

**Approaches to Customer Information
for Public Transportation:
Application to the San Juan Metropolitan Area**

by

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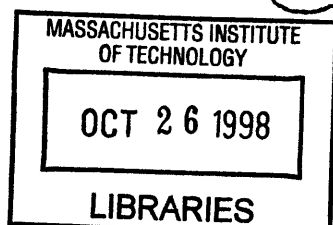
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APPROACHES TO CUSTOMER INFORMATION FOR PUBLIC TRANSPORTATION:
APPLICATION TO THE SAN JUAN METROPOLITAN AREA

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ABSTRACT

This thesis considers inadequate customer information as a factor contributing to poor public transportation utilization. The goal is to identify what issues transit decision-makers should consider in identifying weaknesses in existing customer information provision, and in defining a customer information strategy to improve upon these weaknesses. To begin, key concepts in public transportation information and its provision are identified from existing literature on the topic. An analytical framework is then developed for evaluating customer information methods, both pre- and post-implementation. This evaluation has three components: method use, benefit, and cost. The evaluation framework is then used as a foundation in formulating a formal decision-making process.

Five cases of customer information methods and strategies are studied, both as a demonstration of the ideas developed and to summarize particularly interesting customer information initiatives. The cases studied are the London Transport Countdown and Hampshire County STOPWATCH real-time bus arrival time display systems, both in the UK; the GoTIC integrated information system architecture in Gothenburg, Sweden; four regional information systems in the San Francisco Bay Area; and a general review of transit customer information in Hong Kong.

Several key lessons arise from the case analyses. There are significant challenges to providing customer information when transit service is privately operated with little or no regulation, however the government can play a significant role in this. Regional government is particularly appropriate for integrating information about multiple regional transit services. Indeed, integrated advanced technologies can simplify the process of collecting information from multiple transit providers, and allow efficient use of collected information by disseminating it to different segments of the public via a variety of methods. All five cases use the World Wide Web, although each for slightly different purposes, and it is seen as a valuable, cost-effective media for promoting transit service. Real-time customer information at bus stops is successful in terms of benefit to passengers, although technical issues make reliability and accuracy a concern and require considerable technical support resources. The details of the project environment has an impact on the success of such initiatives, particularly the distinction between publicly operated, tendered, and deregulated transit service.

The knowledge learned from this research is then applied to the San Juan Metropolitan Area. An evaluation of existing customer information is performed. From this, goals for improvement are identified and a series of recommendations given. It is suggested that a

strong focus be placed on the largely ignored owner-operated público van service. Basic, traditional forms of information must be provided accurately and consistently, and should be integrated across all transit modes. Finally, a regional strategy should be developed to leverage the “new age” in public transportation in San Juan that culminates with the introduction of Tren Urbano heavy rail service in 2001. However, the issues of customer information budgeting, further research into customer needs, prioritization of alternatives, and possible changes to the public transportation institutional structure need to be considered in detail by decision-makers in the region.

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Glossary

Acuaexpreso	Urban passenger ferry system in San Juan
ADA	Americans with Disabilities Act of 1990
AMA	Autoridad Metropolitana de Autobuses Metropolitan Bus Authority (MBA)
APTS	Advanced Public Transportation System
ATIS	Advanced Traveler Information System
AVL	Automatic Vehicle Location
DTOP	Departamento de Transportación y Obras Públicas The Puerto Rico Department of Transportation and Public Works (DTPW)
FTA	Federal Transit Administration
GIS	Geographic Information System
GPS	Global Positioning System
Metrobús	Higher-quality fixed-route bus transportation in San Juan
PSC	Public Services Commission Comision de Servicio Público (CSP)
PRHTA	The Puerto Rico Highway and Transportation Authority Autoridad de Carreteras y Transportación (ACT)
Públicos	Jitney public transportation in San Juan
SJMA	San Juan Metropolitan Area
Tren Urbano	Heavy rail transit system in San Juan, opening in 2001
WWW	World Wide Web

1. Introduction

1.1. The Role of Customer Information

In most cities in the United States and many worldwide, public transportation ridership falls well below the capacity of the services provided. This has many causes, including the decreased comfort and convenience (perceived or real) of transit when compared to automobile travel. This research focuses on one factor that generally contributes to poor transit ridership – the poor provision of information to customers about available transit services.

Several characteristics of transit service which distinguish it from automobile travel create a reliance on customer information to make these services useful. Fixed-route transit serves only a fraction of city streets, and it is likely that a particular route that serves the origin of a particular trip does not serve the corresponding trip destination, requiring a transfer between routes. Transit services are not provided continuously but rather at some time interval, whether it be scheduled or demand-responsive, and scheduled transit services are often unable to keep perfectly to their schedules. Finally, there are many service-specific rules regarding transit use, such as what fare needs to be paid.

As a result, both existing and potential transit passengers are at a disadvantage when the quality and/or quantity of information provided about available services is poor. Many travelers are unaware of the potentially useful transit services available to them. Riders are frequently confused about which route they need to take, when the bus or train will arrive, whether they need to pay a second time when transferring to a different route, etc. Customers often experience some level of stress when waiting for or riding transit, especially when their arrival time is important and/or when they need to transfer to a different service. And customers effectively waste time while waiting for the bus or train to arrive.

Therefore, one can reduce the disadvantage to transit customers by improving the information provided to them. In doing so, one can hope to achieve any or all of the following:

- increasing public awareness of transit services available,
- increasing the efficiency with which passengers use transit,

- providing information that increases current users' level of satisfaction with transit service, and
- improving the image of the public transportation services.

Achieving these broad goals can result from numerous incremental improvements in transit service due to improved customer information. Some of these specific benefits of better information are identified in later chapters.

There are many methods of providing customer information in use today. Traditional methods, such as printed brochures, timetables, and maps are commonplace for most medium and large transit agencies, as well as many smaller ones. Many agencies in the United States also typically provide some form of information via telephone, using either human operators or a voice-mail system, or both. And some have taken advantage of more sophisticated technologies, such as cable television, LED displays, electronic kiosks, and the Internet, to provide information to riders at all stages of the trip.

Substantial changes in an agency's or region's customer information plan often coincide with significant alteration in the transit services provided, such as the introduction of a new transit system or increase of services for a special event. Improvements can also be made in tandem with improvements to another aspect of transit operations. For example, the installation of Automatic Vehicle Location (AVL) devices on transit vehicles to improve dispatching and performance monitoring provides an excellent opportunity for providing real-time information to passengers waiting at stops about the proximity of vehicles.

The purpose of this research and the resulting thesis is to provide a synthesis of the concepts and lessons to be learned regarding transit customer information. Existing literature evaluates specific methods of information provision, or summarizes the implementation of customer information methods by specific transit agencies. This research will integrate the concepts defined in existing literature and the lessons learned by prior implementations of customer information methods to both identify criteria for evaluating future projects and develop a framework to aid in transit agency or regional decision-making. The goal is to assist the transit agency in identifying what the information needs of its potential ridership are, and developing an information strategy to meet these needs.

The broad focus of this research necessitates some restriction. The marketing and customer information functions of a transit agency are highly interrelated, in fact at many agencies both functions are performed or coordinated by a single department. However, for the purposes of this research the functions which are strictly marketing in nature, such as

commercial advertising and promotions will be ignored. In addition, while a polished customer information method can enhance the image of the transit service, these secondary benefits of quality information have been considered only briefly throughout the course of this research. Instead, this research focuses on the potential improvements in quality of transit service experienced or perceived by the passenger.

1.2. Motivation

The customer information function of a transit agency has traditionally been to provide as much information about the agency's services as possible within the constraints of the budget. Few agencies take the time to evaluate the effectiveness of this information. Instead, changes to how an agency provides information occur primarily due to changes in budget or transit services offered. When innovation is introduced in transit customer information, it is usually in the form of an experimental project with no long-term goals in mind.

Herein lies the first motivation for this research – the need for a framework to guide the transit agency's or region's decision-making with regards to improving the quality of customer information they provide, using a comprehensive set of evaluation criteria to determine the benefits a particular method or plan offers. To achieve this, a synthesis of customer information concepts and methods as identified in existing literature and case studies is necessary. Lessons learned from agency's past experiences provides valuable insight on the potential success of a customer information method in meeting specific agency goals.

Furthermore, there are many regions in the world where multiple transit services, modes, and agencies provide the total public transportation system. In regions such as these, decision-making should not take place on a service- or agency-specific base if one hopes to maintain compatibility between customer information methods and provide information about all transit services.

A second motivation for this research is the future provision of transit customer information in the San Juan Metropolitan Area. Currently, transit service is provided by three public agencies and numerous private operators via three modes. Historically, the transit providers in San Juan have placed a low priority on providing information about their services, as improving service reliability and performance has taken center stage. The demand-responsive nature of the público (jitney) service and its provision by loosely regulated

private operators has resulted in little effort to inform the public about them, yet públicos provide two-thirds of transit trips in San Juan.¹

However, steps are being taken to improve the overall quality of transit service in San Juan. Two heavily used bus routes are operated under tendered contract to provide a higher-quality service. Local bus service is being converted in phases into a “transit center” network. And in 2001 the new Tren Urbano heavy rail line will be added to the regional transit system. These significant changes create both an opportunity and a need for improved information about the services, and thus the San Juan context provides a rich setting for applying the concepts and lessons learned from this research.

1.3. Research Approach and Thesis Organization

The organization of this thesis directly follows the research approach taken. Chapters Two and Three provide a background discussion of transit customer information, largely from a review of existing literature relevant to the topic. Chapter Two, **Transit Customer Information**, presents a synthesis of concepts related to transit customer information and its influence on the passenger. Chapter Three, **Providing Customer Information**, looks at issues directly related to providing information to customers, including a summary of the different methods of customer information used by transit agencies. The methods summarized are identified and categorized according to the various concepts identified.

Chapter Four, **Selecting and Evaluating Alternatives**, uses the information learned during the literature review as a basis for the development of a framework to be used in decision-making regarding customer information. The chapter first discusses various issues unique to the local context that should be identified, and presents a methodology for identifying customer information methods that may be appropriate for meeting the decision-maker’s goals. Then, a comprehensive set of evaluation criteria are introduced and incorporated within a framework for analyzing the merit of customer information methods. This evaluation step is finally incorporated into a framework for selecting and evaluating customer information plan alternatives, both on a single agency and regional basis.

Chapter Five, **Case Studies**, reviews five customer information initiatives. These cases have been selected to provide a view of particularly interesting and instructive implementations using a variety of information methods. The cases also represent different

¹ Attanucci and Wensley, “Enhancing Public Transportation in San Juan.”

implementation contexts, including both privately and publicly operated services, single agency and regional plans, and in regulated and deregulated environments.

Chapter Six, **The San Juan Metropolitan Area**, describes the environment in San Juan as it pertains to public transportation and customer information. Information about the people of San Juan and the current transit system is provided as background. The recent history of customer information provided for these transit services is given along with a summary of existing problems with transit information in San Juan. The chapter concludes with a synopsis of current plans for improving customer information in the region, including a discussion of transit information that will be provided for Tren Urbano when it begins operation.

Chapter Seven, **Developing a Plan for San Juan**, follows the decision-making framework presented in Chapter Five. First, goals are defined for improving customer information within the San Juan context. Then a series of recommendations for implementation are given, including four critical issues. The third section raises some questions that should be considered in a more detailed study of implementation alternatives, especially for longer-term customer information decisions. Finally, the chapter concludes with a brief summary of the key points.

In concluding this thesis, Chapter Eight summarizes the lessons learned regarding transit customer information during the course of this research. This is done in regard to both the general application of the concepts and analysis presented in the earlier chapters as well as the specific application to the San Juan Metropolitan Area.

2. Transit Customer Information

The first step in planning how a transit agency should provide information to its customers is to answer the question of how customer information can help us. To do so, an agency must first determine what they want to accomplish. This chapter provides a foundation for answering these questions by summarizing a review of existing literature. First is to define customer information and who the customer is. Of course, for provided information to be useful, the customer must use it. Thus, this chapter shares some thoughts on how a customer makes the decision to use a given information source. Related to this is the question of how information provided to customers can influence their trip-making decisions. Finally, this chapter concludes by identifying some common goals for introducing or improving a transit provider's customer information services.

2.1. What is Transit Customer Information?

The topic of this thesis is the information provided to customers about public transportation – what the transit service is, how, where, and when it operates, and how to make use of it. Such customer information is essential to transit because most transit services:

- operate on fixed routes which cover a small subset of the overall transportation network, and
- operate discontinuously, according to a fixed schedule.²

As a result, customers need to know, at the very least, where the transit service goes, when it runs, and how much it costs. The basic traditional forms of transit customer information, printed maps, schedules, and fare information, answer these questions. Of course, providing more detailed and sophisticated information is possible, and can allow passengers to make better use of the transit services available.

Suen and Geehan categorize the possible detail into three levels of information:

- **Generic** – service publicity, with the general aim of increasing ridership through informing the customer about the types of services available (such as a sign)
- **Specific** – service specifics, with the aim to increase accessibility to the transit system (such as a schedule or route map)

² Demand-responsive services and other transit options do not operate according to a fixed schedule, however general information about these services and how they operate is still essential to making use of them.

- **Operational** – service operations, to allow customers to make informed decisions about use of the transit system (e.g. advising customers of the current status of the system)³

Again, at the very least, customers need generic information to make any use of transit services. Trip-making then becomes easier and more likely with greater information detail.

Rather than thinking of information in terms of the level of detail provided, the GoTIC research project (Gothenburg, Sweden) categorizes information into three “aspects”, or functions, of a customer information method:

- **Communicative** – information that helps the customer recognize the transit agency’s physical service: the vehicles and infrastructure (such as stops, stations, right-of-way, etc.)
- **Pedagogic** – information allowing the customer to become familiar with and thus make use of the transit agency’s provided services (such as routes, hours of service, etc.)
- **Operational** – information that reduces the level of uncertainty among passengers when faced with choice situations⁴

These aspects of customer information relate to the specific needs of the customer – the needs to recognize the infrastructure, understand the services, and efficiently make use of them. This categorization is discussed in more detail later in this chapter.

2.2. Who is the Customer?

How an agency should provide transit information to its customers is entirely dependent on who those customers are. With a firm understanding of who the target audience is, the types of information and how it should be disseminated can be better decided. In addressing this idea, a semantic clarification about who is the customer is given first. Following is a discussion of market segmentation needed to identify, categorize and target the majority of members of a public audience.

2.2.1. The Customer vs. The Passenger

Users of transit information fit into four categories:

- Regular users who use information and then take a transit trip
- Regular users who, because of information, decide to use a different mode
- Infrequent or non-users who, because of information, decide to use transit

³ Cassidy and White, “Use and Perceptions,” p. 4, citing Suen and Geehan (1987).

⁴ Gothenburg Traffic Information Center, *Three Aspects*, p. 2.

