnership as they had hoped to with the IDOT for gathering arterial transit information. Although some progress has been made in introducing real-time information in to transit trip planning, in the trip planners reviewed, most transit trip planning systems are based on static schedules and itineraries generated are not dynamically responding to transit or traffic delays.[12,] The discussion below focuses on some examples of trip planners that seek to incorporate real-time information.

The Transport Direct Journey Planner in the United Kingdom, Stockholm's Trafiken.nu, and the Danish Rejseplanen do not take real-time information into account when producing transit or driving itineraries; however, they do take expected traffic levels based on historic data into

[12] J. Q. Li, K. Zhou, L.P. Zhang, W.B. Zhang, A Multi-modal Trip Planning System Incorporating Park-and-Ride Mode, Real-time Traffic/Transit Information and Customized Alerting Methods, ITS World Congress 2010.

account for a more realistic presentation. One member of the peer advisory panel offered to provide technical assistance to the RTA on incorporating this feature. The Journey Planner website also provides a feed of current and planned incidents and events updated every 15 minutes, and the rail timetables include planned changes.

Figure 3: Screenshot of Denmark's Rejseplanen



Those trip planning services that do incorporate real-time information do so only for certain modes and do not include driving information or itineraries. For example, SCOTTY, the door-to-door route planner provided by Österreichische Bundesbahnen (ÖBB), the national railway system of Austria, for all public transport services across Austria includes real-time information for ÖBB trains in calculating optimal itineraries.[13]

Attempts to fully integrate real-time transit and traffic information for trip planning web- and mobile-based applications are still largely in early development stages. Researchers at the University of California at Berkeley developed PATH2Go, a web-based multimodal trip planning tool that allows travelers to plan and compare the cost, time, and carbon footprint of trips using any combination of driving and/or transit along the 101 corridor in the San Francisco Bay Area. The service also provided real-time parking information for Caltrans Park-and-Ride lots. In partnership with a number of federal, state, regional, and private partners, a field test took place from August 2010 to November 2010.[14]

[13] Available at http://www.oebb.at/en/index.jsp

[14] L.P. Zhang, et al., Design and Implementation of a Traveler Information Tool with Integrated Real-time Transit Information and Multi-modal Trip Planning, Accepted by TRB Annual Meeting, 2011. Available at http://www.networkedtraveler.org/nttrb.pdf

In addition to reliability concerns, another challenge with real-time information is that not all users are planning a journey they are planning to take immediately, so information that includes a temporary diversion would not necessarily provide the optimal route for a trip at some unspecified date. Also, by definition, real-time information changes during the journey; this underscores the importance of making information available for mobile devices so travelers can monitor information as the trip progresses to maximize the usefulness of the information. It is important, however, that this information does not create a distraction for drivers. To overcome this, services that incorporate real-time information into trip calculations must also provide the ability to deselect this feature to allow for a hypothetical or future trip to be planned.

4.1.2. Google Transit and GTFS

One of the major changes that occurred as the MMTPS project was ongoing was the development of what is now the GTFS. Google Transit launched in Portland in December 2005 utilizing data submitted to them in a particular specification, GTFS (then Google Transit Feed Specification), a standardized data format for public transit schedules and route information developed and controlled by Google. The specification was later open sourced and is now maintained by a community of interest. Although Google Transit was the original application, Google is now just one application developer at this point. Because it is an open source specification, anyone can create an application that reads GTFS-type data. To encourage the use of the data, a number of transit agencies provide GTFS feeds for developers along with resources to facilitate their use. There are a number of other resources available as well, for example, the TimeTablePublisher is a system that creates timetables for the public using GTFS data.[15]

The information provided by the agencies consists of a series of comma-separated files that contain data on the agency, stops, routes, trips, stop times, and calendars. This can be supplemented with additional files containing rules on calendar exceptions, general fare attributes, fare rules, map shapes, frequencies/headways, and transfers. The feed specification does not contain other useful information for trip planning, such as accessibility. The cost of providing this information is discussed in greater detail below. To provide trip planning services through Google Transit, agencies must not only develop a feed, but also come to an agreement with Google and upload their data to Google Transit servers for use, rather than Google Transit pulling from the public feed. Although Google Transit may provide itineraries across multiple transit agencies, it is not a function of GTFS, but rather of Google's routing algorithm. The routing engine will route across any/all transit modes/providers submitting a feed to them.

In the past several years, GTFS has become a common specification for transit schedule data; Google claims 448 worldwide cities on their planner, including approximately 125 in the United

[15] Additional information on TimeTablePublisher available at http://code.google.com/p/timetablepublisher/.

States. Other agencies beyond this list may have GTFS data, but not have submitted it to Google. Third-party developers have created many “apps” for the web and phones designed to use GTFS data, which means that an application designed for users of one agency can be easily adapted for others. Other services that use GTFS include Bing Maps and OpenTripPlanner. While the number of “apps” is growing, most third parties are not trying to provide region-wide trip planning with these data; they are making specialized or niche apps or conducting research. Despite the gains that have been made through the proliferation of GTFS, one of the recognized shortcomings is that it only provides static information. Another potential shortfall may be limited agency resources for updating and maintaining the static information. Some agencies don’t have the resources to update the information on a regular basis, and the information may become outdated. However, if GTFS is revised for real-time, it could transform the trip planning environment by moving trip planning towards more real-time integration.

4.1.3. Mobile Traveler Information

Both real-time information and open source development have reinforced the development of mobile applications. Mobile devices, particularly smartphones, are in turn playing an increasing role in the dissemination of traveler information. To supplement traditional traveler information distribution channels, a growing number of transit and other transportation agencies are developing or making their data available to third parties to develop mobile apps for riders. These data feeds can also be useful in providing apps for desktops and non-mobile sources. Agencies facilitate their development by providing resources for developers. Massachusetts Department of Transportation, for example, provides resources for developers interested in working with the static and real-time data available for transit, highway, registry of motor vehicles, and other planning data. In Chicago, the CTA provides a Developer Center with resources for developing traveler information tools. Apps also exist for information on Metra and Pace Bus service. One of the concerns with this approach is that not all travelers have smartphones, so the information should also be accessible in other forms.

In light of efforts to prevent distracted driving, there are also some concerns about the presentation and use of mobile applications. To address this concern in the PATH2Go project, "geofencing" was incorporated to prevent the PATH2Go mobile application from being used when used on the corridor. When this is detected, the warning "Application Disabled while Driving" was to be displayed, though it is unclear how, if at all, a distinction is made between a driver or passenger using the application.

4.2. System Costs

One of the goals of the MMTPS was a desire to lower information dissemination costs (per user and potentially overall) and/or provide greater value for each information dissemination dollar. By providing truly multi-modal, real-time information, the MMTPS could be a single source of information for area travelers. This could reduce the cost per information request by shifting users from high-cost information methods (e.g., the staffed call-center) to low-cost methods, and by potentially increasing the market for traveler information such that fixed-cost inputs can be spread over a larger number of customers. While there is the possibility that the greater

number of users would make up for the lower cost per user, increasing costs overall, it would still represent an increase in the value of each traveler information dollar spent.

The difficulties in developing the MMTPS following the original plan of "knitted together" databases negated some of the expected reduction of costs. That is, the larger than expected development costs due to developing a new, replacement system may have ended up increasing average costs, even if people have shifted to lower-cost methods.

The situation was further complicated by the introduction of Google Transit, as described above, as an information provider in the Chicago area. As the trip-planning information lives "in the cloud," that is, the data and trip-planning engine are stored and operated by an "always-on" third-party provider, marginal cost to the agencies is zero, but there is still a recurring cost of providing the data to Google itself.

The cost of developing a trip planner varies with the starting investment level of an agency and the ultimate complexity of the project. Starting without the data development work completed can add significant expense; conversely, agencies that already have consolidated, standardized databases will face much lower upfront costs.[16] Regional trip planners like the MMTPS shift the cost to regional organizations, which could make it more feasible for smaller agencies to be included in a more dynamic, multimodal trip planner. This, of course, could change based on evolution in GTFS.

As shown in Table 2, the development cost for the MMTPS is estimated to be $4,187,800, 96% of which consists of the development contract. Marketing costs are not included in this total, with one exception, because the goroo team received the services of a marketing consultant the RTA procured for the DLLM campaign. A search engine optimization (SEO) expert was separately contracted by the goroo team and is included below. Furthermore, the cost of the labor expended by RTA staff is not included in this table, as the RTA was unable to provide an estimate.

Table 2: Approximate Development Costs for MMTPS

Expense item	Cost
Development contract + trip planning engine procurement	$4,000,000
Focus group research	$39,300
Initial user research study (performed prior to designing system)	$100,500
Search engine optimization (SEO)	$48,000
Total[17]	$4,187,800

[16] No nation-wide or region to region standard on database design exists; however, prior investment in a single database containing all agency information in a standardized format would lower the expected cost of developing a multimodal trip planner.

[17] Excludes non-SEO marketing expenditures.

Based on future web volumes and using an approximation of a 10-year lifespan and averaging the development cost evenly over this period, the cost per goroo visit was $0.23 (21.6 cents development + 1.2 cents operations and maintenance), assuming 19.4 million visits over 10 years extrapolated from the study period). Agencies planning on developing multimodal trip planners can re-create this estimate using their own development costs and expected lifespan.

The MTC estimates the cost to develop its multimodal trip planner, including licensing, development, and rollout budget to be roughly $2 million, including 6 months of maintenance. This estimate does not include a recent trip planning engine upgrade that prepared the existing 511 trip planning system for multimodal integration. For an alpha product on OpenTripPlanner, TriMet estimates an initial investment of $69,000 for developer time and another approximately $69,000 for a routing engine and interface. For TriMet, there is no new significant cost to develop a data feed for OpenTripPlanner as the initial work to develop the feed has already been created. While the system is capable of providing driving directions, it should be noted that no demonstration of OpenTripPlanner, including TriMet's, includes this feature.

Before alternatives such as those described above were available, each individual agency had to develop or procure a trip planner, requiring the agency to engage in web design and other related costly, resource-intensive activities. This approach limited the ability of smaller or budget-restricted agencies to offer trip planners. Multimodal planners faced the additional difficulty of requiring transit agencies to procure or develop high-quality road network data, as well as a routing algorithm that can provide driving directions. The Chicago RTA already had possession of a high-quality base map, but this element can raise costs for other agencies.

The advent of alternatives such as Google Transit, Bing Maps, MapQuest, and open source products, such as OpenTripPlanner has lowered costs, as small agencies may offer trip planning services without having to procure a full trip planner.[18] However, many large and some medium agencies continue to see benefit in continuing to maintain their own trip planners as they can provide amenities or features that Google does not.

Although worldwide trip planning providers such as Bing and Google reduce the cost of providing trip planning services, there is still some cost to develop and maintain a static data feed of transit data and for regional transit authorities to maintain regional feeds. Using these services requires an initial investment of developing a GTFS feed. Transit agencies estimated this effort to require anywhere from 12 hours to two person-months. The main factors affecting the development cost are the quality of existing databases and the compatibility of the operations scheduling software. If an agency does not have scheduling software or its scheduling software is not GTFS-compliant, it will have to custom build a GTFS output and

[18] MapQuest released walking directions and transit information in New York City, Washington DC, Chicago, San Francisco, Philadelphia, and Boston in February 2011.

maintenance tool. Agencies using older versions of scheduling software may have to develop an intermediate database; one large agency reported using Access for this process, though smaller agencies may be able to develop this information in a spreadsheet. The cost is lower for agencies that have newer versions or modules of scheduling software that output data directly in GTFS, though this output may still need some adjustment for any agency-specific issues. The level of effort required to maintain the feed once it is created is relatively minor. Two agencies reported approximately 30 minutes for each update (usually quarterly). One large metropolitan transit agency estimates three person days of an ITS coordinator's time for each quarterly update, plus an additional four days per year for addressing problems or abnormalities. After upcoming planned modifications to its scheduling software, the agency expects this estimate to be reduced by half.