- Infrequent or non-users who, because of information, decide to use their usual mode

The term “passenger” is short-sighted – taken literally, it includes only groups 1 and 3, those actually making use of transit services for a given trip. All four, however, are customers of transit, for even non-users draw from the societal benefit of public transportation. But the term “customer” should also include a fifth group – those who never even use information about transit. These members of the public also need to be targeted in providing information, so as to be drawn to using transit services.

The choice between the terms “passenger” and “customer” may appear to be purely semantic. However, the subtle difference between the two can result in a strictly limiting view on whom information should be provided to. If information is targeted at existing transit users, it may be of no use to non-users, and thus leaves no hope of increasing ridership. In many cases, customer information should be used as a marketing tool aimed at promoting transit services to non-users. The role of customer information in a transit agency’s marketing function is discussed further in Chapter 3.

2.2.2. The Need for Market Segmentation

There are numerous demographic factors which affect whether or not a person will make use of available customer information, and if so, what benefits are likely to result. While many of these depend on the quality and manner in which the information is provided, some factors can be generalized over specific subsets of the population. A partial list of these includes:

- age
- gender
- trip purpose
- frequency of transit use
- familiarity with transit service
- knowledge of the local language

It is impractical to consider all combinations of these factors in the design and evaluation of a transit customer information method – attempting to do so would result in too complex an analysis. Instead, one can define a reasonable number of segments that represent the major divisions in the public’s use of, and need for, information. A customer information strategy, defined further in the next chapter, can then be developed to target each of these segments. In addition, evaluation of each customer information method can be performed

in light of the use and benefits of information to each of these segments – by doing so one can address the major differences in impact of these demographic factors.

This practice of market segmentation is a fundamental component of market research, being used for everything from product definition to advertising. Many of the concepts behind market segmentation apply to defining target segments for customer information approaches. Kotler identifies five requisites of market segments as a basis for effective market research:

- **Measurable** – if a segment cannot be clearly defined, it may not be worth targeting
- **Substantial** – a segment should be the largest possible homogenous group for whom it is worth tailoring a specific marketing effort
- **Accessible** – marketers must believe they can effectively reach the proposed segment with their message
- **Differentiable** – to merit segmentation, segments must be shown to respond differently to the same marketing message
- **Actionable** – the agency must have sufficient resources to pursue each of the segments it defines; where resources are constrained, less segmentation will be possible⁵

These criteria can be redefined in the context of transit customer information as follows:

Measurable

If a segment cannot be clearly defined, reliable evaluation will not be possible. Uncertainty in the boundaries of a segment would make it difficult to measure or estimate the performance of an information method in terms of one of the evaluation criteria identified later in this chapter.

Substantial

A segment should be defined to include all customers with similar trip purposes, needs for information and abilities to access different types of information, and should be the largest possible homogenous group for whom one can generalize these purposes, needs, and abilities.

Accessible

All potential transit users can be reached by some form of customer information. Thus this criteria does not apply in this context. Instead, the question becomes whether or not the

⁵ Planck, *Transit Marketing*, p. 22, citing: Kotler, Philip. *Marketing Management*, 8th ed. Upper Saddle River, New York, 1994, pp. 280-1.

agency has the resources and/or ability to provide the needed information, which is covered under *actionable* below.

Differentiable

To merit segmentation, each segment should respond differently to a customer information method in some measurable way. This can be in terms of ability to access and use an information source and to comprehend the information provided. The difference can also be the influence such information has on the user's behavior and/or attitude, and the benefit the user receives.

Actionable

The agency must have sufficient resources and data to target specific methods to, and evaluate potential alternatives in light of, each of the segments defined. If budget constraints limit the scope of new customer information activities, it may be necessary to prioritize which market segments are in most need of, or may benefit most from, the improved information. Likewise, if insufficient data is available to evaluate potential methods for each market segment, less segmentation will be necessary.

2.3. User Acceptance and Adoption

This chapter has thus far addressed what customer information is and who is the customer to which it is targeted. This section introduces three perspectives on how customers decide whether information provided is acceptable in terms of meeting their needs, and whether or not to adopt the method as a regular source of knowledge. The first perspective is a cognitive look at how a person uses information. The second divides the decision-making process before a user accepts a traveler information source into five stages. The final perspective develops this further, providing a formal model of user adoption.

2.3.1. The Information Process

The GoTIC project suggests that there are five steps in the use of information – illustrated in Figure 2-1 below.⁶ According to the GoTIC research, the user must first notice that the information source does indeed exist. Next, the source must be distinguished from other messages, such as other information or advertising, which accompany it. The user must then identify the significance of the information, and recognize what benefit it is providing. And the final step, essential to making use of information, is to understand the message.

⁶ Gothenburg Traffic Information Center, *Three Aspects*, p. 4.

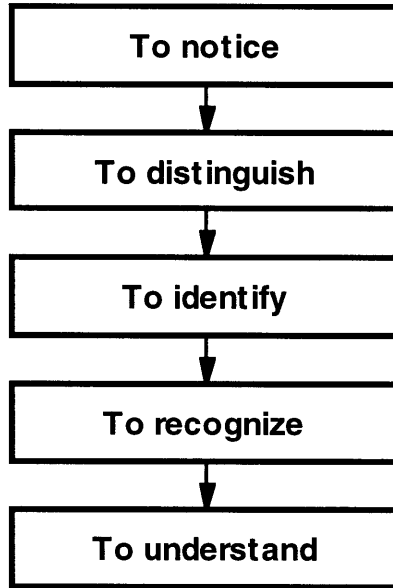


Figure 2-1: The Information Process

This information process is centered around the three “aspects” of information introduced earlier in this chapter, and revisited here in more detail. These aspects, or functions, of information are essential to the information process – making the information, and the transit services, noticeable, distinguishable, identifiable, recognizable, and understandable. They are essential to the successful implementation of customer information, and form an integral part of the method use component of the evaluation framework in Chapter 4. These three general functions are discussed below, with emphasis placed on the requirements for them to be successful:

The Communicative Function

The communicative function allows a customer to recognize the transit agency’s products through a definable image and distinguishable idiom. Information is also a product – thus information should also be recognizable.

Image

From the transit agency’s various products, a customer will form an opinion of the transit agency – this hopefully will conform to the image the transit agency wants portrayed. The agency’s image identifies the standard of quality of vehicles, driver/employee conduct, customer service, and customer information. Customer information influences the image of the company, through its form, style, tone, and usefulness. Careful design of customer information methods can then help portray the agency’s desired image.

Distinguishable idiom

The customer must be able to distinguish transit service and service products from other elements of the environment. Customer information, being a transit agency's product, must therefore be distinguishable from advertisements and other information (noise). Furthermore, products (including information) should be identifiable according to their function – for example, recent changes in information should be highlighted so as to stand out.

The Pedagogic Function

The pedagogic function allows customers to become accustomed to transit products – both services and customer information. To do so, the information must be easy to learn, consistent and clear.

Easy to learn

It should be easy to learn the principles of the information being provided. Doing so reduces the need for information as customers grow accustomed to the service. Note that this reduced dependence on information stresses the need mentioned earlier for changes to stand out.

Consistent and clear

Consistency and clarity allows the customer quickly to identify and understand what he or she is looking for. Consistency can be thought of in terms of:

- **Space** – the user knows where to look for specific information (i.e. where to find an informational sign at a bus stop, and where to find a schedule on the informational sign)
- **Design** – the user knows where within the information he or she will find the specific information desired
- **Principles** – if a standard set of symbols, terms, units, etc. is used, information will be easier to identify and understand

The Operational Function

The operational function is aimed at reducing the uncertainty of transit travel, and should provide all information necessary to plan and make a trip, including altering trip routing should delays or disruptions arise. To do so, the information needs to be:

Complete, correct, and up-to-date

Accuracy is extremely important – it is usually worse to give out wrong information than no information at all. Perceived accuracy can be as important as actual accuracy – if information appears to be old, a customer will not trust it, likewise if service does not operate as scheduled, the information provided is useless.

Relevant

Different types of information are necessary for a customer to plan a trip, begin the journey, change routes if necessary, and finish the trip. An agency must present all possible information that could be relevant to each and every customer. Therefore there is a need to organize and store information in such a way that it is usable (see communicative and pedagogic functions), and relevant to a specific person at a specific point in his or her trip.

Signaling

Customer information should clearly and plainly identify any changes and disruptions to services that will affect a trip. Again, such information must be distinguishable from other messages, yet should still conform to the agency's image and idiom.

Clear and confirming

There must be no doubt or ambiguity about where a passenger is and where he or she is headed. Information should be provided at all stages of the trip to keep the passenger aware of this at all times.

2.3.2. Five Stages in User Acceptance

Charles River Associates developed a conceptual framework for analyzing user response to Advanced Traveler Information Systems (ATIS). This was based on identifying the different types of decisions a customer makes in accepting information provided to them. Based on the findings of Ben-Akiva, et. al., they suggested that this decision process be thought of in five general stages:⁷

System Decisions

- **Awareness** of the information services available
- **Access** to the information services

⁷ Charles River Associates, "User acceptance of ATIS products," p. 14, citing Ben-Akiva, et. al., 1993.

Trip Decisions

- **Use** of the information services
- **Travel response** to the information

Use Feedback

- **Learning and adaptation** based on experience with the information

Charles River Associates view this as a sequential process, in that for each stage a successful outcome is required for the decision process to continue. Awareness of an information source is required before access is an issue, but then access is a necessity for use to be possible. Use of the source, in turn, permits a response to the information. Learning from, and adaptation to, the particular information method results from the feedback from each stage of the decision process. For each of these five stages, a quantitative evaluation model can theoretically be developed – such models can be used to perform a detailed evaluation of information use.

2.3.3. A Model for User Adoption

Polydoropoulou further developed these ideas by specifying and estimating a model for user adoption of the SmarTraveler multimodal ATIS in Boston, Massachusetts.⁸ SmarTraveler is an interactive telephone system that provides real-time information about traffic and transit conditions via a touch-tone telephone menu.⁹ While some information is provided about Massachusetts Bay Transportation Authority (MBTA) transit services (primarily information about rail disruptions and delays), the bulk of information is about traffic conditions on major roads. However, Polydoropoulou's general model framework should be transferable to other ATIS deployments, including a variety of transit customer information projects.

The SmarTraveler behavioral use model, illustrated in Figure 2-2, attempts to model the user adoption of a newly introduced ATIS. It divides use into three primary phases, each attempting to answer key questions about user experiences and the impacts on their thought and decision processes.¹⁰ The three phases, and corresponding questions, are provided here, although they have been generalized from the specific SmarTraveler case to customer information in general:

⁸ Polydoropoulou, *Modeling User Response to ATIS*, pp. 72-6.

⁹ SmarTraveler real-time information has recently been made available on the Internet via the World Wide Web address <<http://www.smartraveler.com/>>.

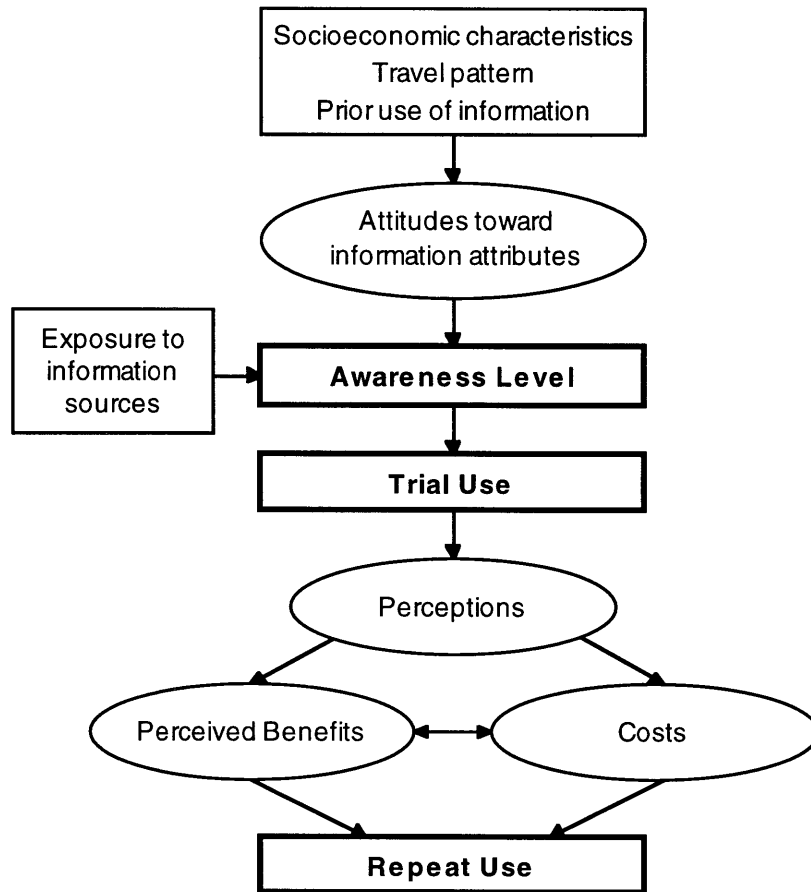


Figure 2-2: SmarTraveler Behavioral Framework¹¹

- **Awareness** – the customers’ exposure to and knowledge about the information source, including what it is, how it is used, and the potential benefits of using it
 - How does the previous use of traditional information sources affect the use of new ATIS products and services?
 - How do attitudes toward information in general affect the awareness of ATIS?
- **Trial Use** – in ATIS systems like SmarTraveler, this second phase is essential so that users can try the system before committing to fixed costs like equipment purchases or subscriptions
 - How does perceived importance and value of information affect trial use of ATIS?
 - How does media advertising affect penetration rates?
- **Repeat Usage** – long-term use of an ATIS is dependent on the users’ experiences with the trial phase, and whether the benefits of the information justify any costs involved

¹⁰ Polydoropoulou, et. al. “Modeling User Adoption of ATIS,” p. 2.

¹¹ Polydoropoulou, et. al. “Modeling User Adoption of ATIS,” p. 2.

- How does the quality of information provided influence repeat use rates?
- What is the perceived advantage of ATIS information over other information sources, and how does this affect usage decisions?

2.4. The Influence of Information

Customer information produces benefit to customers by influencing their behavior or attitude. How traveler behavior and attitude can be affected by information depends on several factors, including:

- the location and stage in the journey at which information is provided,
- the type of information provided,
- the needs and characteristics of the customer, and
- the success of the particular implementation in providing useful information.

These factors are discussed in detail in following sections of this thesis. The first two are discussed in the next chapter, *Providing Customer Information*. The last two signify the challenge in evaluating the success of customer information, and are addressed in Chapter 4, *Selecting and Evaluating Alternatives*.

In the remainder of this subsection the potential ways in which customer information can influence customers are identified and discussed. The influences are divided into two categories, those that result in changes in travel behavior and those that result in changes in customer attitude – toward transit, toward particular transit services, and toward a specific transit trip. For each, some examples of the types and locations of information which can provide such an influence are given.