For a regional consolidator of information, the cost and level of effort are greater. One state DOT reported that their consultant calculates the price to create GTFS data at $325 per agency, $7.50 per stop, and $450 per route (this basic scheme may be adjusted up to account for complex fares, difficult to locate stops, or other complexities). For this service, annual maintenance is calculated at 35 percent of the creation cost plus $300 per agency. A regional consolidator interviewed for the evaluation reported that the data it receives from agencies come in a number of formats, some of which use an XML tool the regional entity provides to standardize the format of their output. The information is then read into a regional database. For smaller agencies, it was reported to be a mix of semi-manual work and custom programming utilities to convert their formats to be read into the regional database. The data output comes from converting this regional data that is in one format into a backend Oracle database, then into GTFS. When any of the agencies change their data it must then be read into the standardized database format, and then updated by writing it out in GTFS from the regional database.

5. FINDINGS

This section includes key findings on institutional and technical issues related to the development of the MMPTS. The findings center on the technical, institutional, and standards-related issues that affected the design, development, operation, and public usage of the MMTPS.

5.1. Institutional Issues

The departure of the MMTPS from the original product envisioned in 2005 resulted in an increased focus in this evaluation on the institutional issues that affected the design, development, operation, and public usage of the MMTPS. Particular areas of focus are project management, systems engineering, the role of the peer advisory panel, and the marketing campaign.

5.1.1. Project Management and Systems Engineering

The MMTPS project provides an opportunity to understand some of the common project management and systems engineering pitfalls that can be encountered during a technology demonstration project.

First, it is paramount to remember that research and demonstration projects are designed to try out new technologies and methods to accomplish the project goals. As a result, many, if not most, demonstration projects will fail to achieve the goals or, even if they do, will do so in a way that may not become "best practice." Aborting a project then does *not* represent a failure of the research and/or demonstration program. The fundamental purpose of projects like the MMTPS is to test out new ideas, and it should be expected that some well-conceived ideas will not come to fruition. All levels of management and a project team should consider this as new ideas move forward. Recognizing the nature of technology demonstrations and creating a culture where making appropriate decisions, even if that decision is to terminate a project, will help encourage optimal investment of agency funds.

Because of the nature of research and demonstration projects, project management activities need to be designed to frequently benchmark project progress against goals with criteria for deciding when technology, project progress, or the general environment have rendered a project no longer worth continuing. This was not sufficiently addressed in the MMTPS project management plan and schedule. Three particular issues that provide useful examples of the ideas above arose in the MMTPS project. These three issues that provided an opportunity to evaluate project progress but were not utilized are as follows:

- The use of go/no-go decision gates
- The changing nature of the trip-planning environment, notably the introduction of Google Transit
- The unanticipated technical complexity of the project

These issues are discussed in detail in this section.

Incorporating Decision Gates into Project Schedules

The MMTPS was initially to be deployed in two phases, with a go/no-go decision to be made following Phase I. The COTS solution made it more likely that the two phases could be deployed simultaneously. This acceleration in project completion was welcomed, but unintentionally introducing a systemic flaw into the project management process. Given the lack of phasing, there was no need for a go/no-go decision between the two phases and this gate was removed from the project plan. However, no gates were added back to the plan, and the MMTPS project was now on a course to continue to project completion, regardless of how it would proceed from this point forward. This is not to say, of course, that the project *would* or even necessarily *should* have been stopped. However, a frank conversation of the marginal benefit to continuing the project would have helped focus all stakeholders as to the value of remaining project activities and how well they serve user needs and the demonstration program goals.

Regular decision gates would have also allowed a conversation about the changing trip planning environment. The COTS solution made the most sense at the time it was selected. However, in the time between the alternatives analysis and eventual deployment, CTA and Metra created GTFS feeds and submitted them to Google Transit (and later, Bing Maps and MapQuest). This change, particularly if additional support could have been given to PACE to create their own feed, reduced the need for a COTS product and made something more like the original project idea more feasible. Again, it is difficult to know retrospectively if the best decision would have been to cancel the COTS project and start again on a GTFS-based project, but it would likely have been a worthwhile conversation, particularly given the encountered difficulties with the TCIP-SCH standards and the eventual development of the OpenTripPlanner using this philosophy.

Changing Trip Planning Environment

Over the course of the project, the environment in which the MMTPS project existed changed dramatically. For example, when the project was conceived, maps were rarely featured on trip planning websites and were static, rather than interactive, sometimes as cumbersome PDF files when present. Major international driving direction websites (such as Google Maps, Microsoft MSN/Live/Bing Maps, MapQuest, etc.) did not provide transit information, and planners that could provide itineraries across multiple transit providers were extraordinarily rare.

As the changes described in the Trip Planning State of the Practice section of this report occurred in the broader environment, the MMTPS project needed to adapt. In some cases, such as mapping, it was decided to broaden the scope of the project to include this feature, at the expense of additional development time and effort. In other cases, such as the emergence of Google as a destination for transit users and its ability to provide multi-agency directions, additional conversation about the MMTPS role in the trip planning environment may have been warranted. In general, the entry of competitors to the market of providing single-source multi-agency transit directions was seen as confirmation that the project was worthwhile and as reason to continue to push ahead in the project. Furthermore, the comparison between the potential capabilities of the MMTPS and Google Transit further encouraged the project team to continue without further course corrections.

It should be clearly stated that Google Transit and the MMTPS, while similar on the surface, had key differences in the intended feature sets, some of which have since been added by the other, or have proven infeasible to integrate into the MMTPS. Foremost, the MMTPS provides true door-to-door directions across combinations of modes, including drive-to-transit. Google does provide both driving and transit directions, though not quite head-to-head, though as of April 2011, in some areas, Google Transit does suggest alternative modes for travelers, including suggesting transit to drivers, who specify one mode for a better or comparable option based on travel times and transit availability. Also, in the last year, some transit itineraries will now suggest "drive/taxi" to transit. This feature has not been advertised feature and does not specifically include park-and-ride information, as the MMTPS intended to do. The MMTPS also supports advanced search functions, allowing users to define which modes they would be willing to take, maximum walking distance, accessibility needs, and preferred optimization (time, transfers, walking). For agencies with mixed accessibility across services and stations, this is an important difference.[19]

As project time and cost continued to mount, Google Transit added additional agencies, refined its feature set, and subsequently open-sourced the underlying specification, GTFS (described above). While there remained (and remains) notable differences between the feature sets of the two sites, the project team did not re-evaluate whether the margin between the MMTPS and Google Transit remained wide enough to warrant the continued commitment of resources. In fact, the one place the project plan had allowed for this conversation, the go/no-go decision, was removed from the project plan.

Project Complexity

As a demonstration project, the MMTPS was to utilize various new technologies and to combine existing technologies in novel ways. As a result, the project carried risks above and beyond traditional technology deployments. A careful balance must be struck in advance of such projects to determine how much risk the project can tolerate in order to balance usefulness/novelty of the demonstration and the likelihood of producing a useable product. Furthermore, the project team must set out criteria for understanding when a project should continue and when it should be stopped, and a clear timetable for when such decisions should happen.

It is important to note that a project aborted before completion need not represent a failure of the project or the team, and can likely provide significant feedback about the usefulness of an idea or process. The project may also be a useful indicator of how one may choose to go about pursuing another attempt to fulfill the same user needs with a different project structure or product. The MMTPS project serves as a perfect example of such a case. The original concept and plan were to knit together various disparate planning and information systems into a single

[19] Some of these features were added to Google Transit in December 2010.

source for travelers to get pre-trip information. Upon project initiation, it was discovered that the database formats and communication techniques were difficult, if not impossible, to adapt in a simple system. At the time, this in itself was useful feedback about the current state of transit and traveler information systems.

The RTA then conducted an alternatives analysis to determine the most effective way to address the user needs, considering various in-house alternatives and purchasing a COTS system. The RTA, with Federal approval, adopted the latter option. While this option had significant potential to fulfill local traveler user needs, the team did not fully consider its continued utility as a demonstration project. That is, what would other cities/regions learn from this specific deployment and how would a COTS solution affect the likelihood of getting useful feedback about ATIS and TCIP-SCH standards? This question highlights one of the tradeoffs faced between mere completion of the MMTPS versus strict adherence to other project objectives such as transferability and demonstration of the ITS standards.

Adherence to the Systems Engineering Process

At the project inception, the RTA made a commitment to using the SE process to manage the technical development of the project. While the SE process can add significantly to the effort required prior to "breaking ground" and writing code, it will, by design, ensure that all system functions are mapped to, and necessary to accomplish, a user need.

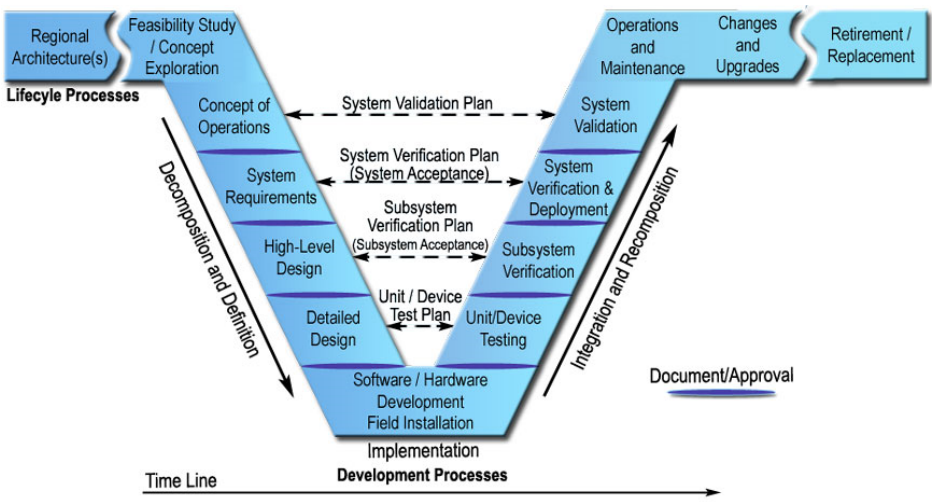
The International Council on Systems Engineering defines SE as:

> an engineering discipline whose responsibility is creating and executing an interdisciplinary process to ensure that the customer and stakeholder's needs are satisfied in a high quality, trustworthy, cost efficient and schedule compliant manner throughout a system's entire life cycle. (International Council on Systems Engineering, "A Consensus of the INCOSE Fellows," http://www.incose.org/practice/fellowsconsensus.aspx)

The SE process is often represented by the "V" model shown in Figure 4.

Figure 4: Systems Engineering Process[20]

[20] Federal Highway Administration, Systems Engineering for Intelligent Transportation Systems, January 2007. Available at http://www.ops.fhwa.dot.gov/publications/seitsguide/section3.htm



Vertically, note that the higher-level elements deal with broader conceptual issues, while the lower-level elements deal with more detailed technical considerations. Also important to note is that the horizontal arrows indicate that each element on the right side is intended as a form of test or verification of the corresponding left-side component. In other words, the right side of the "V" is intended to ensure that the final product has achieved the goals and requirements defined on the left side.

The RTA delivered a Concept of Operations, which then fed the development of a Detailed Design Plan. However, once it was agreed to use a COTS provider of a trip-planning engine, the drive to use the SE process diminished. To the degree that the process continued, it became less central to the Federal/RTA communication and deliverable review activities.

The lack of a continued SE process led to difficulties in tasks that would be considered the "backside" of the SE "V." Most notably, failure to continue the SE process resulted in a system acceptance and verification plan that focused on technical functionality rather than user needs.[21] The RTA relied on their systems integrator to develop an acceptance plan, and the resulting plan did, in fact, verify that each individual website component (links, buttons, automated emails, etc) functioned as intended. Tests were conducted on some individual system requirements (e.g., user preferences about icons and location of information on pages, site accessibility, server loads, etc.). However, no one took on the responsibility to create an integrated system validation plan focused on user needs. This may be due to delegation of SE activities to a developer who was not involved in the initial identification of user needs and an insufficient focus on these user needs as a continual driver of project activities. As a result, it

[21] At one point, the RTA did bring in call-center operators to test a number of trip routes. This test did have criteria for acceptability, but was not formally tied to the ConOps, System Requirements, or User Needs. Furthermore, this test was limited to a couple dozen routes.

was not until an attempted site launch that it was revealed that the site failed to provide useful and/or superior itineraries.

From that point it was another year before the site was actually launched. It is probable that if the developer had more clearly defined system acceptance goals tied to user needs, the initial failure to accept could have been avoided, or at least the additional time to correct for user experience issues could have been reduced. It is also important to note that in order for user needs to be an effective guide throughout the systems engineering process, the SE documentation should articulate them clearly and concisely, in a separate and prominently featured section.

Incorporating Risk

The original federal plan did anticipate many of the difficulties that arose that have been described in this evaluation. The project RFP notes, "Due to limited funding, anticipated technical and institutional challenges, and the complexity of the envisioned multimodal trip planning system in general, the FTA realizes that the operational test may not be able to fully achieve the visions described above." As an attempt to control for these risks, the process began with a commitment to the SE process and included the decision gates that would ultimately be eliminated.

A risk management process, such as a risk management plan with updates, identification of trigger points, and regular meetings on contingency plans could have reduced the risk of undesirable outcomes. However, without sufficient plans in place, the project was allowed to be completed, but not always along the best route, or gathering the most useful feedback for research and demonstration purposes. A clear demonstration of this was the failure to use ITS standards in the development of the MMTPS, notably TCIP-SCH. The MMTPS was initially envisioned as a flagship rollout of the communication standards and the additional utility they would provide. However, throughout the process, the standards ran into technical problems (see ITS Standards section, (below) and the lack of effective communication between project partners and the federal team diminished the usefulness of the feedback to the standards process and the federal standards setting effort. One possible approach would have been to emphasize that if standards proved truly unviable despite a good faith effort to apply them (including attempts at marginal modifications or additions), then a white paper explaining the standards' shortcomings could be a sufficient, reasonable, and valuable product. By loosening its insistence on standards implementation in this way, the federal team may then have been able to engage the RTA (and ideally its contractor) in a forthright conversation on the substance of the difficulties it was experiencing. The lack of such a conversation limited the ability of the team to gain useful feedback, and thus to advance the effort of better, easier, and cheaper ATIS. The insistence of federal players, both inside and outside the project, that the TCIP-SCH standards *must* be adopted reduced the ability of the Chicago RTA, local partners, and others to feel that critical or even constructive feedback about experience with TCIP-SCH standards would be received, much less appreciated and acted upon.

It is potentially for this reason that the RTA did not reveal the lack of standards implementation in the goroo product and did not provide constructive feedback about the difficulties in

implementing the standards (the RTA ITS Standards Whitepaper) until nearly a year after site deployment. It should be noted that the TCIP-SCH standards have not yet been widely adopted in the development of traveler information systems. One of the exceptions the evaluation team was able to confirm is the Orlando LYNX TCIP Traveler information pilot, which provided bus locations, advertising, and other information at the LYNX Central Station in Orlando. This pilot included functionalities such as importing Trapeze Geographic Information System and schedule data and converting to TCIP for use in file transfers, importing vehicle assignments and converting to TCIP for real-time use, and provides TCIP bus location and map updates in near real-time. Several other cases exist where TCIP is listed as a requirement in an RFP or project proposal.[22]

Despite these revealed difficulties, the federal team maintained absolute adherence to the requirement for implementation of the TCIP standard, rather than exploring other potential options. For example, it may have been a greater benefit to the overall federal standards-setting effort to have received the RTA ITS Standards White Paper in 2008 when Chicago RTA first identified difficulties in implementing the standards, even if it meant allowing the MMTPS to continue without using the standards. There are, of course, other options the federal team may have considered including everything from fixing problems in the standards before continuing the MMTPS project to stopping the MMTPS at that point. It is unclear in retrospect what the federal team would have chosen, but it is probable that at least having the conversation would have likely improved project outputs.

5.1.2. Communication and Coordination

Communication and coordination between project partners is central to the success of a project. As the project lead, the RTA was responsible for facilitating communication between all entities involved in the development of MMTPS. The RTA reported that it held biweekly status meetings with the lead developer.

In addition to the lead agencies involved, there were a number of project partners in an external collaboration role. Maintaining communication with these partners and providing them with periodic updates on the progress of the project were important since regular communication helps keep contacts involved and facilitates future communication. Overall, these partners reported in interviews that they were satisfied with the level of communication, though some expressed that they would have liked to receive more regular updates and communication, either about the project as a whole, or on their specific areas of involvement or expertise.

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[22] Okunieff, Paula, "TCIP Transit Standards, Status and Applications," Proceedings: National Institute of Standards and Technology, Centrum dopravního výzkumu, v.v.i. Workshop on Intelligent Transportation Systems, Prague, Czech Republic (September 29-October 1, 2010). Available at http://gsi.nist.gov/global/docs/sit/2010/its/PollyThursAM.pdf

Communication with partners is particularly important at project milestones. Other factors that contributed to strong interagency communication and cooperation included maintaining detailed documentation of project-related meetings, saving project correspondence, and setting up and frequently updating a detailed action-item registry. Project documentation was a useful reference throughout the project, and from an evaluation perspective tracked the processes and issues encountered during development for others who would like to learn about developing a multimodal trip planner in the future.

Although communication with partners and contributing agencies was often reported as satisfactory when it occurred, there were areas where a lack of communication coordination may have adversely impacted the development of the MMTPS. For example, the problems with the use of the ITS standards were not effectively communicated between project partners and the federal team, prolonging many of the project difficulties and reducing the quantity and quality of feedback to the standards process and the demonstration effort, to the detriment of the RTA, Chicago-area travelers, other sites seeking to implement regional ATIS products, and the federal standards setting effort. Also, the effect of Google Transit on the MMTPS may have been different had communication been better between the RTA and the service boards of the transit agencies or internally within the RTA. The RTA project team's lack of awareness of CTA's agreement with Google Transit was a symptom of the lack of regional coordination or a communication failure between the RTA and its service boards.

Peer Advisory Panel

In support of the Operational Test of the MMTPS, the FTA wanted to convene a peer advisory panel to provide insight and feedback during the course of the project. The panel was also expected to facilitate the transfer of the technology to other metropolitan agencies by involving transportation staff from agencies with a potential to develop a multimodal trip planner.

The panel was composed of members of the transit community representing a cross-section of the international, federal, state, and local transportation communities. The peer panel provided some useful insight on the potential role an advisory group can play in a technology demonstration project. The composition of the group fluctuated slightly from meeting to meeting, but in general, the participating organizations and panel members remained consistent. This continuity was important, as a strong institutional and participant memory provided panelists with a more solid understanding of the project and process, enabling them to provide more constructive feedback at project milestones.

A few examples of contributions made by the peer advisory panel are highlighted below:

- One panel member provided information about using real-time condition information on major roads and historic information in urban areas, and offered to send the RTA the specifications for applying historical data to the calculation of trip time predictions.
- To ensure that all alternatives were adequately vetted, several panelists noted the need for additional information on the cost and schedule estimates used to assess the COTS option in the Alternatives Analysis. Based on this request, RTA conducted additional research, and a follow-up meeting was convened to discuss the findings.

The panel has also fostered communication among the panel members' agencies. Although the MMTPS development ultimately became COTS, one result of initial efforts to develop an open trip planner included the formation of the Transit Forum Network, which started with over a dozen transit agencies and other members of the transit community meeting for a two-day workshop in October 2005 to explore opportunities for software and data sharing.[23] The Network still has a Yahoo Group that sees occasional activity.

Because the final MMTPS was developed with a COTS solution, transferability in the initial sense anticipated was not a result of the peer panel. The peer panel, however, did lead to increased collaboration between members and also with the RTA. In the interviews, in response to the question "Did participation on the peer panel result in increased collaboration with other peer panel transit agencies?" responses included:

> "It opened up a lot of new connections, many of whom I've stayed in touch with for this and other issues over the years… That's helped in other areas than just the multi-modal development."
>
> "I've drawn upon what I learned from this panel, as well as stayed in communication to discuss lessons learned with staff from RTA as we've proceeded on our own project development."

Another panelist, however, noted that the panel was probably not convened often or regularly enough to create a proper community of interest. This may have been less of a problem if the project had not so significantly diverged from plans in technical approach and schedule.

Marketing

Because the MMTPS was expected to expand the user base to those living in the suburbs who were less frequent transit users, one element of the project was to develop a marketing plan that effectively targeted major MMTPS user groups. The RTA developed an initial draft marketing plan that primarily outlined promotional activities. This document was revised in 2008 to reflect a new marketing strategy; rather than market the MMTPS independently, the RTA opted to leverage existing resources through a cross promotion campaign with RTA's DLLM effort and contract. The DLLM initiative, funded by a Congestion Mitigation Air Quality (CMAQ) grant, sought to reduce congestion by raising awareness of alternatives to driving.

In January 2008, the RTA MMTPS team began working with a marketing and publicity consultant the agency had procured to work on DLLM. Without a cohesive identity or way to refer to a system, it is difficult to market and create awareness. Accordingly, establishing a name and logo (i.e., a "brand") for the MMTPS product was one of the first steps in the marketing effort. RTA selected the name "goroo" for the MMTPS product and worked with the consultant to develop a brand, logo, and identity; goroo was then incorporated into DLLM

[23] Transit Network Forum meeting proceedings are available at http://www.trimet.org/opensource/ http://tech.groups.yahoo.com/group/TransitForumNet/?tab=s.

promotional materials. The marketing campaign included four months of advertisements on transit and six weeks of radio and web ads. The advertisements targeted broad groups such as transit riders and those who used online mapping and direction services. Because of RTA management concerns about the quality of the itineraries provided, the goroo portion of the marketing campaign was terminated early and postponed (indefinitely) and the RTA directed users to the TripsWeb planner. Better internal communication practices for the approval of RTA products before a public outreach campaign may have prevented this problem. Additionally, in response to this issue, the goroo website was also affixed with a "beta" label.

Since the MMTPS was to have the capability to provide driving only and driving to transit directions, it was anticipated that users would be drawn from a larger geographic area and from places where a higher percentage of people have access to a car in comparison with TripsWeb. Because of the broad reach of the DLLM campaign, however, there was no individual campaign or strategy to expand the market and target specific market segments such as low-frequency transit riders from the suburbs or tourists and those who assist tourists.

A cross-promotional campaign is not inherently a bad way to approach marketing, especially given the ability to leverage scarce resources; however, the particular decisions that were made by the RTA may have negated the possible expansion of the market originally anticipated as a part of the project. By relying solely on an existing marketing campaign, the RTA goroo team lost some of the benefits that would have come from a goroo-specific campaign, such as the ability to control the message or target particular market segments, and really get across what goroo was and how it was different from other existing trip planning products. The latter was particularly important as the name selected, goroo, does not convey much information about the product itself.

To prevent this type of problem, areas where the goals, interests, and strategies of the partner, in this case a group within the same organization, may conflict with those of the grantee should be identified, and their implications assessed. Any significant risk presented by the partnership should be acknowledged and weighed strategically against the potential benefits.

Another issue that had the potential to impact marketing was the lack of information collected on how users accessed or were directed to the site, as users may be directed to goroo from the websites of the RTA, all three RTA service boards,[24] the DLLM campaign, or other sites such as search engines. Until November 2009, the RTA did not track these referrals to MMTPS. Knowing how users are accessing the site will be valuable information for future marketing and for new multimodal trip planning efforts; this information should be tracked starting from deployment.

[24] The RTA service boards consist of the CTA, Metra, and PACE.