This categorization is illustrated in Figure 2-3 below, in which the influences are presented in decreasing order of impact on the passenger. The unshaded boxes indicate a change in travel behavior, while the shaded boxes represent a change in attitude.

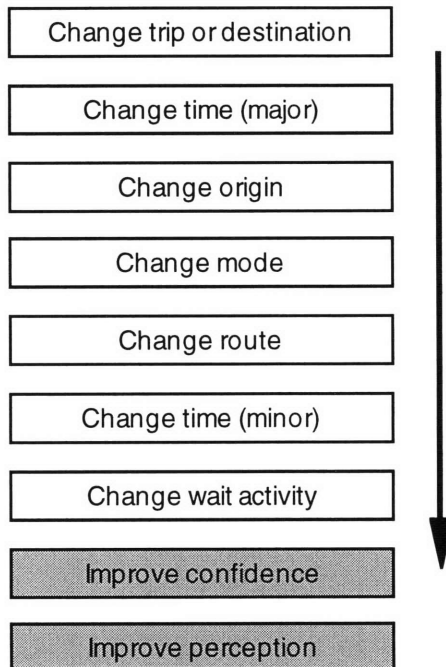


Figure 2-3: Impact on Customer Behavior

2.4.1. Influence on Travel Behavior

The first five ways information can influence a customer involve changes in behavior:

Change trip or destination

Information is necessary to plan a trip by transit. It can also result in the cancellation of a trip, or substitution with a trip to a different destination (particularly if similar activities can be performed at the substitute destination). All types of information can affect the trip decision – static information about available service options or real-time information about current transportation network status. It is most likely that a customer will make such a change if the information is provided before he or she begins the trip. However, wayside information provided at stops or terminals can also influence such decisions.

Change time (major)

The traveler will alter the time at which he or she makes a trip either if it is impossible to make it at the desired time, or if it is advantageous (in terms of trip time, convenience, or cost) to change the trip time given the cost of not traveling at the desired time. A major change in trip time can be characterized as making a trip at a different period of the day (perhaps when transit service is more frequent or more direct). Clearly the purpose of the trip is a strong factor in the flexibility of one’s trip-making and the likelihood that one will

adjust his or her plans based on travel information provided. Again, all types of information can affect this decision, and while pre-trip information is most likely to have such an impact, wayside information can also have some influence.

Change origin

The customer may find it more efficient to begin a particular trip from a different point of origin, again if it results in a shorter trip time, decreased cost, or is simply more convenient. Note that a change in origin requires walking to (or being driven to) a different stop (we are considering only the transit portion of the trip here – distinguishing this case from a change in mode). Again, all types of information can result in such a choice, and while pre-trip information will have the most impact, wayside information can also be of influence.

Change mode

A customer may choose to use a different mode of transportation if the information provided indicates a net benefit to him or her. In many cases, this can be the result of pre-trip or wayside real-time information which indicates that the original mode is not operating on schedule. In such a case, customers may choose to walk or take a taxi to their destination, or drive their automobile (in the case of pre-trip information). Again, static information can also have such an effect if the customer learns something new about a service.

Change route

Similar to changing mode, customers may choose to use a different route (or combination of routes) to get to their destination. Again, both static and real-time information provided both pre-trip and wayside could prompt such a change. In addition, information provided within the transit vehicle can be of benefit – if a passenger learns that his or her intended connection has already left a transfer point, he may be able to use a different route to get to the destination quicker.

Change time (minor)

Similar to major changes in trip time, a customer may find it beneficial to delay making a trip by a relatively short amount of time in order to minimize waiting time. A change of no more than an hour is probably a reasonable definition of a minor change. Once again, all types of information can affect this decision, and while pre-trip information is most likely to have such an impact, real-time wayside information can be very useful in making such a decision.

Change wait activity

Finally, real-time information provided at bus stops or in terminals about the arrival time of the next vehicle on the desired route(s) can allow the customer to perform short activities, such as running errands or getting food or drink, instead of waiting. Similar information provided pre-trip can also help customers make better use of their time, avoiding arriving early and waiting for their vehicle at the stop.

2.4.2. Influence on Customer Attitude

The remaining two impacts of information on customer behavior reflect influences on customer attitude:

Improve confidence

Customer information can improve a customer's confidence in using transit in several ways. Information about when a vehicle is scheduled to arrive, or even better, real-time information about when it will arrive, prevents a customer from feeling like he or she is waiting indefinitely for something that may not show up. This can also provide an increased sense of security, especially at night. Information about a vehicle's service route, along with headsigns or some other indication of which route the vehicle is serving, reinforces that the passenger is on the correct vehicle heading towards the correct destination. Stop announcements prevent the passenger from worrying about when to get off the vehicle and frantically trying to identify where the vehicle is from street signs or other landmarks. Similarly, transfer information notifies the passenger that he or she is exiting the vehicle at the right place.

Improve perception

Transit information can impact how a customer perceives a transit agency and its services. Information that is well presented can suggest a more professional image for the agency, while accurate and complete information can make transit services appear to operate more smoothly.

2.4.3. Summary of Influences of Customer Information

The following table summarizes the types and locations of information which can influence customer behavior:

Type of Influence	Content		Location		
	Static	Real-time	Pre-trip	Wayside	In-vehicle
Change trip or destination	✓	✓	✓	(✓)	
Change time (major)	✓	✓	✓	(✓)	
Change origin	✓	✓	✓	(✓)	
Change mode	✓	✓	✓	✓	
Change route	✓	✓	✓	✓	(✓)
Change time (minor)	✓	✓	✓	✓	
Change wait activity		✓	(✓)	✓	
Improve confidence	(✓)	✓		✓	✓
Improve perception	✓	✓	✓	✓	✓

Table 2-1: Summary of Influences of Types of Customer Information

2.5. Defining Goals for Transit Customer Information

This chapter has thus far defined customer information and discussed who the customer is, how the customer decides to use an information source, and how information can influence customers' trip-making behavior. To conclude, this section identifies some possible goals for providing transit information.

The U.S. Department of Transportation has developed a set of evaluation guidelines generalized for all Advanced Public Transportation Systems (APTS) technologies. These guidelines are based on a series of primary objectives for the APTS Program. Many of the objectives are applicable to customer information – these are listed here:

- Objective 1: Enhance the Quality of On-Street Service to Customers
 - Improve the quality, timeliness, and availability of customer information
- Objective 2: Improve System Productivity and Job Satisfaction
 - Reduce transit system costs
 - Reduce worker stress and increase job satisfaction
- Objective 3: Enhance the Contribution of Public Transportation Systems to Overall Community Goals
 - Improve communication with users having disabilities
 - Increase the use of public transportation
- Objective 4: Expand the Knowledge Base of Professionals Concerned with APTS Innovations¹²

¹² Casey and Collura, *Advanced Public Transportation Systems: Evaluation Guidelines*, pp. 9-10.

These objectives are clearly very general, aimed at evaluating the success of a nationwide initiative for a variety of purposes including but not limited to customer information. A more specific set of goals can be developed for a specific application. For example, objectives for providing information at bus stops include:

- to increase ridership by making the transit system easier to use,
- to maintain current ridership by providing more easily accessible information,
- to reduce reliance on more costly information sources, such as telephone information centers,
- to reduce reliance on bus operators as sources of information, and
- to serve as advertising for the transit agency to non-users.¹³

The final goal listed touches again on the difference between “customer” and “passenger” – that one does not need to be a regular user of transit to benefit from information. It is essential for agencies trying to increase ridership that information be targeted toward non-users so that (a) they can use transit if other alternatives are temporarily unavailable (this is related to the goal of improving use of transportation network), and (b) so they may become regular transit users at some point in the future.

¹³ Dobies, *Customer Information at Bus Stops*, p. 20.

3. Providing Customer Information

The previous chapter looked at the concept of customer information. This chapter discusses the task of providing it. To begin, the definition of customer information is expanded into the different agency functions responsible for its provision. Then the task of providing customer information is broken down into a three-step process. In doing so, we find that the different methods an agency uses in providing information to its customers are not exclusive – instead we must differentiate between a method and a comprehensive agency strategy. Finally, the chapter identifies the characteristics that distinguish one method from another, and concludes with a typology of customer information methods.

3.1. A Functional Look at Providing Information

The role of providing customer information is shared among several functions of a transit agency. The task of providing customer information can be attributed to three functional departments: customer service, public information, and marketing. Furthermore, three other departments, operations, planning, and scheduling, contribute to the task. While these three do not directly share the responsibility of providing information, they do contribute to the collection of data and place some restrictions on how it can be disseminated. This relationship is depicted in Figure 3-1 below.¹⁴

While some agencies use this functional separation as a basis for their organizational structure, this is certainly not necessary. More often, two or all three of the direct customer information providing functions are combined in one department, especially with smaller transit operators.

¹⁴ This relationship is based loosely on the relevant functions within the organizational structure of the Bay Area Rapid Transit District (BART), Oakland, California.

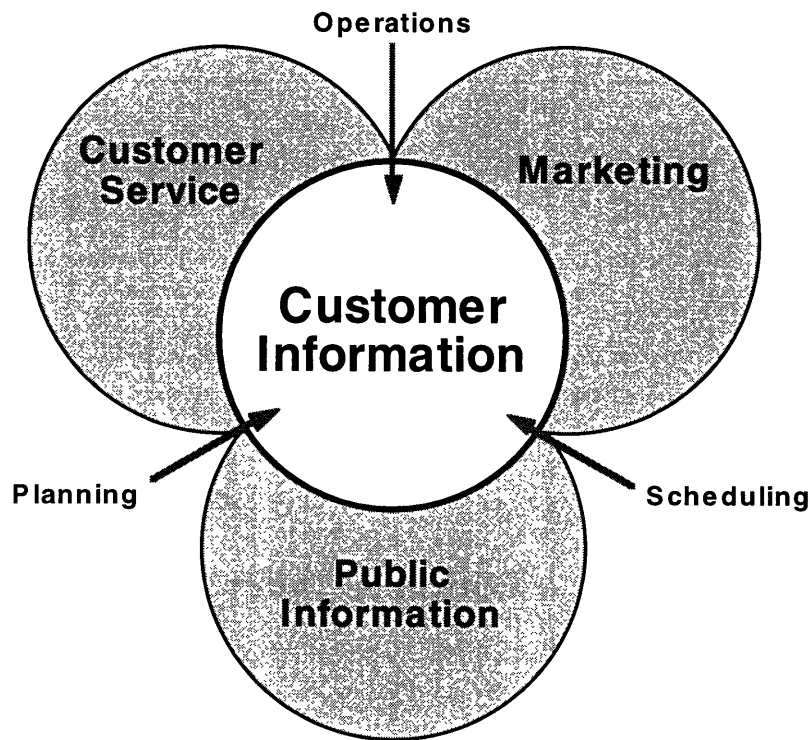


Figure 3-1: Dividing Customer Information Among Agency Functions

Of the three direct providers of customer information, public information and marketing tend to be proactive, reaching out to their audience. Customer service, on the other hand, tends to be more reactive in responding to public inquiries, requests, and needs. While specific duties of each vary for each transit provider, there are some general responsibilities that distinguish them:

- **Customer service** – responds to direct customer inquiries, for example staffing a telephone information line, and to indirect customer needs, such as printing and distributing schedules on vehicles
- **Marketing** – markets transit services to the public via print, broadcast, or electronic media, such as placing advertisements in a local newspaper with new, improved transit service schedules
- **Public information** – actively communicates information about unplanned events, incidents, and services, such as informing broadcast media about service interruptions¹⁵

Ideally, the boundaries between the different customer information responsibilities within an agency should be transparent to the customer. To ensure that this occurs in practice, it

¹⁵ Planck, *Transit Marketing*, p. 30, adapted from: Lovelock, Christopher, Gordon Lewin, George Day and John Bateson. *Marketing Public Transit: A Strategic Approach*. New York, New York, 1987, p. 173.

may be advantageous to designate a public information officer responsible for coordinating all the various customer information activities.¹⁶ A person holding such a role can make sure that the information provided by the various departments is:

- consistent in image and style
- consistent and clear in content
- complete, correct, and up-to-date

These should be recognized as the three functions of customer information introduced in Section 2.3.1 – communicative, pedagogic, and operational.

To facilitate the success of meeting these goals, an agency should develop and use a communication manual which explicitly defines and specifies the tasks to be performed, the persons responsible for these tasks, and the image and style in which the information is presented.¹⁷

The three indirect contributors to customer information play a more passive, but no less important, role:

- **Planning** – develops the service description in terms of routes and frequencies
- **Scheduling** – develops the service schedules
- **Operations** – provides real-time information about service as operated

In addition to the information these departments provide, they also impact how information is provided. The planning group influences where signage or information booths can be located. Similarly, there can be operational implications of providing customer information. For example, supplying schedules on buses requires some understanding of vehicle-to-route assignment in the garage, and vehicle operators need to be able to correctly enter codes for headsigns and automated stop annunciators.

3.2. Customer Information as a Process

The task of providing customer information can be broken down into a three-step process, as illustrated in Figure 3-2 below. The first step is the **collection** of raw information from the various sources. This could include obtaining route descriptions from the service planning department, timetables from the scheduling group, agency fare policies from revenue, real-time vehicle locations from the automatic vehicle location (AVL) system, and incident reports from central dispatch.

¹⁶ Gothenburg Traffic Information Center, *Creating Messages*, p. 8.

¹⁷ Gothenburg Traffic Information Center, *Three Aspects*, p. 5.

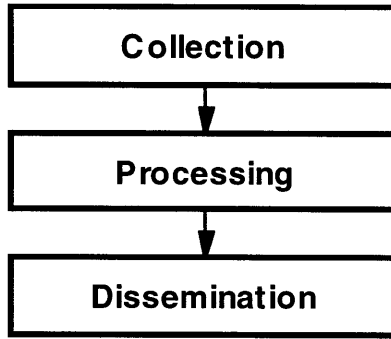


Figure 3-2: Three Steps in Providing Customer Information

The second step is **processing** the raw data into a usable form. With static information such as schedule or fare information, this is often simply reformatting it into a readable, publishable format. Maps need to be drawn from textual route descriptions, or they can be generated electronically from data in a geographic information system (GIS). And for a real-time bus arrival system, arrival times need to be predicted based upon current vehicle locations and historical information about traffic conditions.

The third and final step is the actual **dissemination** of information to the public through one of many means. Dissemination methods include paper schedules, maps posted on bus shelters and at transit centers, real-time bus arrival displays, telephone information center operators, electronic kiosks, and world wide web sites.