5.2. Technical Issues

It is anticipated that there will be technical challenges that arise during the development of a new, complex technology. This section discusses some of the broad technical challenges faced by the developers and the RTA. In particular, it focuses on data integration challenges and the ITS standards.

Because of the nature of the multimodal trip planner system, data from a number of agencies had to be acquired and integrated. This integration presented developers with more of a challenge than expected, as data provided by the transit service boards were very different in terms of format, content, and terminology. Additional problems (cited in project records) included a lack of documentation from agencies and the existence of few personnel with a strong knowledge about the scheduling systems. As a consequence, significant effort was spent in identifying the data within the service boards' databases, and pulling and presenting the data in a cohesive manner took more time than expected.

Following are a few specific examples provided during interviews of the complications that arose when the MMTPS developers were integrating data from the multiple transit agencies:

- Terminology is not standardized among transit operators, and terms such as run, trip, and block may have different interpretations across agencies. Some terminology is used that is unfamiliar even to those with extensive transit exposure.
- Several developers mentioned the difficulty accounting for bus direction. Some buses lack a direction (e.g. a loop route), while others may have a specified direction that is unclear to riders.
- One interviewee reported that Pace Bus had more routes in their database than they publish to the public. Additional routes listed were for special occasions, but there was no way to distinguish them from others based on the data received.

These problems were exacerbated by the difficulty with implementing the ITS standards related to transit scheduling. The following section describes findings related to these challenges.

5.2.1. ITS Standards

The ITS/JPO, the FTA, and the American Public Transportation Association (APTA), among others, established the ITS standards in order to help ensure that ITS systems/products/components are integrated, are compatible with each other, and function together. While many of these standards have gained acceptance among state, local, and federal partners, the TCIP-SCH and ATIS J2354 standards the MMTPS project was intended to showcase have had less success. The feedback and lessons learned on the application and relevance of ITS standards were expected to be a valuable outcome of this project. Tellingly, in the extended development timeframe of the MMTPS, it appears that only the LYNX pilot

project in Orlando, (described above) has implemented the TCIP-SCH standards. Other projects that cite TCIP standards use appear to be in the proposal or planning stages.[25]

A breakdown of the issues that prevented the Chicago RTA from implementing the standards and identification of tools, processes, or refinements to the standards themselves may be instructive for other transit agencies, as well as the larger standards community.

This section includes the following:

- a discussion of the project-specific, but generalizable, issues related to standards compliance that emerged in the course of the MMTPS project.
- a discussion of broader difficulties the RTA faced with the TCIP-SCH standards in particular
- a discussion of the possible future of the TCIP-SCH and trip-planning standards

From project inception it was made explicit that one of the primary goals was to gain insight on the use of the ATIS and TCIP-SCH standards. The RFP released in 2004 clearly describes the standardized data messages that were to be standards compliant and what standards were to be used for each. For example, the transit itineraries were to use XML ATIS or XML TCIP-SCH or a combination of both to transfer itinerary messages to the multimodal trip planner. The project, however, revealed substantial and significant difficulties in implementing the standards. During the development process, the FTA provided support to help determine which standards it considered relevant and which messages should adhere to which standards. Even with this support, the RTA still had difficulty determining which message sets were available.

The FTA anticipated working with the technically complex standards would be a challenge and hired an ITS standards expert to provide guidance on standards implementation and compliance during development of preliminary documentation and also during product development. Having an expert provide technical assistance was productive both for the RTA and developers and for the evaluation team. In an early example, the RTA initially planned to add XML incidents and congestion reports from the GCM Corridor Coalition. However, after review, the standards expert said the GCM feeds were not compliant, but were close, and he provided Extensible Style Sheet Language (XSL) style sheets for conversion and demonstrated how it worked. It has not since been reviewed for compliance.

The transit incident information available on the MMTPS homepage is acquired using interfaces provided by the data providers. RTA uses the CTA Incident API for CTA incidents, GovDocs for Pace incidents, and web parsing for Metra incidents. None of these three interfaces are TCIP-compliant.

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[25] Okunieff, Paula, "TCIP Transit Standards, Status and Applications," Proceedings: National Institute of Standards and Technology, Centrum dopravního výzkumu, v.v.i. Workshop on Intelligent Transportation Systems, Prague, Czech Republic (September 29-October 1, 2010). Available at http://gsi.nist.gov/global/docs/sit/2010/its/PollyThursAM.pdf

One of the difficulties reported early in the development phases by developers was that the data that were provided by the transit service boards were not standards compliant. This was an institutional issue beyond the control of the developers and the RTA. In the context of this project, the RTA lacked authority to require the service boards to provide standards-compliant data. The broader issue at hand here, however, is that the scheduling software used by transit agencies is not standards complaint. These limitations cannot be used as an excuse for the planner itself not to be compliant should compliant input data be available in the future. More open communication about the difficulties in importing the non-compliant feeds into a standards-compliant MMTPS could have resulted in a different project path. For example, the RTA may have continued to build *ad hoc* agency-specific import tools for the initial MMTPS, but also build an additional module that could receive and integrate standards-compliant data feeds as soon as they were available from the local service boards. This method may have helped solve a "chicken or egg" problem wherein the service boards had little incentive to create compliant data feeds when no one would be using them. The practicality of that solution would have to be evaluated by various stakeholders.

In 2010, the RTA presented a draft white paper to the FTA regarding the difficulties the RTA had in implementing the TCIP-SCH standards. This document is highly instructive, and when finalized and published, should be of significant value to federal, state, and local stakeholders. Findings in this section are liberally informed by this white paper, as well as by informal conversations with knowledgeable state, local, and federal employees and partners over the course of the project.

TCIP is an APTA standard that was an ambitious attempt to "define standardized mechanisms for the exchange of information in the form of data among transit business systems, subsystems, components and devices" (p. 1).[26] The relevant business area of TCIP for this project was the scheduling (SCH) area. In attempting to account for all the various operational procedures and service types offered by transit agencies, the TCIP-SCH standard became quite complex, and with many features and options irrelevant to any given agency, though over the entire nation, all features may be used by some agencies.

Any new standard will be difficult to implement when using legacy systems. The RTA developers believed that the standards would be more useful when building a new system. While this observation is almost surely true, the norm, for most agencies, is that they are constrained by legacy systems; it would be unusual for an agency to be presented with this kind of fresh start. Conceivably, any cause of such a situation would be linked to the presence of a particularly outdated or poorly constructed legacy system. As a result, it is necessary for standards-setting bodies to provide useful guidance to those who will be transitioning to the standard, particularly from closed-source, legacy, and proprietary systems.

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[26] American Public Transit Association, Standards for Transit Communications Interface Profiles, Volume 1, TCIP-S-001 3.0.3, January 2009. Available at http://www.aptatcip.com/APTA-TCIP-S-01%203.03.htm.

Unfortunately, as initially distributed, the documents explaining the TCIP-SCH standards were difficult to read, understand, and apply. The standard was presented as a series of Microsoft Word documents, often referencing other documents that made up the TCIP or other ITS standards. However, these references were not hyperlinked, much less presented in an integrated or query-able form. Moreover, without a method to be directed to the "core" features common to most, if not all, agencies, it would be a daunting task to sort through all elements of the standard.

Since then, APTA has released additional tools designed to address some of these issues. In 2008, APTA released the TCIP Implementation and Requirements Capabilities Editor (TIRCE), which "provides a user-friendly means to create, modify, document, and compare interface specifications based on TCIP."[27] Then in 2010, APTA released the TCIP Interrogator, a tool designed to help directly with feed creation/validation. The National Transit Institute also now offers a two-day course on Integrating Transit Applications: Defining Data Interfaces Using TCIP that instructs on using TRICE and how to "create and respond to RFPs for applications that are TCIP compliant."[28]

While these APTA documents and tools helped systems developers better apply the standards, a similar clarification for project managers, agency decision makers, and appointed officials has not been developed. Technical issues aside, this deficiency has made it difficult for agencies to maintain momentum and interest in deploying standards-compliant systems, particularly when there additional costs or tasks associated with becoming standards compliant. Guidance on best practices and project walk-throughs would have also assisted on this account.

While better documentation may have helped ease entry into the process of developing a standards-compliant trip-planner, technical problems with the standards themselves further made deployment difficult, if not impossible. For example, the development team attributed some of the confusion to a lack of logical consistency in the standards, and a lack of "an overarching database schema." They also noted that logical consistency is also important in the development and maintenance of referential integrity, which is a desirable characteristic of relational databases.

> The TCIP standards, even though developed with relational database (sic) in mind, lack logical consistency between logical groupings. While TCIP follows general model architecture, the standard does not have an overarching database schema... While referential integrity is not

[27] American Public Transit Association. "Transit Communications Interface Profiles (TCIP) Standards Development Program." Last accessed January 6, 2010, Available at http://www.aptastandards.com/StandardsPrograms/ITStandardsProgram/TCIPProgram/tabid/113/language/en-US/Default.aspx.

[28] National Transit Institute, *Integrating Transit Applications: Defining Data Interfaces Using TCIP,* Last Accessed: April 11, 2011, available at: http://www.ntionline.com/courseinfo.asp?coursenumber=tri27.

> implicitly (sic) needed for standards, having logical consistency in the standards will reduce confusion and provides a consistent structure and understandable schema (pp. 24-25).[29]

Other best practices in developing TCIP XML schema appear to have been ignored, though the reason for doing so is unknown to the evaluation team, and may have been justified.

> This issue makes TCIP messages difficult to generate and parse, especially for large data sets like CTA and Pace schedule data. For example, industry best practices for XML suggest no more than 3 or 4 layers; TCIP has 6 to 10 layers on average.

The ambitious scope of the TCIP-SCH standards also presents challenges. Because the standard is designed to accommodate essentially all possible combinations of operational procedures and data formats, a large volume of the standards documentation, features, and options are irrelevant to any given agency. Furthermore, because the TCIP-SCH standards are designed to fit within the broader array of ITS standards, the RTA's developers saw them as having too broad a scope and requiring "more information than necessary." This integration with other ITS standards is objectively a good thing, and can provide a superior experience for all ITS infrastructure users in a future when all tools, systems, and agencies are standards-compliant. However, until such a time, the significant inputs required represent a challenge for lead-adopter agencies, particularly in light of the documentation deficiencies, as noted above.

As an interim step, it may be useful if individual standards could be "tagged" for specific applications, types of applications, or tagged as general/basic. It looks like there was a great deal of time and effort devoted to figuring out which standards were relevant. Such a tagging system (or other logical organized/grouping) could have allowed the RTA and its developers the benefit of starting out with a more finite and manageable universe of potentially-relevant standards to choose from; then they could have looked outside that set to see if there was anything that could fill some of the remaining gaps.

The standards deployment has thus far been focused on the transit agencies. However, the RTA pointed out that they purchase most of their software from a limited set of vendors for automatic vehicle location (AVL), scheduling, and other functions. They suggest that it is difficult for them to implement standards before their software providers build such features into their systems. Obviously, this can become a chicken-and-egg situation as vendors will have little interest in implementing a feature the agencies do not use, but it is a useful point in considering the strategy for standards implementation in the future.

Given that in the last few years, GTFS has become a particularly common specification for transit schedule information (see above), agencies looking to apply TCIP-SCH may already use GTFS and will realistically have to understand how to convert data between the two. The RTA ITS Standards White Paper provided some useful feedback about difficulties in doing so.

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[29] Regional Transportation Authority, Intelligent Transportation Systems Standards & the Multi-Modal Trip Planner System, August 2010.

> Within [GTFS schedule/feed] files, GTFS lists the fields of data, which are the basic elements. TCIP uses a hierarchal structure where dialogs are formed using messages (the best representation of GTFS' feed). These messages are formed through a combination of data elements and data frames where multiple layers and/or combinations can be used to form the message (p.22).[30]

Examples are given of difficulties in using TCIP-SCH compared to GTFS in the following areas:

- Data formatting issues
- Missing Key Data Elements in TCIP
- Semantics Mismatch
- Lack of Logical Grouping
- Redundant Data
- Limited Business Rules & Broad Scope

It is possible that the RTA White Paper and other similar efforts may reveal enough useful information to make TCIP-SCH an attractive alternative or supplement to existing GTFS-based data at transit agencies. However, given the emergence of GTFS and the difficulties experienced in building support for TCIP-SCH, it may be warranted for the FTA, ITS/JPO, APTA and other relevant parties to re-evaluate the state and strategy of the transit standards program. While GTFS clearly is not a one-for-one replacement for all the functionality of TCIP-SCH, its common usage makes it a significant part of the ITS standards community, whether *de jure* sanctioned or not, particularly as TCIP-SCH has not yet made the expected inroads into the community. While an evaluation of the potential alternatives is beyond the scope of this paper, should such an evaluation occur, strategies to be analyzed and subjected to a cost/benefit analysis could include:

- Revising TCIP-SCH guidance and potentially the standard itself to correct technical issues and make deployment easier
- Adjusting TCIP-SCH to accept some types of data in formats and layouts similar to GTFS, or at least easily converted, reducing the burden in using both
- Replacing parts of TCIP-SCH with GTFS entirely, while keeping support for features GTFS does not include (i.e., Making TCIP-SCH in to GTFS + more)
- Phasing out TCIP-SCH and utilizing the resources available to the FTA, APTA, and other stakeholders to become an active supporter of the GTFS open-source community. This could include helping to add missing functionalities to GTFS and developing "hooks" into the other ITS standards to further improve interoperability.

[30] Regional Transportation Authority, Intelligent Transportation Systems Standards & the Multi-Modal Trip Planner System, August 2010.

5.3. Customer Response to Multimodal Trip Planner

One of the goals of this evaluation was to examine the effects of multimodal information on traveler behavior. While a full exploration of the relationship between traveler information and traveler behavior is an extensive area of study beyond the scope of this evaluation, the MMTPS project did provide some insight into the role of multimodal trip planners as a tool to influence travel behavior, as well as the role of transit agencies as the primary host of multimodal trip planners.

The original evaluation plan presented a number of hypotheses related to the characteristics and needs of MMTPS users and the effect on mode choice and transit ridership of the MMTPS compared to TripsWeb. For reasons described above, in particular the decision to replace TripsWeb with goroo rather than run the two simultaneously serving different markets, these hypotheses were no longer directly relevant. Still, the goroo web-intercept survey and the 2005 TripsWeb survey provided some information in this area.

RTA's former trip planner, TripsWeb, was primarily used by urban dwellers. Since the MMTPS has the capability to provide driving only and drive-to-transit directions, one of the hypotheses of the original evaluation was that users would be drawn from a larger geographic area and from places where a higher percentage of people have access to a car, resulting in greater usage of the MMTPS in suburbs with less transit service. Another hypothesis that was being tested via this survey was that a greater proportion of MMTPS users, compared to TripsWeb users, would report owning or having access to a vehicle. The reasoning behind this hypothesis is that the multimodal features of goroo would attract a new pool of suburban users, who would be more likely to own or have access to a vehicle. This hypothesis is <u>not</u> supported by the data. According to the 2005 TripsWeb survey, 76% of the sample owned or had access to a vehicle, compared to only 54% of goroo users.[31]

Although goroo customers are primarily transit users, there are signs that customers are using new transit services, based on information they acquired from the website, and that at least some users are taking advantage of the multimodal aspect of the website. The survey findings show that a large majority of users already know what mode they plan to use *before* they visit the website. This finding gets at the public acceptance of multimodalism, which requires a new mindset on the part of the traveler. (Interestingly, however, the majority was found to be much smaller among individuals who had been living in the area for three years or less. This suggests that goroo may be useful in helping newer residents establish efficient transportation habits as they develop their knowledge of the local geography.) The results also suggested that goroo

[31] A difference in question format might explain some of the difference in the findings, but is unlikely to explain all of the difference in the two measures. In the TripsWeb survey, respondents were asked if they owned a car, and if they responded no, they were asked a follow-up question on whether they had access to a vehicle. In the goroo survey, however, respondents were asked a single question on whether they owned or had access to a vehicle.

may be effective at encouraging transit use (at least for the trip in question) among users who are *unsure* what mode to take – and even among users who had reported knowing they would *not* take transit. Furthermore, nearly 40% of all survey respondents – including *over half* of suburban residents – reported using at least one transit service that they do not usually use. It is important to note, however, that during some of the study period and as of the completion of this report, when travelers navigated to goroo through the CTA and RTA websites, both the driving and drive-to-transit were disabled.

6. EVOLVING ROLES IN THE TRIP PLANNING ENVIRONMENT

The evolving trip planning environment suggests that the direction of trip-planner evolution is towards seamless end-to-end products that work across modal, agency, and jurisdictional boundaries. This section provides from preliminary insight on how this evolution, together with the technical and institutional findings addressed in this report, has implications for the role of multimodal traveler information as a tool to influence traveler behavior, as well as the roles of the federal government, regional transportation bodies, transit agencies, and private sector.

6.1. Role of the Multimodal Trip Planner in Influencing User Behavior

The MMTPS project also raised broader issues related to how transit customers interact with multimodal trip planners and the role of this technology in influencing travel behavior. One of the assumptions driving a multimodal trip planner is that it works under a modal neutrality perspective with an unbiased presentation of results. At the time, market research supported the idea that travel time was one factor, but not the sole reason for mode choice. After goroo was released, there was concern by some project agencies and collaborators that the trip planner did not produce results that are favorable enough to transit. However, the goal of the MMTPS project was to supply accurate information that enables “seamless” multimodal travel, even if this sometimes conflicts with the goal of promoting transit use. The RTA acknowledged that the results produced by the trip planner are sensitive to the set of assumptions and variables that are incorporated into the model – improving the system by incorporating congestion data would provide more realistic driving time estimates (a task that was indeed part of the original plan). Similarly, it was noted that changing the default trip optimization setting from “quickest” to “cheapest” would produce results more favorable to transit, but such a change would not likely be favored by users. As noted above, the intention of the project was to create a mode-neutral product, a result the RTA successfully achieved in the development and branding of the project.

The experience indicates that as trip planners go multimodal, there will inevitably be some degree of tension between the goal of promoting transit use and the goal of providing accurate and useful multimodal information. Nonetheless, a well-designed trip planner will be able to effectively capture and convey real-world factors, such as gas price and congestion that would likely make transit an increasingly attractive option for the user.

Although trip planners originated in the transit community, the demands and inputs needed to create a truly multimodal trip planner may go far beyond the scope of the transit agency mission or areas of expertise. While these multimodal trip planners have the potential to encourage transit ridership by providing directions on walking, biking, or driving to transit, it is not reasonable to expect transit agencies to develop or even coordinate all of this information. In fact, it is important to emphasize that given the uncertainty over the benefit to transit and the state of flux trip planning is in, it may be the case that multimodal trip planners are better suited for transportation organizations with a more multimodal focus such as regional transportation bodies or some other consortium of transportation stakeholders, as well as the private sector.

6.2. Federal

In the trip planning environment described above, the role of central governments may be to oversee the common referencing and standards/protocols. Responsibilities under this would include standards development, maintenance, and adoption, taking into account existing standards in use nationally or in other countries that U.S. transit agencies might want to adopt.

The FTA may also facilitate implementation and deployment through peer exchange programs and sharing lessons learned from agencies implementing new technologies. Another federal role may be to fund research and support field test demonstration of trip planning projects at University Transportation Centers.

6.3. State, Regional, Local

As alternatives to the traditional trip planning model develop, it may be politically difficult for transit agencies and state or regional authorities to continue investing in proprietary trip planning products when other, less expensive options are available. As described above, a growing number of third party developers are creating traveler information resources from information provided by local or state transportation agencies. If the traveler information environment continues to evolve in this direction, particularly with respect to trip planning, the future role of transit agencies in traveler information service provision will decline while their role in data provision and standardization grows.

The traveler information and trip planning applications, however, are limited to information provided in the available data feeds and do not typically provide integrated, multimodal, region-wide trip planning. State or regional authorities or a regional partnership can serve as aggregators to facilitate multimodal information.

As multimodal integration continues, the role of promoting or hosting regional multimodal trip planners may expand beyond transit agencies and more naturally fall within the jurisdiction of other transportation stakeholders such as regional multimodal transportation organizations like MTC, other transportation bodies or stakeholders, and the private sector. In Europe, for example, many of the trip planners described above and trip planning demonstration projects have been the product of collaboration.

Having a transit agency as one of a number of project partners, rather than the project lead, may also help underscore the modal neutrality underlying a multimodal trip planner, thereby deflecting the criticism that a transit agency trip planner did not produce results that were favorable enough to transit.

Multimodal cooperation may be encouraged through research demonstration projects. For example, the Transportation Research Board Research in Action database shows an active Florida Department of Transportation sponsored research project at the University of South Florida to look at the use of publicly available data to link bicycling, walking, and transit using GTFS and OpenStreetMap.

6.4. Private Role

Access to transit schedule information is a critical part of transit service. With standardized transit schedule data, , the private sector can take a greater role in providing transit traveler information to the public, which will help transit agencies to focus on their core function and mission of moving people safely, effectively, and efficiently. Application developers will have open access to the standardized “raw” schedule data allowing for the most creative minds to focus on producing quality and value-added traveler information services in the form of both desktop and mobile applications. Then, travelers will have access to the most pertinent information on deciding how and when to make a trip.

7. LESSONS LEARNED AND RECOMMENDATIONS

This section of the report presents a number of the lessons learned from the MMTPS operational test and provides targeted recommendations based on these lessons. The key takeaways relate to project management, the systems engineering process, ITS standards, technology transfer, and the trip planning environment.

7.1. Lessons Learned

7.1.1. Project Management

- For future projects, project teams and management should determine how the plan and objectives would have to be revised, if at all, as a consequence of changes in the technical, institutional, or external environment. These developments may be either internal to the project (e.g., the decision to go with COTS) or external (e.g., the introduction of Google Transit).
- A frank conversation of the marginal benefit to continuing the project would have helped focus all stakeholders as to the value of remaining project activities and how well they serve user needs and the demonstration program goals. The schedule should build in regular decision points to consider the value of remaining project activities.
- Research and demonstration projects are designed to try out new technologies and methods to accomplish the project goals. Decision gates designed to determine whether it is beneficial for a project to proceed should be built into projects. If a decision is made to end a project it should be clear that this does *not* necessarily represent a failure of the research and/or demonstration program.
- An aborted project may still provide useful insight into other ways to approach the same user needs with a different project structure or product. It was not until the project started that it was realized the database formats and communication techniques were difficult, if not impossible, to adapt in a simple system. It is important to remember that at the time, this in itself was useful feedback about the current state of transit and traveler information systems.

7.1.2. Systems Engineering

- A diminished focus on the SE process resulted in a system acceptance and verification plan focused more on technical functionality rather than user needs. A focus on user needs as a continual driver of project activities may have avoided the initial failure to accept or at least minimized the additional time for correction.
- In order for user needs to be an effective guide throughout the systems engineering process, the SE documentation should articulate them clearly and concisely, in a separate and prominently featured section.

7.1.3. Marketing and Communication

- Ensure that project partners share the same goals, and that cumulative small decisions do not move the project away from one partner's goals.
- Grantee decisions to leverage other internal partner activities or contracts, as with the marketing campaign, should be examined carefully and critically. Any significant risks these partnerships may pose to certain aspects of the project should be weighed strategically against the potential benefits.
- Third party channels to market can be useful, but probably as part of the overall mix rather than as a standalone solution. By relying solely on an existing marketing campaign, the RTA goroo team lost the ability to control the message, target particular market segments, or clearly convey what the product was.
- Establishing connections with peers and experts facilitates an information exchange that can extend beyond the project itself. The peer advisory panel resulted in connections that were maintained beyond the MMTPS project. While developing their own multimodal trip planner, for example, the MTC discussed their approach with the RTA before moving forward.