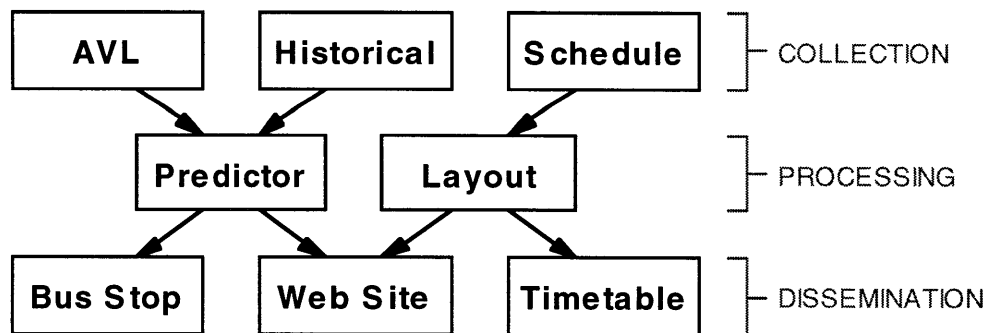


Figure 3-3: An Example of the Three Step Process

Figure 3-3 above illustrates the process for three information methods – a bus stop arrival time system, a world wide web site, and traditional printed timetables. In this example, AVL and historical data are fed to an arrival time predictor, and the resulting predictions are provided to the public via displays at bus stops and the world wide web site. In addition, schedule information is laid out for publishing, both on the web site and via traditional

printed timetables. Two real-life examples, the GoTIC project in Gothenburg, Sweden and the Regional Transit Database in the San Francisco Bay Area are examined in Chapter 5.

Dividing customer information provision into these three steps produces a more intuitive way of looking at interrelated information sources. This is of use in the financial analysis of a project – it becomes easier to identify and allocate shared costs among all appropriate information methods. Furthermore, customer information projects can be developed or upgraded to make efficient use of common data sources, which can reduce the overall budget for customer information. This idea is addressed further in the next subsection.

3.3. Methods and Strategies

The preceding example demonstrates that in a particular context, customer information is usually provided by multiple methods. It is likely that the benefits of an information source are largely dependent on these other methods that are being developed or are in operation at the same time. This is especially true from a cost-benefit standpoint. Therefore, this section defines two terms, information method and information strategy, to highlight this distinction. The information strategy is then expanded to include information provision by multiple transit providers.

3.3.1. A Customer Information Method

It was shown in the previous section that customer information methods overlap, using the same data sources and/or the same processing procedures. Therefore, an information method can be defined by its dissemination process, but should include the necessary data collection and processing functions. Multiple methods can share the same collection and processing components – in fact, doing so can allow more efficient use of resources.

The terms “information method” and “information system” can be used interchangeably. However, the word “system” carries with it a connotation of hardware and technology , while “method” is more inclusive of traditional methods like paper schedules or human telephone operators (it is difficult to consider a rail station agent as a system for providing information). Thus, “method” is the preferred term, and is used more extensively in this thesis.

3.3.2. The Information Strategy

An information strategy is the total information plan of a transit agency, composed of all activities that provide customer information to the public. It is important to consider all

information methods as a unit. In design, this helps maintain consistency between different types of information being provided, avoids unnecessary overlap in providing the same information to the same people twice (and helps prevent such information from being contradictory), and can ensure suitable coverage – that information is provided to all customers and meets all customers’ needs.

In operation, considering an information strategy as a unit can improve efficiency, by avoiding any duplication of effort, such as recollecting the same information and reprocessing or reformatting the same materials. Each method’s process can be optimized to make the most use out of available resources. In development, considering information provision as one larger strategy rather than as individual methods allows an agency to ensure that as many different customers as possible are receiving the information they need.

3.3.3. The Regional Information Strategy

In areas where transit service is provided by multiple operators, it may be necessary to use more than one service for any particular trip, or for a regular user of one agency’s service to use the services of another occasionally. To facilitate such multi-agency use, it is preferable to have some level of cooperation in providing information. Thus a regional information strategy is defined as the cooperative information strategy of two or more regional transit providers.

3.3.3.1. The Need for Consistency and Compatibility

To allow different services to perform seamlessly, information provided should be consistent across agencies. The information does not necessarily have to be identical in appearance,¹⁸ but should be intuitive to use. A regular user of one agency should be able to switch to another transit service, and easily obtain and understand the customer information that is provided. Thus the same types of information should be available for each agency, and the information should be obtainable via similar procedures and presented in a similar format.

The customer information methods used by each agency should also be compatible with one another. This allows one agency to provide information about others, which is essential for regional trip-planning as it saves the customer from having to call two or more different operators and allows the determination of an optimal route considering all

¹⁸ Marketing staff will insist that maintaining a unique identity is important in promoting a service.

available transit services. The technical specifications for the Metropolitan Transportation Commission's Regional Transit Trip-planning System require a system that can import schedule data from each of the many local transit agencies.¹⁹ In addition, the design specifications require a system that stores schedule data in a format that can be exported to other trip-planning packages used by individual transit agencies.²⁰

3.3.3.2. How Much Cooperation?

The level of cooperation between transit operators can vary substantially. At the very least, the cooperation can be classified into one of two categories: coordination or integration.

From an organizational standpoint, **coordination** can be informal, such as conversations between different agencies' staff, or formal through a regional body (such as an MPO). The San Francisco Bay Area's Metropolitan Transportation Commission sponsors a Regional Transit Coordinating Council of transit agencies, with a marketing subgroup for customer information concerns.²¹ Ideally, such a council would adopt standards for information content, appearance, procedures, and technology. At the very least, the coordination should encourage the reciprocal provision of relevant information about other agencies' services (such as including neighboring agencies' routes and applicable transfer agreements on a system map).

Taking the cooperation a step further means the **integration** of customer information provision. The degree of integration can vary, from only certain activities to full integration of all of customer information functions. The role of providing comprehensive information can be performed by one (or several) of the transit providers. Typically, though, a regional agency assumes this responsibility, such as the ROMANSE project run by the Hampshire County Council.²² In some situations, an independent organization can fulfill the role as information provider – these organizations can be publicly funded (like the Bay Area Transit Information Project World Wide Web site for the San Francisco Bay Area), or for-profit companies.²³

¹⁹ The Metropolitan Transportation Commission is the metropolitan planning organization (MPO) for the San Francisco Bay Area.

²⁰ GIS/Trans, Ltd., *Trip Planning System Specifications*, p. 2.

²¹ Metropolitan Transportation Commission, *Citizen's Guide*, p. 26.

²² See Chapter 5 for more information about the ROMANSE project.

²³ For-profit companies typically generate revenue through advertising or use fees.

While the integration model would certainly be preferable from a customer's point of view, it is often politically difficult to achieve. A high level of coordination is therefore a more realistic goal.

3.3.3.3. Obstacles to Cooperation

The benefits of cooperating in providing regional transit information are clear. However, there are several issues which can become obstacles to this. Three of these are identified and discussed in this subsection.

Expense

Generally, the more information an agency provides, the greater the cost. The use of technology can help limit this added expense. A system can be implemented such that an agency is responsible for entering and maintaining their data, and other agencies can then access it and relay it to customers with ease. However, it should still be expected that the cost of providing information will increase.

In a region without cooperation, the following sequence of events can occur. A customer contacts Agency 1 for information for a trip that includes Agency 2's service, and is therefore asked to call Agency 2. Under a cooperative relationship, Agency 1 provides the customer with the needed information about Agency 2's service, which results in more work and cost. However, presumably Agency 2 is providing information about Agency 1's service to some of its customers. Because of this zero-sum exchange, there should be no net increase in work or cost for either agency. But there are two flaws in this logic. First, by making it easier to get information and increasing the quality of that information, an increase in demand for information can be expected. Second, the assumption of a zero-sum exchange of customers is implausible.

An example of the latter point can be found in the San Francisco Bay Area. The Bay Area Rapid Transit District (BART) heavy rail system and Alameda - Contra Costa Transit District (AC Transit) bus operator use a single trip-planning package, TranStar, in their telephone information centers (TICs). A project is underway to expand this system to the more than two dozen other regional transit operators. BART Customer Service is concerned that once the public learns that BART, with their access to TranStar information, can provide most needed information about AC Transit services, demand on BART's telephone operators will increase dramatically.²⁴

²⁴ Bay Area Rapid Transit District staff, personal interview on March 1998.

One reason for this is differences in TIC staffing hours. AC Transit operates service from 5 a.m. to 1 a.m. seven days a week, but their TIC is staffed from 8 a.m. to 6 p.m. on weekdays only. BART, on the other hand, staffs their TIC from 6 a.m. to midnight (8 a.m. to midnight on Sundays), roughly the same as their service hours. It is reasonable to expect that people needing information when AC Transit's TIC is closed will call BART, even if they have no intention of using the BART system. Furthermore, if customers find that calls to one agency are answered quicker than to the other, they will call the more responsive agency, again regardless of whose service they will be using.

While to some degree this will result in a more efficient use of regional transit dollars, as telephone information demand will be spread more evenly, it is not very equitable. One solution could have an agency compensating another for the extra expense, but this is simply a first step towards some degree of integration.

Accountability

Besides cost, accountability is also an issue. There is a reluctance within transit agencies to give out other agencies' information, and having others provide their information. An agency does not want to be held accountable if they provide inaccurate information about another agency as a result of the other agency's negligence in keeping them up-to-date.²⁵ Similarly, the agency does not want to be blamed if another agency provides incorrect information about their services.

The same situation can arise if a third party is providing information for a transit operator. This has often been an issue with the San Francisco Bay Area Transit Information world wide web site, which provides information for more than two dozen transit agencies and several private operators. Accountability was especially a concern when the project was an "unofficial," independent effort.²⁶ There is unfortunately no simple solution to resolving this issue, other than through trials resulting in positive experiences.

Competition

In many regions, transit providers operate in active competition for a percentage of total transit ridership. It is therefore reasonable to expect that such an operator will not provide

²⁵ Alameda – Contra Costa Transit District staff, personal interview on March 26, 1997.

²⁶ For two years the Bay Area Transit Information Project operated without funding and without any official ties to government. The Project is now funded through a contract with the Metropolitan Transportation Commission.

information about its competitors, unless required to by regulation or contract.²⁷ This is an issue in communities like Southampton, UK, where several private operators are actively competing for patronage along the same (or similar) routes. Each operating company only provides information about its own services. Thus the local government needs to, in the interests of the public, assume a customer information role, as they have done with the ROMANSE project.

Note that competition can also be an issue with public operators, where these agencies provide similar services in the same geographic space. In this situation, if a cooperative arrangement cannot be worked out, some intervention from a higher governmental level may be necessary.

This issue of competition and customer information is revisited in Chapter 6.4.3, in considering the privately operated públicos in the San Juan Metropolitan Area.

3.4. Customer Information Characteristics

Suen and Geehan identified three components that characterize information methods:²⁸

- **Content** – what is the message?
- **Media** – the channel of communication, defined in terms of:
 - method: passive, active, or interactive
 - location: where in the trip journey is the information available
- **Form** - how is the message presented? (e.g. symbolic or literal)

A weakness of this structure is that it undervalues the importance of location. The stage in a trip in which the information is available strongly affects how that information can influence a customer's trip-making choices. In addition, the idea of form is not particularly useful in defining an information method. How a message is presented is more a function of the information content and the media used to communicate it.

Thus, this characterization can be modified to include four components: location, content, method, and media. These are developed further in the remainder of this section.

²⁷ If the private operator receives public subsidy for the services provided, they can be required to provide other information as a stipulation in their contract.

²⁸ Cassidy and White, "Use and Perceptions," p. 4, citing Suen and Geehan (1987).

3.4.1. Location

The first characteristic is location – where the information is provided to the user. This is defined both in terms of physical location and stage in the trip-making process. The physical location of a method influences the type of customer who can and will access it. However, the trip stage is more important. The stage of a traveler in a journey affects the type of information that needs to be provided, and how it can influence a traveler’s decision-making (as discussed in Section 2.4.1). The three stages are: pre-trip, wayside, and in-vehicle. Table 3-1 below lists these stages, the types of decisions that travelers can make at that point in time, and some examples of each.

Trip Stage	Decision	Location	Examples
Pre-trip	mode path departure time origin	home office shopping center	printed information telephone operator kiosk web site
Wayside	mode path wait activity	station / terminal transit center bus stop	posted system/route map real-time arrival display service delay annnc.
In-vehicle	path	vehicle	posted system/route map next stop announcement transfer options annnc

Table 3-1: Three Stages in Trip-making

3.4.2. Content

The second characteristic is the type of information provided. Content can be divided into three groups. The **static** category includes all information about transit service as scheduled, while **dynamic** (or real-time) information reflects transit service as actually operated. **Semi-static** information is a hybrid of the two, including information about longer term deviations from scheduled service.

Static information

Static information includes signs, maps, schedules, and other guides to using an agency’s transit service. The information typically changes on a regular basis – depending on the size of the operator this can range from every two months to every few years. It can be invaluable in learning about and making use of transit. However, static information loses its value if it is inaccurate, or unreliable service makes it appear to be inaccurate.

Dynamic (real-time) information

Real-time information reflects the current status of transit service. Examples of the type of information include vehicle locations, expected arrival or departure times, vehicle loads, incidents and delays, and connection information. This type of knowledge allows travelers to make informed decisions about their choices in making the trip. Real-time information, of course, changes continuously throughout the day.

Semi-static information

The third type is a hybrid of the two. Semi-static information is typically route or schedule change information that results from an unexpected situation, but has a life longer than a single day. Such information would therefore allow travelers to prearrange alternate transportation plans for the life of the service change. This is distinct from real-time information, where any changes to travel behavior are made either immediately before or during the trip.

Examples of events for which semi-static information should be provided include rerouting due to construction, anticipated delays due to vehicle shortages, or even effects of labor strikes. Such changes are usually temporary, but can also be permanent. Regardless, the timing of and means for providing this information typically differs from static information. Common methods of providing semi-static information include service bulletins posted in stations, at stops, and in vehicles, recorded messages on menu-based telephone systems, electronic mail subscription lists, and the news media.

3.4.3. Method

The next characteristic is the method of presenting the information. There are two dimensions to this. The first is the level of user interaction required or allowed in accessing the information, which affects the type of information that can be provided. An information source can be:

- **Passive** – fixed content, such as printed maps and schedules
- **Active** – changing content, such as television displays or public address announcements
- **Interactive** – user-directed content, such as telephone operators, kiosk-based trip-planning systems, or World Wide Web sites

The second dimension is how the user makes use of the information. Typically, a customer receives and digests information and then decides how to proceed with the trip. In some cases, however, the user is provided with recommendations or suggestions – this advisory

information is generally more useful but more difficult to provide. Printed information is clearly in the former category, while a route-planning kiosk system is in the latter.

3.4.4. Media

The fourth and final characteristic is the type of media used to disseminate the customer information. Traditional media includes print, such as schedules and maps, the spoken word (public address announcements), or telephone operators.²⁹ Technological developments have added to the variety of media used. These include voice-mail telephone systems, electronic display signs, cable television and teletext, touch screen kiosks, and the world wide web.