7.1.4. Standards

- The lack of TCIP-SCH standards clarification for project managers and other decision makers has made it difficult for agencies to maintain momentum and interest in deploying standards-compliant systems, particularly when there additional costs or tasks associated with becoming standards compliant.
- The standards program has focused primarily on the transit agencies themselves. However, transit agencies purchase most of their software from a limited set of vendors for AVL, scheduling, and other functions. They suggest that it is difficult for them to implement standards before their software providers build such features into their systems.
- The RTA's developers spent significant time and effort figuring out which standards were relevant, despite receiving help on this issue. Some type of tagging or other logical organized/grouping would have allowed them (and other interested agencies) to start out with a more finite and manageable universe of potentially-relevant standards to choose from.
- Given that in the last few years, GTFS has become a common implementation for transit schedule information, agencies looking to apply TCIP-SCH may already use GTFS and will realistically have to understand how to convert data between the two.

7.1.5. Technical Challenges to Project Delivery

- Be prepared for data integration issues. Integrating data from multiple agencies can be difficult. Since each agency is autonomous, the data may differ in both format and content. It is important to expect these challenges and to allow for time in the schedule to address these data integration issues.

- When technology is rapidly changing, the longer projects take to be delivered and implemented, the less useful or necessary they may become. A strategic decision should be made upfront on how to best move forward the technology. A demonstration project on a smaller scale may have enabled a proof of concept that provided valuable insight into single-mode integration and standards over a shorter timeframe.
- The cost of developing a trip planner depends on the investment to date of an agency and the ultimate complexity of the project. Starting without the data development work completed can add significant expense; conversely, agencies that already have consolidated, standardized databases will face much lower upfront costs.
- The standard, multi-year operational test and evaluation model used for the MMTPS project, which requires a significant time investment, may not be most appropriate in areas of rapid technological change. A model specifically designed to address the challenges of testing and evaluating quickly evolving technology may be necessary.

7.1.6. Trip Planning Environment

- Despite the gains that have been made through the proliferation of GTFS, one of the recognized shortcomings is that it only provides static information; if GTFS is revised for real-time it could transform the trip planning environment by moving trip planning towards more real-time integration.
- The MMTPS project accurately predicted evolution in the direction of seamless end-to-end products that work across modal, agency, and jurisdictional boundaries.
- Although there may be movement towards a more open trip planning environment, agencies currently developing or replacing trip planners still show a mix between open source systems and customized, individually ordered proprietary systems.
- A number of trip planners take expected traffic into account for a more realistic presentation. Including this would provide travelers with a more accurate sense of trip length and may also have addressed the concern of those who believed MMTPS was unfavorable to transit. Although some progress has been made in introducing real-time information in to transit trip planning, in the trip planners reviewed, most transit trip planning systems are based on static schedules and itineraries generated are not dynamically responding to transit or traffic delays.

7.1.7. Public Sector Role

- If the traveler information environment continues to evolve in the direction of open source development and third party applications, the future role of transit agencies in traveler information service provision will decline while their role in data provision and standardization grows.
- A number of the applications currently being developed using public feeds are agency/modal specific and there is a continuing need for more integrated products. In this

environment, the federal role may be to encourage the development of seamless, integrated, regional traveler information tools.
- Because of the tension between the goal of promoting transit use and the goal of providing multimodal information, multimodal trip planners may be best suited for agencies or organizations or unique collaborative partnerships whose missions may be more multimodal.

7.2. Recommendations

The MMTPS provides an opportunity to understand some of the common issues that can be encountered during a technology demonstration project. Best project management practices, both at the federal and grantee level are paramount to achieving a successful demonstration. This evaluation has examined the MMTPS within the context of the current trip planning environment, and based on the findings and lessons learned, identifies the following recommendations in the areas of management practices, technology transfer, and the ITS standards program.

7.2.1. Management Practices

- A careful balance must be struck in advance of such projects to determine how much risk the project can tolerate in order to balance usefulness/novelty of the demonstration and the likelihood of producing a useable product. The project team must set out criteria for understanding when a project has crossed a specified risk threshold for project failure, and a clear timetable for when such decisions should happen.
- The federal team should ensure decision points and “go/no-go” decisions are built into project management plans and schedules.
- The “go/no-go” decision should not become a substitute for ongoing vigilance for departure from project goals and objectives.
- Although changes may require regular decision gates to be rescheduled, they must not be eliminated altogether.
- It may be advisable to plan for multiple “go/no-go” decisions, especially for long-duration projects.
- Some well-conceived ideas will not come to fruition, but even if called off, can likely provide significant feedback about the usefulness of an idea or process. All levels of management and a project team should create an organizational culture that reinforces this concept as new ideas move forward.
- Where a project is leveraging another initiative or activity, areas where the goals, interests, and strategies may conflict with those of the grantee should be identified, and their implications assessed.
- A serious assessment of the accuracy and completeness of required datasets needs to be done before project inception and scheduling—or at least build in a buffer in scheduling.
- For future project demonstration evaluations, ensure that a project RFP has provisions for access to not just to the grantee/lead agency, but also their contractors, even if the lead agency must be part of conversations.

7.2.2. Technology Transfer

- Given the evolution of the trip-planning environment, a major federal role will likely be to facilitate implementation and deployment through peer exchange programs and sharing lessons learned, and perhaps fund research and support field test demonstration of projects at University Transportation Centers.
- Especially during a long technology project, the project management plan should be flexible enough to incorporate changes from an evolving environment if necessary.
- APTA-developed documents and tools to help system developers better apply the complex TCIP-SCH standards need to be made available. A similar clarification for project managers, agency decision makers, and appointed officials should be developed.

7.2.3. ITS Standards Program

- The role of transit software and the vendors that provide it should be considered in the strategy for standards implementation in the future.
- Given the emergence of GTFS and the difficulties experienced in building support for TCIP-SCH, it may be warranted for the FTA, ITS/JPO, APTA and other relevant parties to re-evaluate the state and strategy of the transit standards program. Possible areas of analysis include:
- Revising TCIP-SCH guidance and potentially the standard itself to correct technical issues and make deployment easier.
- Adjusting TCIP-SCH to accept some types of data in formats and layouts similar to GTFS, or at least easily converted, reducing the burden in using both.
- Replacing parts of TCIP-SCH with GTFS entirely, while keeping support for features GTFS does not include (i.e., Making TCIP-SCH into GTFS + more).
- Phasing out TCIP-SCH and utilizing the resources available to the FTA, APTA, etc. to become an active supporter of the GTFS open-source community, helping to add missing functionalities to GTFS and developing “hooks” into the other ITS standards to further improve interoperability.
- TCIP-SCH standards could be “tagged” for specific applications, types of applications, or tagged as general/basic.

Ultimately, for all technology research and innovation projects, regular, open communication about project progress and user needs keeps the stakeholder team focused on achieving project goals. This may at times include the possibility of terminating a project early and compiling the lessons learned up to that point. Given the nature of technology demonstration projects, (especially those that represent a truly new technology or innovation, rather than technology transfer from another sector,) it is necessary to create a culture where this type of communication is encouraged to obtain optimal investment of agency funds. Incorporating decisions gates into project management plans is an important way of creating this culture of communication and decision making.

When projects take place in rapidly changing fields, project management plans and research objectives must also be calibrated to the technology environment. For some innovations, this may mean making the strategic decision upfront to have shorter duration projects demonstrating individual components, such as proof-of-concept tests, which may be more appropriate than the traditional multi-year implementation and demonstration. Management and oversight plans and processes should be altered to reflect differences from the conventional process.

Finally, within the realm of traveler information, significant uncertainty remains around the relationship between GTFS and the TCIP-SCH standard. The FTA, ATPA, and transit agencies need to agree on a path forward that will allow agencies to benefit from existing investments, to support the growing third-party developer community, and to facilitate integration with other ITS assets.

Overall, the MMTPS project has provided a useful look into the rapidly changing and exciting world of traveler information, highlighting opportunities for new products, new features, and identifying management and development practices that can help insure the traveling public reaps the benefits of new technology.

APPENDIX A: ORIGINAL PROJECT HYPOTHESES

#	Hypothesis	Data Collection Type	Useable?
1	A greater proportion of MMTPS users, compared to TripsWeb users, will report that they reside outside the city of Chicago.	Survey	Yes
2	MMTPS users, compared to TripsWeb users, will be less likely to report using public transportation on a regular basis.	Survey	Yes
3	A greater proportion of MMTPS users, compared to TripsWeb users, will report owning or having access to a vehicle	Survey	Yes
4	There will be a proportion of MMTPS users who report that they have never used the TripsWeb transit planning service.	Survey	Yes
5	Average MMTPS trips are longer than average TripsWeb trips	Trip Logs	No, sites were not run concurrently, so user base is the same between sites.
6	Average time between MMTPS use and the planned start of the trip is longer than the average time between using TripsWeb and the planned start of the trip.	Trip Logs	No, sites were not run concurrently, so user base is the same between sites.
7	A higher proportion of trips planned with MMTPS start at an intercity public transportation facility than trips planned with TripsWeb. An intercity transportation facility includes any Pace bus station, CTA transit station, or Metra rail station in the region. In addition, the airport is also included as an intercity transportation facility.	Trip Logs	No, sites were not run concurrently, so user base is the same between sites.
8*	MMTPS itineraries that include a particular transit route increase ridership on that route.	Trips Logs Ridership Data	No, ridership data was not available from some agencies.
9	TripsWeb itineraries that include a particular transit route increase ridership on that route	Trips Logs Ridership Data	No, ridership data was not available from some agencies.
10	The effects of MMTPS and TripsWeb itineraries on transit ridership on a route are equal	Trips Logs Ridership Data	No, sites were not run concurrently, so user base is the same between sites.
11*	A proportion of MMTPS users who typically do not use transit for the trip being taken will report (post trip) that they used transit	Survey	Yes
12*	MMTPS provides directions at a lower per unit cost than other channels, including the current trip planner and the RTA call center	Cost Information Call Center Data Site Usage Statistics	No, sites were not run concurrently, so user base is the same between sites. Unit costs for goroo are reported.
13	There are fewer calls for directions received by the RTA call center after MMTPS implementation than before	Call Center Data Sheets	No, changes to the trip-planning environment in Chicago made any conclusion from the data collection impossible.

14	There are more calls received by the RTA call center after MMTPS implementation than before (more MMTPS itineraries lead to more service calls)	Call Center Data	No, changes to the trip-planning environment in Chicago made any conclusion from the data collection impossible.
15	Fewer trips are planned on TripsWeb after the implementation of MMTPS	Trip Logs	No, sites were not run concurrently, so the conclusion is trivial.
16*	The total number of requests for information through the RTA call center, TripsWeb and MMTPS is greater after the implementation of MMTPS than before	Trip Logs Call Center Data	No, changes to the trip-planning environment in Chicago made any conclusion from the data collection impossible.
17*	The cost per customer information transaction decreases after MMTPS implementation	Call Center Data Site Usage Stats	No, changes to the trip-planning environment in Chicago made any conclusion from the data collection impossible.
18*	Total costs of providing customer information rise after MMTPS implementation	Call Center Data Site Usage Statistics	No, changes to the trip-planning environment in Chicago made any conclusion from the data collection impossible.
19*	The parameters of the RTA call volume model do not change between periods before and after MMTPS implementation*	Call Center Data Other External Factors	No, changes to the trip-planning environment in Chicago made any conclusion from the data collection impossible.
20*	Use of the ATIS and TCIP standards facilitated the development of the MMTPS	Interviews	Yes
21*	The ATIS and TCIP standards provided for all data fields required	Interviews	Yes
22	Initial marketing plans effectively targeted major MMTPS user groups	Interviews Marketing Plan	Yes
23	There was sufficient cooperation among MMTPS partner agencies	Interviews	Yes
24	Technical problems were overcome with no change in schedule or budget	Interviews	Yes
25*	Systems similar to the MMTPS could reasonably and appropriately be developed in other complex, congested urban areas	Interviews	Yes

APPENDIX B: PEER ADVISORY PANEL MEMBER ORGANIZATIONS

Table 3: Peer Advisory Panel Organization List

Organization
New York State Department of Transportation
Transport Direct - United Kingdom
Orange County Transportation Authority – California
King County Metro – Washington
Oregon Department of Transportation
TriMet – Oregon
Washington Metropolitan Area Transit Authority - Washington, DC
Metropolitan Transportation Commission – California

APPENDIX C: GOROO USER SURVEY

GOROO USER SURVEY

INTRO SCREEN:

This survey is your opportunity to provide feedback on goroo.com!

The Volpe Center is conducting this survey for the U.S. Department of Transportation to learn about your experience using this online trip planner.

The survey information will be kept strictly confidential and we will not collect any names or release any personal information about survey participants.

The survey will take approximately 7 minutes to complete.

All participants who complete this survey will be eligible to receive $50! Each week 20 winners will be randomly selected to receive $50.

Thank you for your participation!

First, we'd like to ask you a few questions about your general use of goroo.com and other trip planning websites.

Q.1 When did you <u>first</u> use goroo.com? *(Select one)*

- This is my first time -- GO TO Q. 7
- In the past month
- 1 to 3 months ago
- 4 or more months ago
- I don't remember

Q. 2 How often do you visit goroo.com? *(Select one)*

- Daily (5 or more times per week)
- Weekly (about 1-4 times per week)
- Monthly (about 1-3 times per month)
- Less than once a month

Q. 3 Overall, how satisfied are you with the following aspects of goroo.com? *(Select one response for each item)*

	Very Satisfied	Somewhat Satisfied	Not very Satisfied	Not at all Satisfied
Your overall experience using the website				
The quality (accuracy) of the travel information				
The way the information is presented				
The ease of finding the information you need				

Q. 4 Please indicate if you ever consult the following information on goroo.com: *(Select one response for each item)*

	Yes	No
Chicago area attractions		
Transit schedules (e.g., for CTA, Metra, or Pace)		
Next bus or next train		
Travel cost for your trip		
Carbon emissions for your trip		
Other (please specify:_____)		

Q. 4a When visiting goroo.com to plan a trip, do you generally know what type of transportation you are going to use (car, bus, train, etc.), or does goroo.com help you determine what type of transportation to use? *(Select one)*

- I generally know the type of transportation I'm going to use
- Goroo.com helps me determine the type of transportation to use

Q. 5 On previous visits to goroo.com, have you used this website to plan any of the following types of trips? *(Select one response for each item)*

	Yes	No
Commute to or from work		
Job interview		
Other work-related travel (e.g. business meeting)		
Travel to or from school		
Travel to or from the airport (business or leisure)		
Shopping or errands		
Personal appointments (e.g. medical, dentist, hairdresser)		
Local events, attractions, restaurants, recreation (e.g. Taste of Chicago, museums)		
Visit friends or relatives		
Other (Please specify:_____)		

Q. 6 Have you used any of the following types of trip directions provided by goroo.com? (Select one response for each item)

	Yes	No
Combined driving and public transportation (e.g. Park and Ride or Kiss and Ride)		
Driving only		
Public transportation only (e.g. bus, train)		

Q. 6a As a result of information received from goroo.com, have you used a transportation service that you don't usually use?

- Yes, the train (CTA, "L")
- Yes, the bus (CTA or Pace)
- Yes, commuter rail (Metra)
- No
- Other (Please specify:_____)

Q. 7 How often, if at all, do you use websites other than goroo.com to plan any of your trips? (for example, MapQuest, Google Maps etc)

- More than 4 times per week
- About 1 to 4 times per week
- About 1 to 3 times per month
- Less than once a month
- Never → SKIP TO Q. 9

Q. 8 In the past 3 to 6 months, which of the following websites have you used to plan trips? *(Select one response for each item)*

	Yes	No	Can't Recall
Google			
MapQuest			
Yahoo			
Microsoft Bing Maps			
HopStop			
Other (Please specify: _____)			

Q. 9 Have you ever used the Regional Transportation Authority (RTA) trip planner (http://tripsweb.rtachicago.com)?

- Yes
- No
- Can't recall

The following set of questions is about your use of transportation.

*Q. 10 Do you own or have access to a vehicle (a car, truck or motorcycle)?

- Yes
- No

*Q. 11 How often, if at all, do you use each of the following types of transportation in Northeastern Illinois (e.g. the Chicago area)?

	Daily (at least 5-7 times per week)	Weekly (1-4 times per week)	Monthly (1-3 times per month)	1-5 times per year or less	Never
Vehicle only (e.g., drive or be driven)					
Drive to public transportation and park my car (e.g. Park and Ride)					
Get dropped off or picked up at public transportation (e.g., Kiss and Ride)					
Public transportation only					
Bicycling					

The next few questions are about the current trip for which you consulted this website:

Q. 12 First, how did you get to the goroo.com website today?

- Typed goroo.com or used bookmark for goroo.com
- Used a search engine (e.g., Google, Yahoo, Bing)
- Was routed to goroo.com from another website (e.g. from TripsWeb, RTA, Pace, Metra etc. websites)
- Can't Recall
- Other (please specify: _____)

Q. 13 What is the main purpose of the trip you are planning today on goroo.com?

- Commute to or from work
- Other work-related travel (e.g. business meeting)
- Travel to or from school
- Travel to or from the airport
- Shopping or errands
- Job interview
- Personal appointment (e.g. medical, dentist, hairdresser)
- Local events, attractions, restaurants, recreation (e.g. Taste of Chicago, museums)
- Visit friends or relatives
- Other (Please specify:_____)

Q. 14 When do you plan on making this trip? *(Select one)*

- Today
- Tomorrow
- Other (please specify date:_____)

Q. 15 Before visiting goroo today, how did you plan on getting to your final destination? (*select one)*

- Not sure
- Drive (or be driven) the whole way
- Drive to public transportation and park
- Get dropped off at public transportation
- Public transportation only
- Taxi or shuttle
- Bicycle
- Walk the whole way
- Other (please specify) _____

Q. 16 Have you traveled to this destination before?

- Yes
- No → GO TO Q. 17

Q. 16a How do you usually get to this destination?

- Drive (or be driven) the whole way
- Drive to public transportation and park
- Get dropped off at public transportation
- Public transportation only
- Taxi or shuttle
- Bicycle
- Walk the whole way
- Other (please specify) _____

Q. 17 How could goroo.com be improved to better meet your needs?

_____
_____

The final set of questions is used for statistical purposes only.

Q. 18 Are you

- Male
- Female

Q. 19 How old are you?

- 17 years of age or younger
- 18 to 24 years of age
- 25 to 29 years of age
- 30 to 39 years of age
- 40 to 49 years of age
- 50 to 64 years of age
- 65 years of age or older

*Q20 Where do you live?

- City of Chicago [SKIP Q 21a, Q. 21b; ASK Q.21)
- Surrounding suburbs of Chicago [SKIP Q 20a, Q. 20b; ASK Q. 21)
- Northeast Indiana (including Lake, Porter, or LaPorte counties) or Kenosha County, Wisconsin
- Other location in Illinois (ASK Q.21a and 21b THEN SKIP TO Q. 22)
- Outside of Illinois (U.S.) ASK Q.21a and 21b THEN SKIP TO Q. 22)
- Outside of the U.S. (ASK Q.21a and 21b THEN SKIP TO Q. 22)

Q.20a Please specify your home zip code

Q.20a Please specify city or town

Q.20a Please specify city and state

Q.21 How long have you lived in the Chicago area?

- Less than 12 months
- 1-3 years
- 4-10 years
- 11+ years

Q. 21a How long are you visiting the Chicago area?

_____ days (use drop-down: 1,2,3,4,5,6,7,8+)

Q. 21b Is your visit to Chicago mainly for business or pleasure?

- Business
- Pleasure
- Other (please specify:_____)

Q. 22 What is the highest level of schooling that you have completed?

- Some high school or less (no degree)
- High school graduate or GED
- Technical or vocational school graduate
- Some college
- College graduate
- Post-graduate degree

Q. 23 What is your current employment status?

- Employed full-time
- Employed part-time
- Homemaker
- Student
- Retired
- Unemployed
- Other (please specify) _____

Q.24 Do you work for RTA, CTA, Metra or Pace?

- Yes
- No

Q. 25 Including yourself, how many people live in your household?

Number of people aged 16 and older _____

Number of people aged 15 and under _____

Q. 26 Please indicate the category that best describes your annual household income

- $0 - $24,999
- $25,000 - $49,999
- $50,000 - $99,999
- $100,000 - $149,999
- $150,000 or more
- Prefer not to say

Thank you! We appreciate your participation in this survey.

Survey participants who complete the survey will be eligible to receive $50 in a random drawing conducted each week

(20 winners will be selected each week, and if you are not selected, you remain in the running for future weekly drawings).

To participate in the weekly drawing, we will need your email address. Your email will be kept confidential and will not be shared with anyone. After the last drawing, your email address will be destroyed.

Email address for weekly drawing: _____

In addition, we would like to send you a very brief follow-up survey (only 5-6 questions) after you've made the trip for which you consulted goroo.com today. This will provide us with some important information on the usefulness of the directions you received.

Would you be willing to participate in the brief follow up survey?

- Yes
- No

Follow up Survey

Q.1 Did you make the trip that you planned on goroo.com?

- Yes
- No (SKIPS TO LAST PAGE)

Q. 2 Did you use the directions provided by goroo.com?

- Yes, I used the directions
- Yes, though I changed the timing or the routing a bit
- No (SKIPS TO LAST PAGE)

Q. 2a Can you please tell us why you did not use the directions provided by goroo.com?

.

Q.2b Did you seek directions from another website?

- Yes (GO TO Q.2c)
- No (GO TO Q.2d)

Q. 2c What website did you use for directions?

- RTA's original transit trip planner (tripsweb.rtachicago.com)
- Google
- MapQuest
- Yahoo
- Microsoft Bing Maps
- Hopstop
- Other

Q.2d What type of transportation did you use to make the trip? *(Select one)*

- Vehicle only (drove or was driven)
- Public transportation only
- Both vehicle and public transportation
- Other (please specify)

Q. 3 What type of transportation did you use to make the trip that you planned on goroo.com? *(Select one)*

- Vehicle only (drove or was driven)
- Public transportation only
- Both vehicle and public transportation
- Other (please specify)_____

Q. 4 How would you rate the accuracy of the directions provided by goroo.com? *(Select one)*

Not at all Very

Accurate Accurate

1 2 3 4 5 6 7

Q. 5 How easy to use was goroo.com? *(Select one)*

Not at all Very

Easy Easy

1 2 3 4 5 6 7

Q. 6 Overall, how useful to you was the information on goroo.com? *(Select one)*

Not at all Very

Useful Useful

1 2 3 4 5 6 7

Q. 7 Please use the following comment box to provide any additional comments or suggestions regarding goroo.com

LAST PAGE:

Thank you very much for participating in our survey!

APPENDIX D: PROJECT TIMELINE

2004	**May**	FTA issues RFP.
	October	Cooperative Agreement Estimated completion date for Phase I implementation: Aug. 11, 2006
2005	**March - August**	Planning and preliminary work A timeline is developed, which lays out a two-phased approach – core system development, followed by additional features/functionality. Care is taken at this point to ensure the inclusion of a "go/no-go" decision upon completion of the first phase. RTA delivers draft Project Management Plan. RTA conducts baseline user research, which demonstrates the importance of consolidation of travel information to the user. RTA delivers Concept of Operations
	December	Google Transit is launched in Portland.
2006	**February**	The Volpe Center delivers its Final Evaluation Plan. RTA delivers draft Technical Requirements Document. Due to delays in procuring the developer, the document was developed in-house and delivered two months overdue.
	May	Public launch of Phase I delayed until July, 2007.
	August - November	Alternatives Analysis documents and workshop. After RTA formally evaluates and compares six alternatives, RTA and the federal team agree on Alternative 5: Commercial Off-the-Shelf (COTS).
	December	Revised schedule delays Phase I completion until October 2007.
2007		By this point, it appears that the bulk of the work originally scheduled for Phase II can actually be incorporated into Phase I, and the plan has been modified accordingly. The federal team approves the elimination of the "go/no-go" decision that had been scheduled to take place upon completion of Phase I. RTA delivers Detailed Design Plan RTA delivers draft Marketing Plan. The Volpe Center delivers Interim Evaluation Report.