3.5. A Typology of Customer Information Methods

This concluding section provides a typology of customer information and information methods in use in the transit industry. The following two tables summarize the different types of information content provided, and the different kinds of media employed. The tables also indicate the locations at which each type is appropriate.

Content	Examples	Pre-trip	Wayside	In-Vehicle
static	maps schedules fares	✓	✓	✓
	points of interest itinerary planning	✓	✓	
	park-and-ride locations	✓		
semi-static	service change notices	✓	✓	✓
dynamic	arrival time	✓	✓	✓
	delays incidents vehicle locations	✓	✓	
	next stop major intersection transfer point transfer connections			✓

Table 3-2: Typology of Information Content

²⁹ Note that telephone operators can be assisted by a computer-based support tool such as a trip-planning system. The media classification refers only to the final point of communication with the customer.

Method	Media	Pre-trip	Wayside	In-Vehicle
passive	printed brochures	✓	✓	✓
	signs		✓	✓
active	cable television	✓		
	closed-circuit television monitors public address announcements		✓	
	electronic signs audible messages		✓	✓
interactive	telephone pagers hand-held communication devices kiosk	✓	✓	
	teletext telecommunications devices for the deaf (TDD) FAX computer Internet	✓		

Table 3-3: Typology of Information Media

4. Selecting and Evaluating Alternatives

This chapter presents a framework for transit agencies and regional organizations to use in making customer information implementation decisions. The framework provides a methodology for identifying and evaluating customer information methods, selecting and implementing a preferred set of methods, and evaluating the success of the implementation in meeting the desired goals and objectives.

The first section of the chapter identifies local considerations that influence the decision-making and evaluation processes, including discussions on user market segmentation and customer information needs. The second provides a general model for identifying appropriate information methods for meeting the customer needs. The third section presents a structure for evaluating customer information methods. This structure makes use of a set of evaluation criteria in analyzing alternatives with respect to the various benefits and costs associated with different methods. The fourth section uses the evaluation framework in developing a procedure for making implementation decisions within an agency or region. The chapter concludes with a “shopping list” of potential agency and regional goals and objectives for customer information. This summary also identifies the evaluation criteria critical in selecting alternatives to meet each goal.

4.1. Defining the Local Context

The most effective choices of providing customer information depend significantly on the various characteristics of the local context in which the information method will be implemented. There are three key areas in which local characteristics impact the evaluation, and therefore, selection of customer information improvements: the current situation of the transit agency (or agencies) affected, the demographics of transit customers (both potential and existing), and the specific needs of these customers. Each of these areas is discussed in more detail in this section.

4.1.1. Defining the Agency Context

An agency’s objectives in implementing a new customer information method depend heavily on characteristics specific to that agency. The agency’s age and ridership stability has a strong bearing on the information needs of customers. A new agency (or an agency introducing a new or significantly restructured service) will have different objectives in terms of the target audience, and types of information presented, than an older agency with

a well-established rider base. This is largely a matter of the agency's goals pertaining to ridership – whether a major emphasis is placed on attracting new riders to the transit services, rather than improving the quality of service provided to, and satisfaction of, existing customers.

Financial considerations are also an important consideration. If the agency is strictly limited in funding available for the project, both in terms of immediate expenses and longer-term maintenance costs, greater importance should be placed on evaluation criteria which measure cost-effectiveness. Other considerations include the level of staff resources and expertise that can be devoted to the task, versus the ability and willingness to contract out to a third-party consultant.

4.1.2. Identifying Market Segments

Section 2.2.2 introduced the idea of dividing the customer base into market segments. In this section, an example of a market segmentation for customer information purposes is provided. Following this is a discussion of how to prioritize these different segments in developing a customer information strategy.

4.1.2.1. An Example Segmentation

One possible market segmentation, consisting of thirteen segments, is outlined in Table 4-1 below. This is provided only as an example – again, how an agency develops its segmentation should depend on several factors including desired level of detail (tied to the budget available) and the composition of their potential ridership population (i.e. agencies in many smaller communities need not consider tourists in their information strategy as tourists may form an insignificant portion of the ridership).

This segmentation is drawn from three categorizing measures: familiarity with transit service, frequency of transit use, and primary trip purpose.

Familiarity with Transit Service	Frequency of Transit Use	Customer Type
Unfamiliar		Commute Non-commute Youth Senior / Disabled Tourist Non-user
	Infrequent	Commute Non-commute Youth Senior / Disabled
Familiar	Frequent	Commute Non-commute Youth

Table 4-1: Possible Market Segmentation

Familiarity with Transit Service and Frequency of Transit Use

Based on these two measures, customers can fall into one of three groups (a “first order” segmentation): unfamiliar, familiar/infrequent, and familiar/frequent.

Customers unfamiliar with the available transit services generally need a very basic level of information, and a certain degree of “hand-holding” to get them where they need to go. For these users, interactive assistance, be it via telephone operators or computer-based trip-planning systems, is of the greatest value.

Then there are those familiar with various aspects of the agencies’ services, but who use them infrequently. Such users are often knowledgeable about local geography, general transit network structure, basic rules and procedures, fares, and the locations of key termini and transfer points. What they do not know are details about specific routes, especially schedules. Such customers are well served by traditional static information, such as signs, maps and schedules, but would also benefit from interactive assistance and real-time information.

Finally, frequent users are fully knowledgeable about the route(s) used regularly. While they may occasionally need information about other routes and services, or of their regularly-traveled route but at different times of the day, their biggest need is for information about deviations from the regular schedule, be it the result of rerouting, delays,

etc. These customers would benefit most from “intermediate level” information, such as route change announcements, and real-time information.

These preferences are summarized in the following table (note that all information is of some benefit to all users).

First Order Segmentation	Type of Information			
	Static	Interactive	Intermediate	Real-time
Unfamiliar	+	++		
Familiar Infrequent	++	+		+
Familiar Frequent			+	++

Table 4-2: Preferred Information for First Order Segmentation

Customer Type

While the first-order segmentation defines groups in terms of the type of information needed, the second-order classification, based primarily on the type of customer and the likely trip purpose, is a means of differentiating how valuable information will be to a customer. The example segmentation defines the following subgroups accordingly:

- **Commuter** – timeliness is a strong priority, willing to pay more for a higher quality service, travels during the peak when headways are shorter but service is less likely to be on schedule
- **Non-commuter** – travels off-peak when headways are longer but service more reliable, longer headways increase the cost of missed connections
- **Senior / Disabled** – low value of time, accessibility of information is a priority
- **Youth** – low value of time
- **Tourist** – needs to know how to get to tourist attractions, no prior knowledge to be expected, language can be an issue, timeliness not very important
- **Non-users** – system perception is the most important concern

4.1.2.2. Prioritizing market segments

It is impossible to respond to every information need of every transit customer. A common factor among transit agencies is that budgets are limited, and as a result, it is impossible to meet the needs of all users. One therefore must prioritize the defined market segments, which can be done according to several factors:

- **Ridership Demographics** – a customer information source targeted at a market segment that comprises a large portion of the total ridership base will

provide greater total benefit than if it were aimed at a smaller segment; thus priorities can reflect the distribution of customers among the market segments

- **Mission Statement** – a transit agency’s primary mission may be to provide mobility to the disadvantaged, or to reduce congestion along key transportation corridors; these transit service priorities can be mirrored in the priorities for transit information
- **Transit Dependency** – related to an agency’s mission, priority can be given to those segments, such as senior citizens or youth, dependent upon transit as their only source of mobility
- **Value of Time** – in contrast, priority can be given to groups whose riders will benefit the most (per user) from an information source, using value of time as a key determinant
- **Access to Existing Information** – finally, segments that currently have poor access to transit information can be given higher priority.

This concept of segment prioritization is reintroduced with the method evaluation framework later in this chapter.

4.1.3. Identifying Customer Needs

The information needs of customers (both potential and existing) are related to current agency performance, as well as the types of riders using different transit services. These customer needs can be determined explicitly by market research, through any of the traditional methods such as surveys or focus groups, and from direct customer comments and complaints. The focus of this research can be directly targeted towards inadequacies in existing information provision. For example, riders may explicitly state that it is too difficult to find or access information (such as availability of schedules), that they are not aware of available transit services, that they spend too long waiting on hold when calling the information center, or that the telephone operators are incompetent and not helpful. Customers may also implicitly suggest the need for improved information. If there are complaints about on-time performance on high-demand routes or reliability in making transfers, for example, this may indicate a need for some form of real-time information provision.

One challenge to market research is in identifying potential for improvement that the customer is not familiar with. It can be difficult for a participant in a market research study to estimate a value for services which he or she has never been exposed to. Relying solely on direct customer input can limit both the range of customer needs that are identified and the range of alternatives that are considered. It is therefore important also to look at the activities of other agencies and determine if there is need for similar improvements within the local implementation.

4.2. Identifying Appropriate Methods

Having determined who the customers are, and what their information needs are, the next step is to identify what methods of customer information provision are appropriate for meeting these needs. The conceptual model illustrated in Figure 4-1 provides a five-step process for doing so.

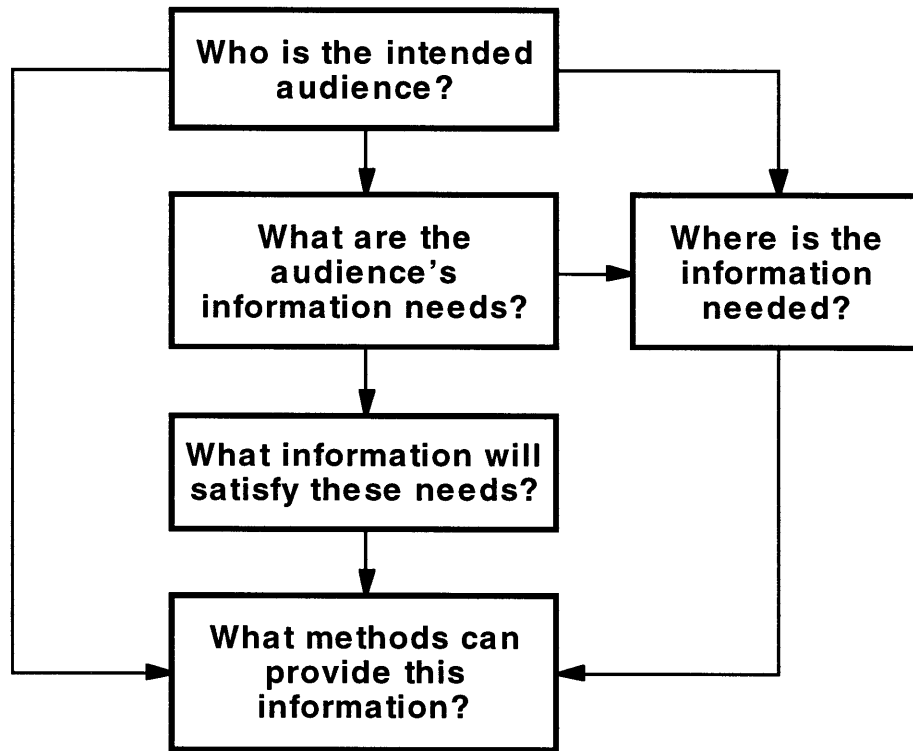


Figure 4-1: Identifying Appropriate Information Methods

This model suggests three factors in determining the available methods: for whom the information is provided, where this information is needed (both in terms of physical location and stage in the trip), and what type of information needs to be provided. The type of information desired is determined by the needs of the target audience. Where the information is needed is also a function of the audience and its information needs.

The generality of this model allows a quick cursory selection of possibilities for further examination. The next section extends the same concepts further, providing a framework for more detailed evaluation of the options.

4.3. A Framework for Evaluation

The framework presented in this section is useful both for identifying successes and shortcomings of existing transit customer information provision, and for evaluating proposed alternatives in anticipation of making customer information improvements. It is intended for use in:

- evaluating and identifying limitations with existing transit customer information,
- selecting and evaluating alternatives prior to implementation, and
- developing a program for evaluating the performance of the chosen alternative(s) after implementation.

However, while the criteria are useful in developing a post-implementation evaluation program, discussion of specific procedures for data collection and analysis for such a program is beyond the scope of this thesis. A thorough discussion of evaluating implemented systems is provided in the U.S. Department of Transportation's *Advanced Public Transportation Systems: Evaluation Guidelines*.³⁰

Driving the structure of this framework is the issue that the use, acceptance, and benefits of a transit customer information method are dependent on characteristics of the user, such as age, gender, trip purpose, and other parameters. Therefore, in order to evaluate a customer information method accurately and comprehensively, one must first divide potential users into appropriate market segments as described above and then analyze the various impacts of the method for each group of users, keeping in mind the priorities determined for each segment.

The evaluation takes place in three stages, analyzing factors which:

- influence the use of customer information methods by a particular customer,
- influence the benefits of information provided to a particular customer or the transit agency (or region), and
- influence issues relating to method implementation.

The following sub-section presents the complete evaluation framework, and explains how one can bring together the results of each stage of the evaluation, both to estimate the cost-effectiveness of a method and to examine the overall content and quality of information provided to the public.

³⁰ Casey and Collura, *Advanced Public Transportation Systems: Evaluation Guidelines*.

The remaining three sections describe each of the evaluation stages in greater detail and discuss the criteria useful in assessing the impact of each factor. An attempt is made to provide appropriate measures for evaluating methods according to each criterion – however, in many cases this is not possible and a qualitative description must suffice. The evaluation framework in Figure 4-2 below suggests that evaluation be carried out independently for each defined market segment. In practice this can be simplified somewhat, since many of the evaluation criteria proposed here measure performance that is not dependent on market groups. Tables in each of these last three subsections summarize the evaluation criteria, and include an indication of which criteria are indeed market-dependent.

4.3.1. Method Evaluation

Figure 4-2 illustrates the proposed evaluation methodology. The three evaluation stages mentioned above are represented by the three boxes with shaded headers. For each market segment *i* that has been identified, the likelihood that a customer in that grouping will use the information source is determined based upon the seven categories of factors listed in the box titled *Method Usage*. The particular information needs representative of customers in that market segment impact the use of a method both in terms of the quality of information provided (considering the content and relevance of the information) and its accessibility.

The *benefits of use* for a method are also determined as a function of market classification, and are divided into passenger benefits, both real and perceived, and agency (or regional) benefits. Perceived passenger benefits are also a factor in method usage – a customer simply will not use information if he or she receives no benefit from doing so, regardless of how accessible the information is. Performing some form of quantitative estimate of benefit requires determining some value for each benefit. This procedure is not at all straightforward, especially for many of the less-obvious perceived benefits, but is discussed further in Section 4.3.2.1.

We can measure the total value of a particular customer information implementation in two ways – in terms of the method's cost-effectiveness, and in terms of how well it integrates with existing customer information methods to meet the needs of the public. A cost-effectiveness analysis is aimed at determining whether or not the value of a method is worth the cost of implementation. In doing so, a traditional cost/benefit analysis can be used to compare the considered alternative with other options.

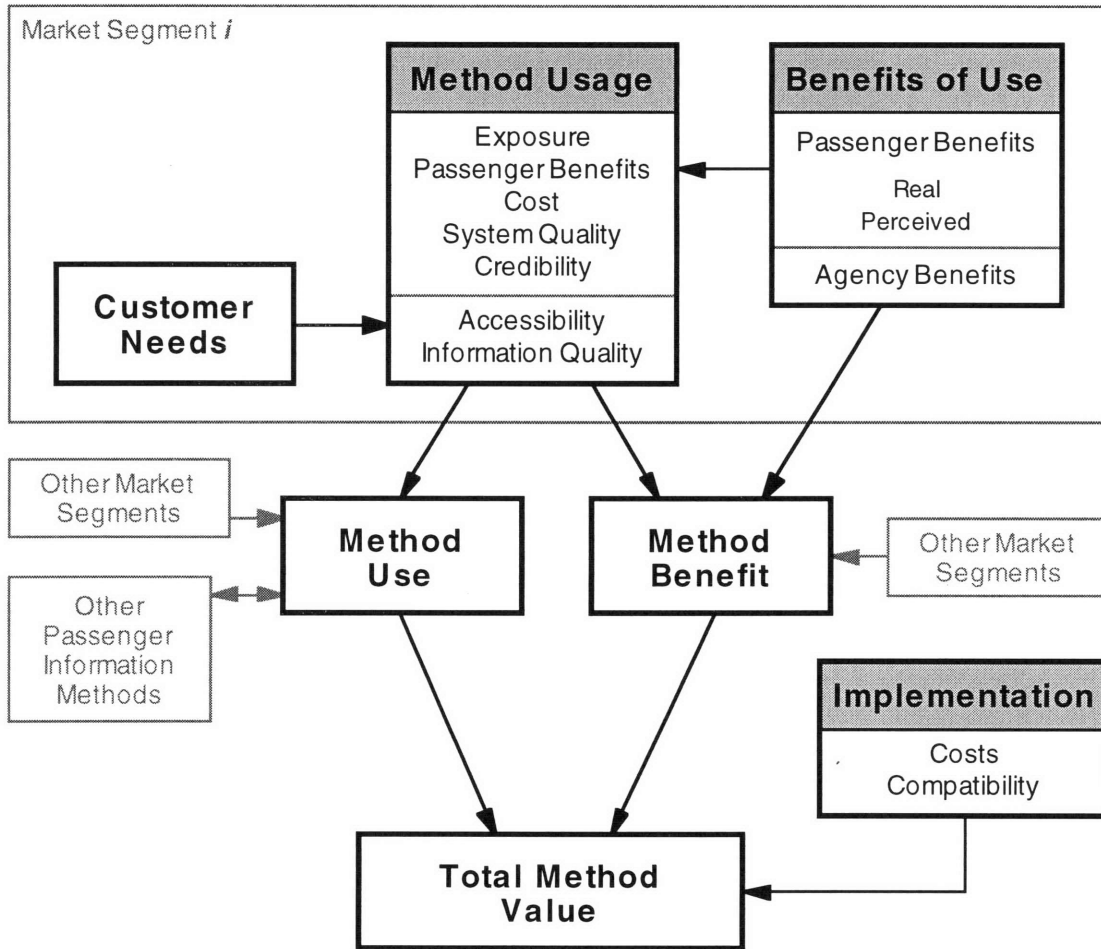


Figure 4-2: Evaluation Framework

An estimate of the value of a method to users in a particular market segment is simply the product of the likelihood of a customer using the information provided, as estimated by the method usage evaluation, and the expected benefits of using the source. The result is the expected benefit to a random member of the market segment being considered. The average of these values over all market segments, weighted by the size of each segment, gives an estimate of the total value of a method to an average member of the public. This can be illustrated mathematically by the following equation:

$$Value = \sum_i p_i \cdot U_i \cdot f_i$$

where p_i is the likelihood of a customer in market segment i using the information method available to him or her, U_i is the value of that information to that customer, and f_i is the proportion of customers (existing and potential) in that market segment.

In Section 4.1.2.2 the importance of prioritizing market groups was discussed. This formulation can be extended to include these relative priorities of each market segment in the analysis. This is accomplished by weighting each component in the summation by a factor, w_i , indicating the relative priority of each market segment:

$$\text{Weighted Value} = \sum_i p_i \cdot U_i \cdot f_i \cdot w_i$$

The selection of the prioritization factor w_i is somewhat arbitrary, as long as the relative priorities of each market group under consideration follows the true priorities of the agency. A segment with a weighting factor double that of a second group will have twice the impact on total method value.

A deficiency in the cost-effectiveness approach is that it ignores the role of a particular method for providing transit information within the overall customer service function of the agency (or agencies, in a regional context). Even if a method appears to be very cost-effective in providing a specific set of information to a specific segment of the population, it may not be equitable in addressing the needs of the public as a whole. There is a need (both ethical and legal) to provide sufficient information to, as an example, visually- or hearing-impaired customers. This may come at considerable additional expense, and therefore might not be justified under a purely objective cost-effectiveness analysis. Thus, a second approach looks at how an implementation alternative fits within and integrates with the other existing methods providing customer information, and considers where information needs are not being met.

A second shortfall with a cost-effectiveness evaluation is, as will be illustrated in the following sections, that many of the criteria cannot be measured quantitatively. As a result, a less “mathematical” evaluation becomes a necessity.

4.3.2. Evaluating Information Use

For an information service to provide any benefit, it needs to be used. It is therefore important when performing an evaluation to understand and consider the factors that influence the use of a method. An individual’s decision to make use of the information provided to them can be separated into three key stages, as illustrated in Figure 4-3 below.

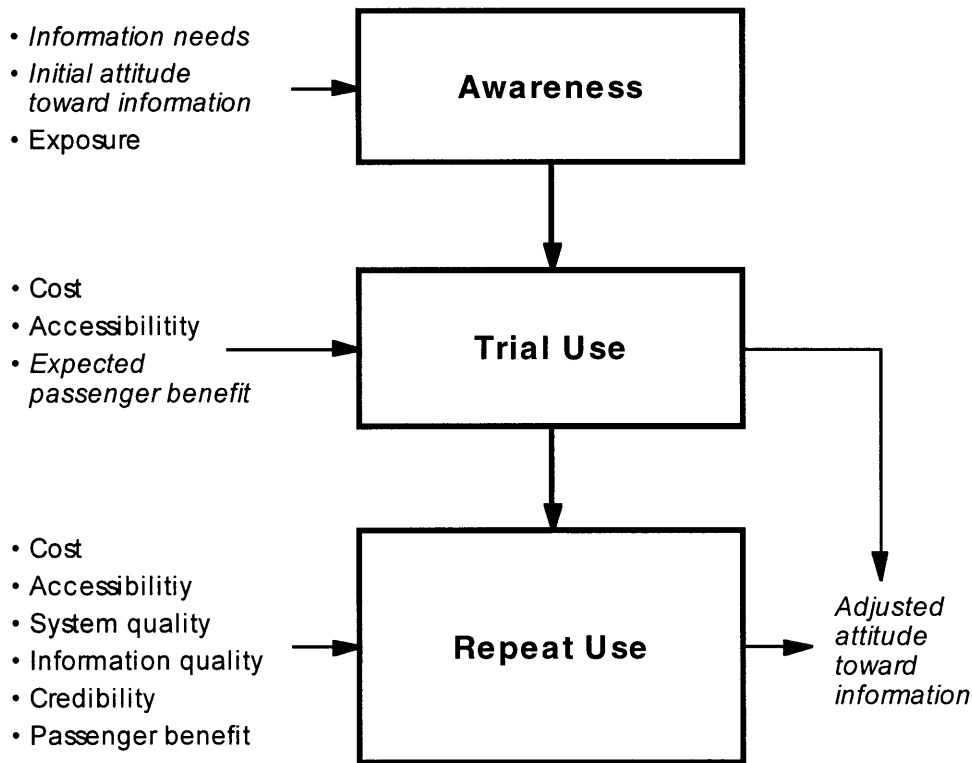


Figure 4-3: Information Use Decision Process

Polydoropoulou et al., in modeling the use and adoption of Advanced Traveler Information Systems (ATIS), state that a user’s **awareness** of an ATIS system “is dependent on their...information needs, their attitudes toward...information, and their exposure to [the system] via media marketing campaigns..., word-of-mouth, or direct mail.”³¹ The first of these, *information needs*, is italicized in the figure above to indicate that it is not a characteristic of the information source, but rather is dependent on the local context. The user’s *initial attitude toward information* is also not a function of the information method being evaluated; instead it is formed by the user’s prior experience with other information sources and their ability to provide benefit to the customer. However, an individual’s *exposure* to the source, via the visibility of the method and marketing and publicity given to it, also determines whether or not the user knows to look to the source for the information he or she needs.

With awareness of the information source, the user then makes a decision on a **trial use** of the method. This initial decision is first based upon the *cost* of the method, in terms of time and money. The *accessibility* to the information is the next factor – if the customer cannot

³¹ Polydoropoulou, et. al. “Modeling User Adoption of ATIS,” p. 2.

get at the information (because of its location, hours of availability, interface, etc.), no trial use is possible. Finally, a customer's expected benefit is a factor in this decision – to justify using an information source, one must expect to gain something from it (especially if there is a cost associated with its use).

If the trial use is successful, the customer will choose to continue making use of the information source. This **repeat use** decision is determined by seven factors. Once again, cost and accessibility are an issue. In addition, system quality (in terms of reliability) plays an important role in the user's ability to get at the information. If a system is malfunctioning or the stock of schedules have run out, the customer is out of luck. Information quality is the fourth factor. The relevance of the information in terms of the customer's needs is important. If the customer's questions are not answered, he or she has gained nothing from it. Accuracy is also an issue – if the information is incorrect or misleading, it will have little, no, or even an adverse impact. In addition, the user must decide whether or not to accept the information provided. For a variety of often cultural reasons, a customer may choose to ignore what has been provided. This credibility of a method can also be affected by its perceived quality. Once again, a customer must gain some benefit from the information provided to warrant using it. Many of these benefits will be described in the next subsection.

Subcategory	Evaluation Criteria	Market-dependent
Exposure	Publicity Visibility	✓
User Cost	Price Time	✓
Accessibility	Location Interface Complexity Availability	✓
System Quality	Reliability	–
Information Quality	Accuracy Relevance	✓
Credibility	Credibility	✓
Passenger benefit	Real benefits Perceived benefits Psychological benefits	✓

Table 4-3: Use Criteria

It is worth noting that a user's experiences with an information source in both the trial and repeat use phases has an impact on his/her attitude to information. This is indicated in italics in the illustration above. A consequence of this is that a user's positive experiences will have a positive impact on his/her use of other and future information sources (and similarly, negative experiences will lead to a negative impact).

Table 4-3 identifies sixteen evaluation criteria for the seven factors specific to the information method that influence the user's decisions in these three stages. These criteria are discussed below in detail.

Exposure

A potential user's exposure to an information source can be evaluated by two criteria – publicity and visibility.

Publicity

A crucial factor in the use of a customer information method is the amount of publicity that it is given. While this is usually not a characteristic of the information source itself, it is a component of the implementation procedure. Some means of publicizing information include signs directing users to kiosks, print advertisements for telephone information centers, and references on other information materials (such as listing an agency's web site address on printed schedules and maps).

The impact of successful publicity can be tremendous. Following a San Francisco Examiner newspaper article about the San Francisco Bay Area Transit Information web site, the first non-Internet publicity of the service, use of the site increases more than 2.5 times to 490 users that Sunday from 184 the previous week.³² Similar increases in use have immediately followed more recent publicity events. In these cases where events have been discrete and very infrequent, use has decreased within the following week, but has always remained at levels higher than immediately before the publicity. The impact of continuous publicity on use of an information source should therefore be even more positive.

Visibility

Also of impact on exposure is the physical placement of the information source. A primary concern resulting from a preliminary evaluation of the London RiverBus real-time information system, which uses television monitors to provide departure and arrival times for the next boat, was that some monitors were placed in such locations that people

³² Gildea and Sheikh, "Applications of Technology," p. 73.

following normal pedestrian flow within the terminal could not see them. As a result, many customers were unaware of the service.³³ It was firmly believed that system use would have been greater had the display been better located.

User Cost

The cost of using an information source can be both monetary and in terms of time spent:

Price

Price reflects the out-of-pocket cost of accessing the information. Such costs can be direct, such as the price of a printed system map or the cost of a local telephone call. On the other hand, indirect costs are common for higher-technology systems, such as one-time equipment purchases and monthly fees for pager access or Internet service. Direct costs are typically known, while indirect costs can be more difficult to allocate.

Time

The time needed to access the information is measured in terms of opportunity cost – time that could have been spent doing something else. For example, receiving transit information via the radio means listening to the appropriate radio station instead of one's favorite music. As the time spent accessing transit information could instead be spent earning, the cost of this time can be estimated using value of time calculations. Alternatively one could use stated preference surveys as a means of estimation.

Note that the time required to access information is often a function of the complexity of the method, such as the number of buttons needed to press on a telephone to access a voice-mail based system.

Accessibility

If a user cannot access an information source, they clearly cannot make use of it. Additionally, if accessing a source is inconvenient, a user may choose not to use it, even if it is technically accessible. Equity is a primary concern in accessibility of information sources – for example, Internet-based systems are primarily useful to only specific subsets of the population. There are four components to method accessibility:

Location

The physical location of an information source affects where and by whom it can be accessed. Home-based methods, such as cable television, cannot be used when one needs

³³ Cassidy and White, "Use and Perceptions," p. 8.

information at work. Similarly, a wheelchair-bound customer cannot read, and therefore, use a television display monitor mounted high in the air, or even a timetable posted on a bus stop post if it is facing the street and there is insufficient space between the post and the curb for a wheelchair.

Interface

The physical characteristics of an information method's interface can also be a barrier to use. Some methods may have prerequisites for use, such as an Internet web site which requires a computer and modem, or cellular services which require a cellular telephone or pager. Others may simply be more attractive or less intimidating to some users. A study of kiosk terminals in the Los Angeles area concluded that there was a greater propensity for males aware of the kiosks to make use of them, which "may indicate a greater interest or willingness."³⁴

A California PATH research report determined that "the single most important characteristic of public transit use for blind and vision impaired people is...related to...improving access to information."³⁵ Printed materials must be available in Braille versions to be usable by vision-impaired customers. Most larger agencies allow customers to communicate with information center staff via Telecommunications Devices for the Deaf (TDD). And real-time information must be provided both visually and audibly for both the hearing- and vision-impaired, as is mandated by the Americans with Disabilities Act (ADA) for stop announcements. The ROMANSE STOPWATCH bus arrival time display system provides impaired riders with electronic key chains to activate the audible messages.³⁶

Complexity

A very complex, or poorly designed interface, may limit the range of customers who can make effective use of the method. A common complaint with telephone voice-mail based systems is that navigation can be difficult, especially when several menu levels must be traversed or menus have many different choices. Computer-based interfaces, including kiosks, often have interface design problems that hamper use. The GoTIC Project has interviewed customers using different kiosk interface prototypes to develop a set of recommendations for interface design.³⁷

³⁴ Giuliano, et. al., *Los Angeles Smart Traveler Field Operational Test Evaluation*, pp. 99-100.