2008		RTA sets new public launch date of April 2008. The RTA team begins working with a marketing and publicity consultant the agency had procured to work on its drive less. live more (DLLM) campaign. The federal team receives confirmation that TCIP-SCH and ATIS standards are not being used. RTA announces that the MMTPS will be called "goroo" and the URL has been secured. Public launch delayed until May, 2008 Google Transit is introduced in Chicago. At this point, only CTA routes are included – Metra Rail would join in November. RTA delivers draft Standards Implementation Plan. Stakeholders begin testing on the website. It is determined that additional development will be needed. RTA's developer delivers Phase 2A Acceptance Test Plan.
2009		Stakeholder review. Public roll-out scheduled for April, with unannounced "soft launch" a few weeks prior. The goroo site becomes available to the public, but it is not yet publicized. Goroo launch media event takes place. RTA delivers Standards White Paper.
2010		Bicycle Planning added to goroo.

APPENDIX E: GOROO CONTRIBUTORS AND ROLES

Table 6: Goroo Contributor List

Provider	Data Supplied
Center for Neighborhood Technology	Pounds of CO_2 generated by transit, the average car, and the average SUV for a specified distance.
Chicago Transit Authority	Bus location, train schedule adherence, transit schedules, and stop and station locations, real-time predicted arrival times.
Illinois Bureau of Tourism	Attractions and events data.
Illinois Department of Transportation	Incident information and construction for regional highways and tollways.
Metra Commuter Rail	Train schedules, station locations and descriptions, fare information, station parking lot information.
National Oceanic Atmospheric Administration (NOAA)	Current and predicted weather.
Pace Suburban Bus	Bus location, transit schedules, and stop location.
Standard Parking	Location, number of spaces, and rate information for parking lots throughout the region

(Source: www.goroo.com)

APPENDIX F: GOROO USER INTERFACE

Figure 7: Goroo Homepage

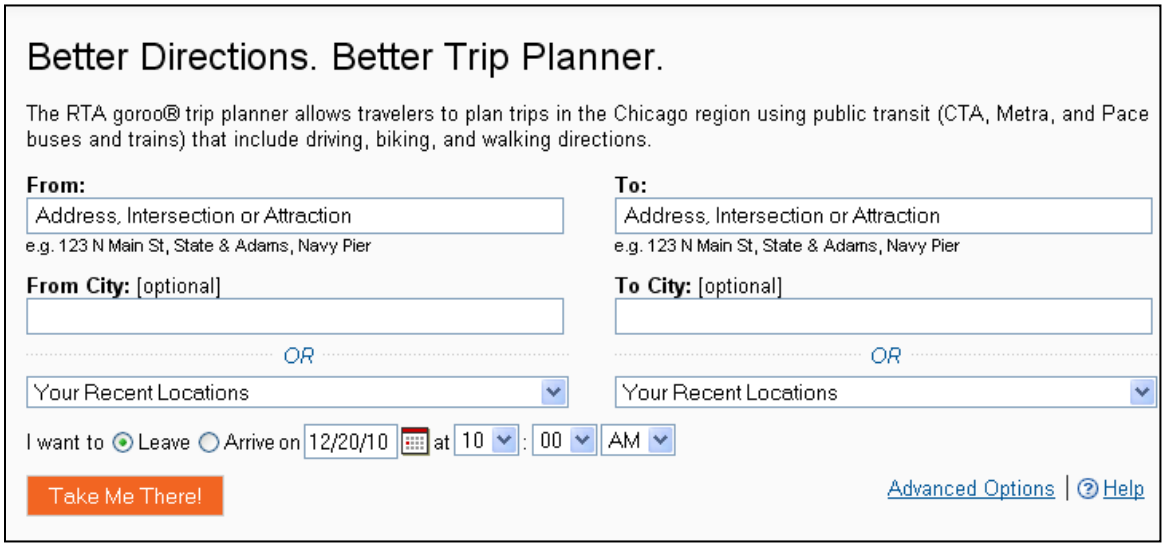
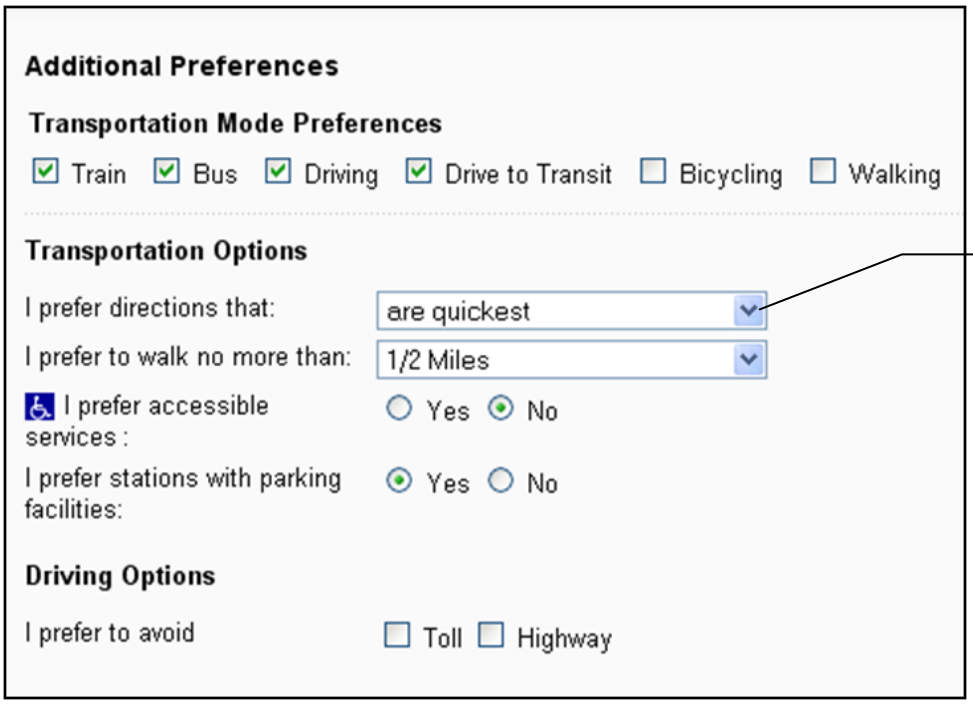


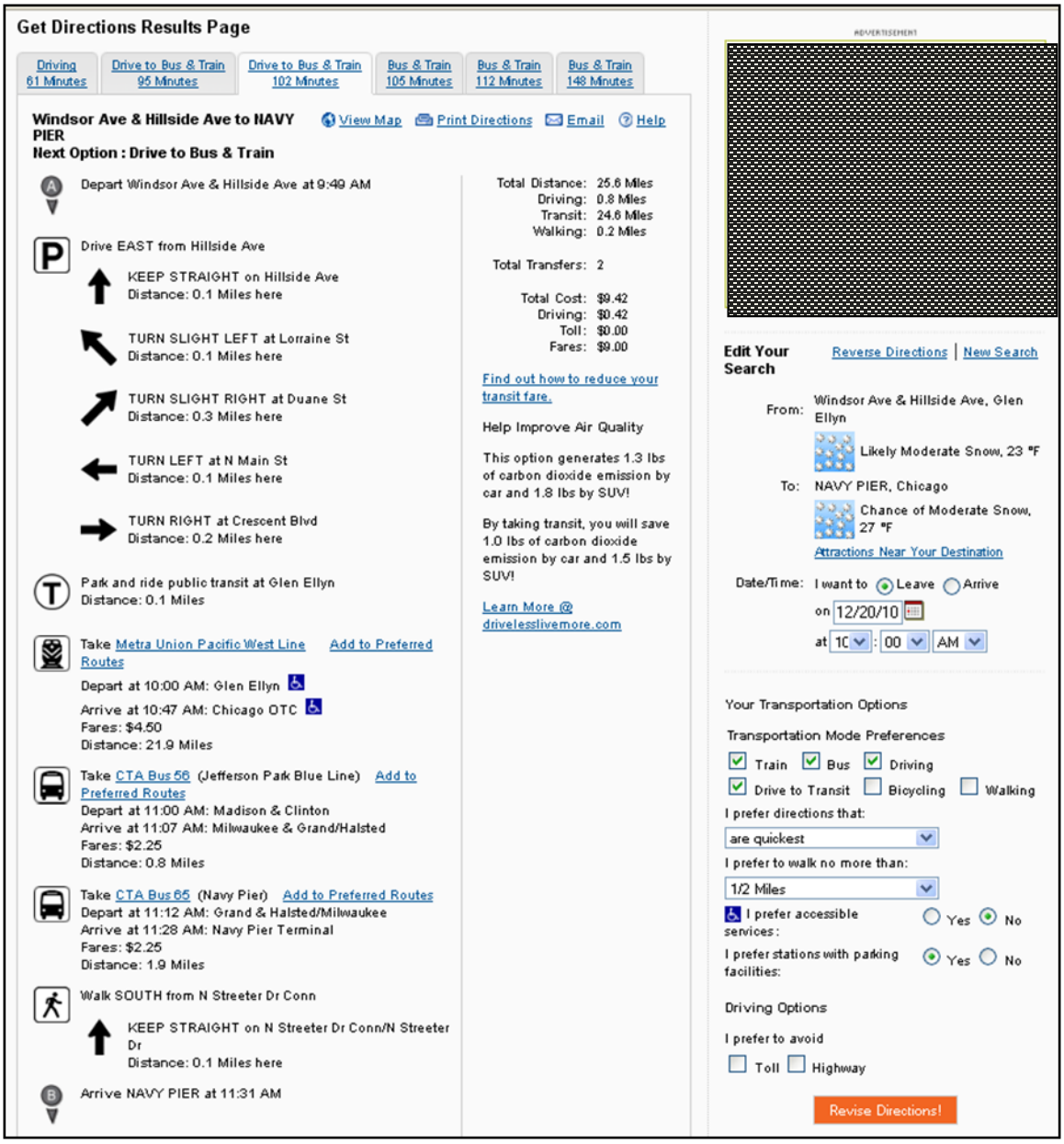
Figure 8: "Additional Preferences" Page



Additional drop-down options:

Are cheapest
Have fewest transfers
Have least walking

Figure 9: Sample goroo Results Page, Displaying One of Two Drive-to-transit Routes



Cover Photo Credits:

"Chicago Transit Authority (CTA) Bus Waiting for Train Passengers to Descend from Elevated Train," Source: Chicago Transit Authority, Available at: Photo Gallery, U.S. Department of Transportation, Federal Transit Administration.

"Metra Commuter Rail Station Ready for Passengers," Source: Metra Commuter Rail, Available at: Photo Gallery, U.S. Department of Transportation, Federal Transit Administration.

Photo of vehicle traffic on a one way street, including a dedicated bus and drop-off lane, Source: U.S. Department of Transportation, Federal Highway Administration, Available at: Congestion Mitigation and Air Quality Improvement (CMAQ) View Photo Library, U.S. Department of Transportation, Federal Highway Administration.

Photo of a bicyclist on a bikeway, Source: U.S. Department of Transportation, Federal Highway Administration, Available at: Congestion Mitigation and Air Quality Improvement (CMAQ) View Photo Library, U.S. Department of Transportation, Federal Highway Administration.