³⁵ Golledge, et. al., "The Mass Transit Needs of a Non-Driving Disabled Population," p. ii.

³⁶ Hampshire County Council, "ROMANSE II," p. 2.

³⁷ Gothenburg Traffic Information Center. *Requirements for the Formation of Interactive Interfaces*.

Availability

A common problem with telephone information centers is that they can be expensive to staff twenty-four hours a day, or even during the full service hours of a typical agency. The times during which a particular information source is available has some impact on its utility. Many users can plan ahead and find out the needed information during hours when it is available. However, an information center with relatively restrictive hours, such as 8 a.m. to 6 p.m. Monday to Saturday for a transit agency with service hours from 4 a.m. to 1 a.m. every day will not be available to serve all users. Note that the time when a user needs information is related to both the type of information needed and the type of trip decision being made.

System Quality

The quality of an information system is also important, and can be measured in terms of reliability. Regardless of the accuracy of the information provided and the benefit such information gives to customers, if a system is not working, it is useless. In the case of higher-technology electronic systems, or even telephone information centers, the downtime rate (the percentage of time a system is inoperative) is important, as is the time of day when these downtimes occur. This idea can be extended to more traditional information sources such as paper schedules and maps – here unreliability is measured as the frequency with which the supply of schedules runs out at a particular location.

Information Quality

The quality of information provided by an information source depends not only upon its accuracy, but also its relevance to the information needs of the user.

Accuracy

The accuracy of information provided to the public is of unquestionable importance. In many cases, no information is better than wrong information – for example, if a potential passenger has a map of routes but no schedule, he will either call the agency for times or simply allow for more time waiting at the bus stop, but if the map has an outdated schedule on it, the passenger may time the trip perfectly, only to have no bus arrive when expected. Not only will this adversely affect the customer's trip, it can also lead to a customer's distrust of other information an agency provides.

Inaccuracies can result from several causes. First, if the process of updating the information as required by the particular method is distanced from the routine scheduling and operations functions of the agency, it is possible that the update will be overlooked.

This is particularly the case when the information is provided by an entity other than the service provider. A second cause for inaccurate information is when the time and cost required for an update is prohibitive. For example, if an agency posts schedules at each bus stop and then undergoes a system-wide schedule change, they will likely not be able to replace all schedules in the short time (perhaps only several hours) between effective periods of the schedules.

The ideal agency goal should be for provided information to be 100% accurate. In the case of static information, while the information as provided can meet this 100% accuracy level, the issue, as mentioned above, is in removing outdated, inaccurate information from distribution and replacing it with the updated information. For this the agency can establish a performance measure, such as replacing all bus stop-mounted schedules within 7 days after a service change or providing both current and new schedules on an Internet site at least two weeks prior to the effective date.

With pocket timetables this becomes more difficult as once they are in the possession of a customer, the agency loses the ability to retrieve them. One solution is to print an “expiration date” on the timetable. If this date is known *a priori*, this can be done with no incremental cost to the agency. In many cases, however, the decision to adjust a particular route’s schedule is made at some point after timetables have been printed and distributed. While a conservative guess at an “expiration date,” such as the next system-level schedule change, could be used, this would require unnecessarily reprinting timetables for routes with no changes, at additional expense. To counter this, some agencies provide timetables for all routes within a single publication that is reprinted with each scheduled service change. Smaller agencies can print the schedules on the back of a system map, while larger agencies publish a system timetable booklet.

It is not usually possible to provide real-time information with perfect accuracy. This is especially true in the case of predictions, such as vehicle arrival times at transit stops. The longer the time until the predicted event, the less accurately a prediction can be made – in the arrival time example, this is due to variations in traffic conditions and loading patterns. An agency should therefore set a range of performance levels for the method. See Table 5-3 in Section 5.1 for target accuracies used in evaluation of the London Countdown project.

Relevance

To provide information that is relevant to the specific, immediate needs of all customers, an agency will need to provide information about all components of the transit system.

Information sources which exclude some types of information or information about some transit services will not be able to answer some customers' questions. However, there is also the issue of information overload – faced with an overwhelming amount of information about the entire transit network, it is difficult for a user to extract the information he/she needs in a reasonable amount of time.³⁸

Thus the question is how to provide each user with only what he/she needs. With traditional static information, there is no perfect answer – instead, a compromise is necessary. Perhaps the best an agency can do is provide information in levels, with only the most basic information about the entire system, but very detailed information about services that are most likely to be needed in that context. A good example is the information provided at several BART stations:³⁹

- System map – posted, showing a basic geographic basemap overlaid with the five BART routes and 39 BART stations
- Neighborhood map – posted, showing station exits, surrounding streets and nearby landmarks, and connecting bus service
- Connecting Bus Timetables – posted (if few enough routes)
- BART Timetables – printed, available nearby
- BART Pamphlets – printed, available nearby, with all other information

Information methods with interactive interfaces, such as electronic kiosk terminals or human information officers (in person or via telephone), can avoid this concern by presenting only the information the user selects. A kiosk-based trip-planning system can, based upon the users input, provide one or more alternative routes, listing route numbers and times, stops, transfer locations, applicable fares, and maps of the route, including neighborhood maps at the origin and destination.⁴⁰

Credibility

Even if information provided is accurate and relevant to the user's needs, it is still not certain that the user will perceive it as such and trust it.

Perceived Accuracy

Research conducted in conjunction with the GoTIC Project identified the issue of perceived accuracy. This is not strictly a problem with accuracy, but rather a problem with the user believing the information is accurate. If information posted has not been adjusted in some

³⁸ Gothenburg Traffic Information Center, *Three Aspects*, p. 7.

³⁹ MacArthur Station, Bay Area Rapid Transit District (BART), Oakland, California.

time, information that is perfectly accurate may appear to be out-of-date purely because of its aged physical appearance.⁴¹ In addition, service needs to operate consistent with schedule – if a bus leaves too early, information can seem out-of-date even if it is indeed correct. This again demonstrates the close link between service information provided to customers and the service operations represented.

Cultural Issues

There can also be cultural influences which affects information credibility. For example, in Puerto Rico, there is a tendency for people to trust information obtained from a human being, more than information from a sign, or even worse, from a computer.⁴² Conversely, one could argue that some groups in the United States would rank these in the opposite order, being more likely to believe electronic information before printed information, and that before information obtained from a person.

Passenger benefits

While passenger benefit is an important factor in the use of an information method, it is also a key component in the method's overall evaluation, as was illustrated in Figure 4-2. Thus, passenger benefits are discussed in the next subsection.

4.3.3. Evaluating Information Benefits

The success of a customer information method from the user's perspective is determined by the benefits the user can realize from the information, the quality of the information, and the availability and cost of accessing that information. The criteria reflecting these aspects are listed in Table 4-4 below and described in greater detail in the remainder of this subsection.

⁴⁰ Gothenburg Traffic Information Center, *Requirements for the Formation of Interactive Interfaces*, p. 3.

⁴¹ Gothenburg Traffic Information Center, *Three Aspects*, p. 7.

⁴² Toledo, Freya, personal interview on January 19, 1996 and Edgar Figueroa, personal interview on January 22, 1996.

Subcategory	Evaluation Criteria	Market-dependent
Real Passenger Benefits	Travel time savings Travel time efficiency	✓
Perceived Passenger Benefits	Travel time savings	✓
Psychological Passenger Benefits	Confidence and stress Security Comfort Service perception	✓
Agency Benefits	Ridership	✓
	System efficiency System perception Indirect benefits	-

Table 4-4: Benefit Criteria

The benefits to a user can be either real or perceived – in the case of customer information improvements, the perceived benefits often outweigh the real benefits. A common measure of these perceived benefits (which also includes at least one real benefit) is the “decreased disutility of wait time”, which captures the reduced stress, increased confidence and security, and travel time efficiency benefits.⁴³ This concept aims to simplify measurement of these benefits by estimating a new value for out-of-vehicle travel (wait) time.

A second measure aiming to quantify the benefits of customer information is a user’s “willingness to pay.” This can be determined through customer surveys by explicitly asking how much of the fare would they want directed toward improved information services. For real-time bus arrival time information this has been estimated to be as much as 25% of the average bus fare.⁴⁴ As some customers may feel that these services should be provided by “the government” at no extra cost to the user, the total value to all users may not be fully captured by willingness to pay estimates.⁴⁵ However, there is some question as to the overall reliability of willingness to pay estimates as a measure of value. See the section on evaluating information benefits in the London Countdown case in the next chapter for an example of willingness-to-pay as determined through surveys.

⁴³ Reed, *Waiting for Public Transit*, p. 41.

⁴⁴ Lam, *The Application of Information Technologies*, p. 143, citing: Warman, Peter and Robert Sheldon, “Real-time Information for Bus Travelers in London,” Steer Davies & Gleave Ltd., 1984.

⁴⁵ Cassidy and Jones, *ROMANSE: Recommended Programme*, p. 90.

Real Passenger Benefits

Real passenger benefits result from changes in passenger behavior. This can be changes in trip, mode, route, or time, but can also be changes in waiting behavior, such as getting coffee while waiting for a bus to arrive.

Travel time savings

The primary benefit of a successful information method to the transit passenger is a reduction in travel time – a fundamental desire for all travelers is to reduce the length of their trip. While there is no real change in vehicle schedules or travel times attributable to improvements in customer information⁴⁶, increasing the user's knowledge of transit services can reduce the length of a particular passenger's trip. First, by learning more about available transit services, a passenger may switch from a different mode to transit or between different transit routes, if such a switch provides a faster trip. The switch between transit routes becomes especially useful in the presence of real-time information – knowing the location and predicted arrival time of a vehicle on one route could influence a passenger to choose an alternate route if it would result in an earlier arrival at his or her destination.

Second, a transit passenger can reduce his or her waiting time due to knowledge of scheduled arrival time or, in the case of real-time information, expected arrival time. Where transit service is very reliable, static information about scheduled arrival times will suffice in allowing passengers to time their arrivals to minimize wait time at the transit stop. In many cases, though, the stochastic nature of transit service results in uncertainty in arrival time. In these cases, higher quality real-time information is needed for passengers to minimize their wait time by both timing their arrivals to meet the vehicle at the stop and finding a better alternative when wait times are predicted to be large.

Measuring reductions in travel time resulting from improved customer information is difficult. Surveys can be used, although it is generally found that riders perceive a greater decrease in travel time than is actually experienced. This perception is discussed further in the next subsection. Instead, one can quantify the customer response to information in terms of the changes in travel behavior identified in Section 2.4.1 (such as changing mode or route) from surveys and observation. For each behavioral change, a mean value of

⁴⁶ This is not entirely accurate – a real-time customer information system may employ an Automatic Vehicle Location system which can also be used for operational purposes (see section 4.3.3.1 on page 77 for a discussion of these indirect benefits).

benefit can be estimated – for example, Hickman used a simulation based on a theoretical path choice model to quantify some of these benefits.⁴⁷

Travel time efficiency

A more abstract benefit to passengers results from the more efficient use of travel time. With a good prediction of the arrival time of the next bus on a route, passengers can make more productive use of their wait time to get coffee, make phone calls, run short errands, etc., without worrying about missing the bus. Similarly, in-vehicle systems that announce stops relieves the passenger of paying close attention to the vehicle location, and he or she can therefore focus more on reading, sleeping, or conversing with a fellow rider.

Measuring these benefits again is difficult. One can use the “decreased disutility of wait time” approach to quantify the benefits in terms of reduced cost to the passenger. An alternative is to determine a qualitative estimate of the benefits via a stated preference survey of transit riders. This estimate can be improved by reconciling the results of a survey with observations of passenger behavior at stops.

Perceived Passenger Benefits

A customer may believe that he or she is benefiting from information provided, even if this is not actually true. This is typically the case with travel time.

Travel time savings

An information method alone does not affect transit service operations.⁴⁸ If in the presence of information (real-time or otherwise), a customer does not choose to alter his/her travel behavior, he/she will not experience any real reduction in travel time. However, studies show that riders provided with real-time information perceive their waiting time as less than the actual wait. This therefore gives the perception of improved service and thus is a benefit. Evidence of perceived travel time savings is presented in both the London Countdown and STOPWATCH case studies in the next chapter.

Psychological Passenger Benefits

The following four criteria, confidence and reduced stress, security, and service perception all involve psychological benefits to the transit customer. These differ from the perceived benefits in that in this case the customer is experiencing a change in attitude, rather than a

⁴⁷ Hickman, *Assessing the Impact of Real-time Information*, pp. 114-143.

perceived change in a real attribute. These three reflect aspects of comfort that play an important role in quantifying the “cost” of riding transit. Therefore, like travel time efficiency, one can use the theoretical concept of “decreased disutility of wait time” to quantify the benefits in terms of reduced cost to the customer. A simpler alternative, again, is to determine a qualitative estimate of the benefits via a stated preference survey of transit riders.

Confidence and stress

A major deterrent that keeps riders away from transit is the stress and anxiety that result from the uncertain nature of transit service. Transit riders are often unaware of how long it will be until their bus comes, whether or not they have already missed it, or whether or not they will make it to a transfer point in time to meet their connecting bus. This uncertainty gives passengers a feeling of powerlessness, and can be a critical factor in the decision not to use transit if the rider must reach their destination by a specific time. Providing accurate real-time information to customers, be it “next bus” arrival time information at a transit stop or transfer information on a vehicle, helps reduce this uncertainty, and should subsequently reduce the number of travelers who choose not to use transit because of this deterrent.

Security

Passenger security is another area in which customer information can improve the comfort of the transit rider. Surveys conducted in London, U.K., have found that some passengers waiting at bus stops at night feel an increased sense of security in the presence of real-time “next bus” arrival information.⁴⁹ Such a system provides the ability to “see” a bus while it is still beyond the passenger’s field of vision, which reduces the sensation that the passenger is waiting alone for a bus that may never show up.⁵⁰

Comfort

When assisted primarily by real-time information, customers can choose which transit vehicle to catch based upon passenger load, thereby avoiding crowded vehicles and increasing their level of personal comfort during the journey. Survey results for the London Transport Countdown project reviewed in Section 5.1 show that some customers did indeed do this. If they saw that a bus was very full, and the Countdown displays indicated

⁴⁸ An AVL system supplying real-time customer information can also be used for dispatching purposes, impacting operations and possibly reducing travel times – this, however, is not a benefit of the information component of the system.

⁴⁹ Atkins, “Passenger Information at Bus Stops,” p. 11.

⁵⁰ Reed, *Waiting for Public Transit*, p. 24.

that another vehicle would be arriving soon, some customers would wait for the second bus.

The NextBus real-time bus information system, currently in conceptual design for a trial installation on the Emery Go-round shuttle service in Emeryville, California, plans to take this a step further. The BusTracker pocket display, similar in size and form to a high-end pager, will provide real-time bus arrival formation to customers wherever they may be. In addition, the system plans on indicating current passenger loads on vehicles.⁵¹ Customers can therefore make this comfort decision before reaching the bus stop, thus being able to choose to wait longer before leaving for the stop or even using a different mode of transportation from a different point of origin.

Service perception

Another perception that transit riders have when provided with improved customer information is that of higher-quality overall service.⁵² Providing information in a neat and comprehensive manner has an effect similar to that of a clean vehicle or station – that the transit service is well managed and operated. While this criterion is also included as an agency benefit, this perception of improved service quality results in a more enjoyable transit experience for the customer.

Agency/Regional Benefits

Apart from the passenger benefits discussed above, customer information can provide other benefits to the transit agency (or metropolitan region).

Ridership

The primary benefit to the agency of a successful information method is increased ridership as a result of the passenger benefits listed above. Increased ridership reflects a more efficient use of transit services provided, an increase in revenue for the agency, and an increase in social consumer welfare (a switch to transit from a different mode or the generation of a new trip is an indication of increased consumer benefit to the customer involved). Unfortunately, measuring an increase in ridership attributed solely to a change in provided information is difficult. Even if all other controllable factors (i.e. service frequency or fare) are unchanged, a change in ridership could still be attributed to an exogenous cause. In practice, however, a change in information occurs simultaneously with other changes, and thus a resulting increase in ridership cannot be reliably attributed to

⁵¹ NextBus WWW site, <<http://www.nextbus.com/>>.

any one cause. An evaluation of the impact of customer information projects on ridership is presented in the London Countdown and STOPWATCH case studies in the next chapter.

System efficiency

Successful customer information can promote the efficient use of the transit system. Well-designed and well-placed signage can improve passenger movement and circulation in terminals and on vehicles,⁵³ reducing crowding and consequently, space requirements and dwell times. Information can also assist a more efficient distribution of passengers over the transit network, as users with more knowledge can make better decisions about their trips.

This is especially true during service disruptions – with poor information, customers are left stranded, waiting for service to be restored. Once service is resumed, the impacts of the disruption can continue for hours until the system has a chance to catch up and stabilize. If customers are well-informed about the incident and other travel options available to them, they can choose an alternative routing to complete the trip. Thus, when the disrupted service resumes, service can quickly be restored to normal.

System perception

Enhanced system perception resulting from well-provided information was shown to improve customer satisfaction with the overall transit service. This demonstrates that successful information provision can be an effective marketing tool, enhancing and promoting the quality of the transit product. Clearly high-technology information systems have the edge here, conveying the idea that a transit agency is “on the cutting edge,” not only with respect to information technology but also overall transit service.

Indirect benefits

An information method can have other benefits beyond the realm of customer information. The best example of this is the Automatic Vehicle Location (AVL) component of a real-time information system, which can also be used for performance monitoring and dispatching purposes. Rather than try to determine the benefits of these secondary⁵⁴ functions and include this in the information method evaluation, it is easier to ignore them and consider only the portion of the costs that are allocated to the information function. This is discussed further in the next subsection.

⁵² Cassidy and White, “Use and Perceptions,” p. 11.

⁵³ Hickman, *Assessing the Impact of Real-time Information*, p. 48.

⁵⁴ Secondary from a customer information perspective.

4.3.4. Evaluating Implementation Issues

Table 4-5 summarizes the evaluation criteria pertaining to the implementation of the information method.

Subcategory	Evaluation Criteria	Market-dependent
Costs	Implementation cost Operation cost Maintenance cost Implementation time	–
Compatibility	Technical specifications User interface	–

Table 4-5: Implementation Criteria

Agency/Regional Costs

There are four components to the “cost” of a customer information implementation – the implementation, operation and maintenance costs, and the implementation time. Each of these are relatively straightforward to measure. Costs (for both labor and equipment) can be estimated to a reasonable degree of accuracy from other agency’s experiences and current market prices. Similarly, implementation time can be projected with some accuracy.

Implementation Cost

The implementation cost is a one-time expense, which includes preliminary research, design, procurement, and installation. It can be helpful to consider these costs separately for each of the three stages of information provision – collection, processing, and dissemination – that were introduced in Section 3.2. Doing so eases the task of allocating costs for components of a method which provide benefits other than customer information.

An example of this would be the AVL component of a real-time bus arrival system, which could also provide information for dispatching and service monitoring functions. These costs should be considered with the indirect, secondary benefits in mind. If the AVL system was already deployed, or would have been regardless of the information component, it may be best in the evaluation to consider only the incremental cost of the adding the customer information function. This would consist primarily of the remaining components, including the arrival prediction computer (processing) and the bus stop variable message signs (dissemination).

Operation Costs

Operation costs include the costs of updating information, printing schedules and maps, and other such expenses. Again, separating tasks into the three stages can be a useful way of allocating costs.

Maintenance Costs

Maintenance tasks include servicing, repairs, and replacement of hardware and other equipment. This includes replacing and upgrading electronic equipment, computers, and software, as well as repairing signs and posts. The susceptibility of the equipment to weather damage and vandalism is a major factor in the maintenance needs. Once again, separating tasks into the three stages can be helpful in allocating these costs.

Implementation time

The period of time required to get an information source up and running can be an important consideration. Particularly if information needs to be provided for a special event or to coincide with the introduction of a new service. In most cases, however, one would not expect this to be a significant factor.

Compatibility

The other implementation issue is the compatibility of a method with other services and operations of the transit agency, as well as other regional agencies. This includes both compatible technical specifications and a consistent user interface. For both of these it is impossible to quantify a particular method's performance objectively. As has been suggested earlier, however, an arbitrary numerical scale can be used to allow comparisons between methods.

Technical specifications

Compatible data formats, communications protocols, and hardware specifications are essential to developing an efficient, effective, scalable information system. Such consistency allows different systems (even if developed by different transit agencies) to interact. For example, AVL systems implemented by different agencies can feed data to a single real-time information channel, which could then supply dissemination components, such as integrated signs at shared bus stops and each agency's respective telephone operators. Similarly, route data used for transit trip planning should be integrated regionally to allow interagency trip planning.

Within an agency, the need is also clear. Using compatible hardware reduces procurement and maintenance costs. And compatible communications protocols allow the collection of information from multiple sources into a single database which can then feed a number of different dissemination points., GoTIC's KomFram, discussed in Section 5.3, is an excellent example of this type of integrated information system.

User interface

The idea of a "consistent look and feel" between different information methods is also important. Consistency reduces passenger confusion and also decreases the learning curve for adjusting to new information sources.⁵⁵ This covers not only interactive interfaces, such as real-time information displays, kiosks or Internet sites, but also printed system maps and schedules.

It is important that an agency's customer information implementation be compatible not only with other components of an overall information strategy, but also with the information provided by other agencies and organizations within a metropolitan region. This allows regular users of one agency to adjust quickly to a bordering agency's services. Such integration, in conjunction with fare integration strategies, is essential to creating a regional transit system which appears to be, and operates as a single unit. Regional coordination and consistency is difficult to achieve, requiring effective cooperation between agencies involved and possibly facilitated through a regional planning body. As was discussed earlier, such a function is provided in the San Francisco Bay Area by the Metropolitan Transportation Commission, albeit with mixed success.

4.4. A Framework for Decision-making

The first section in this chapter discussed defining the local context, including identifying customer needs, market segments, and agency characteristics with regard to transit customer information. The second discussed how to select customer information methods appropriate for providing a specific type of information to a specific group of people. The third presented a methodology for evaluating individual customer information methods, both in terms of cost-effectiveness and their role within a greater customer information strategy. In this fourth section we integrate these components into a general framework for making customer information decisions. This framework is illustrated in Figure 4-4 and is described in more detail below.

⁵⁵ Gothenburg Traffic Information Center, *Three Aspects*, p. 6.

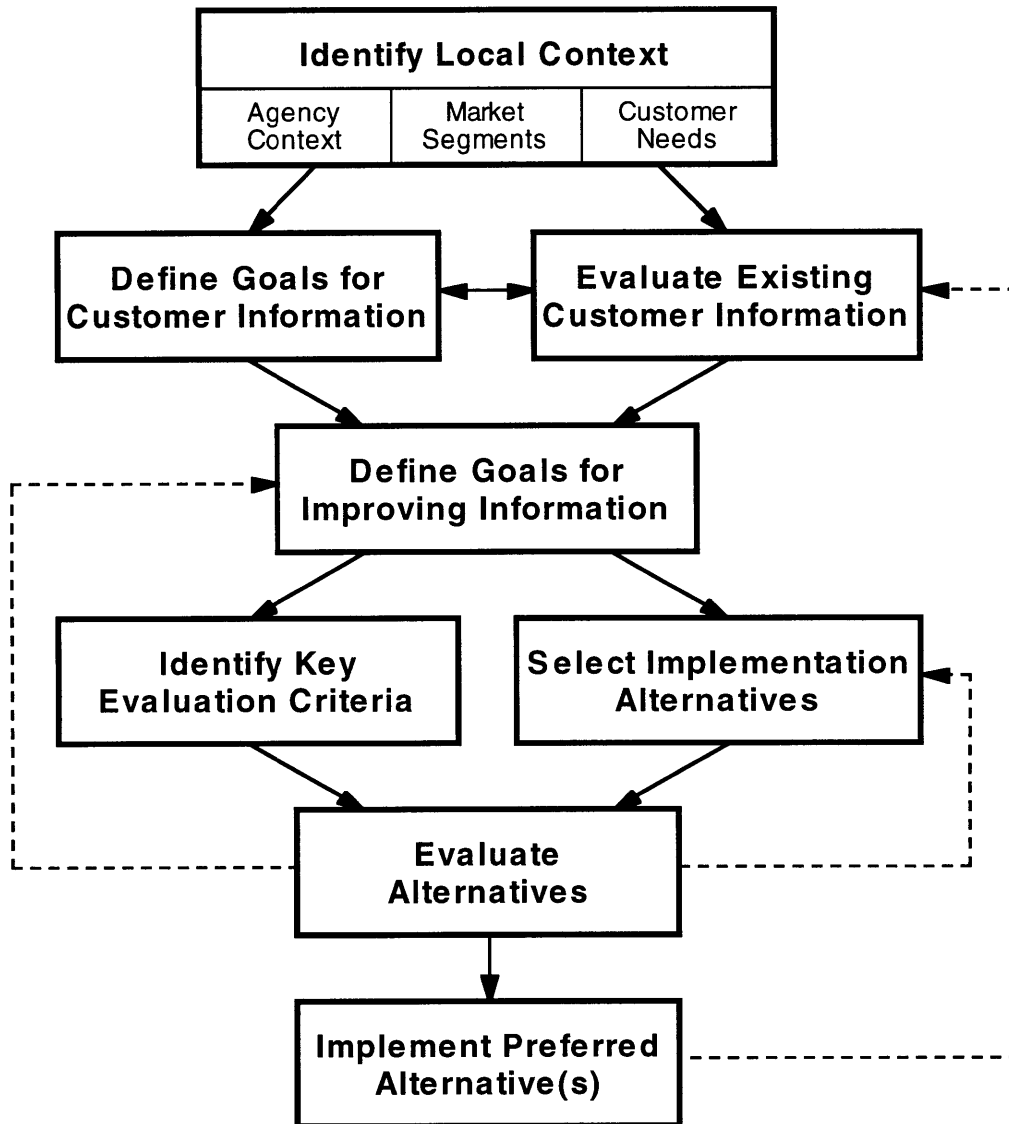


Figure 4-4: Decision-making Framework

1. Identify local context – Considering the issues discussed in Section 4.1, identify the characteristics relevant to the need for and use of transit customer information in the local region.
2. Define goals for customer information – Using the customer and agency needs identified in Step 1, define a set of general goals for transit customer information.
3. Evaluate existing customer information – Based on the goals defined in Step 2 and the relevant local characteristics, use the framework presented in Section 4.2 to evaluate the impact of existing transit customer information, watching in particular for ineffective methods and goals which are not successfully addressed. From the

results of this evaluation, it may be necessary to add to, or revise, the general customer information goals defined in Step 3.

4. Define goals and objectives for improving information – Formulate a set of specific goals and objectives for transit customer information improvements to correct the shortcomings identified in Step 3.
5. Identify key evaluation criteria – Identify the evaluation criteria relevant to analyzing customer information in consideration of the specific goals for improvement defined in Step 4.
6. Select implementation alternatives – Select a set of customer information methods that address some or all of the goals defined in Step 4.
7. Evaluate the alternatives – Using the evaluation criteria identified in Step 5, evaluate the selected alternatives in terms of both cost-effectiveness and their ability to meet the goals laid out earlier. It may be necessary to identify additional alternatives or modify the improvement goals if all alternatives considered fail to meet the desired objectives.
8. Implement the preferred alternative(s) – In many situations it may be advisable or even necessary to implement the alternative(s) in phases. There are two reasons for this – first, many information methods, especially higher-technology ones, are relatively untested, and thus deploying a prototype is a good first step to ensure that the investment is warranted before a full rollout. Second, funding is always limited, and thus it is often necessary to implement projects in steps. Once the first phase is operating, the agency can return to the initial evaluation stage, Step 3, to continue to improve their services.

4.5. Summary of Goals and Key Evaluation Criteria

Step 5 of the decision-making methodology presented above is to identify a set of evaluation criteria which are appropriate for evaluating the customer information alternatives with respect to the goals and objectives defined in Step 4. To demonstrate the process, this final section of Chapter 4 identifies a list of potential goals and objectives for an agency or region, and then for each identifies the evaluation criteria key in evaluating and selecting alternatives.

	Information Use											Information Benefits								Implementation Issues										
	Exposure		User Cost		Accessibility			System Quality	Information Quality		Credibility		Real Passenger Benefits		Psychological Passenger Benefits			Agency/Regional Benefits			Agency/Regional Costs			Compat-ibility						
	Publicity	Visibility	Price	Time	Location	Interface	Complexity		Availability	Accuracy	Relevance	Perceived Accuracy	Cultural Issues	Travel time savings	Travel time efficiency	Perceived time savings	Confidence and stress	Security	Comfort	Service perception	Ridership	System efficiency	System perception	Indirect benefits	Implementation Cost	Operation Costs	Maintenance Costs	Implementation time	Technical specifications	User interface
Increase or maintain ridership													✓	✓	✓	✓	✓	✓	✓	✓										
Encourage multimodal or multiagency transit trips	✓								✓							✓				✓								✓	✓	
Increase use of underused transit services									✓									✓		✓	✓									
Improve passenger satisfaction with transit service										✓			✓	✓	✓	✓	✓	✓	✓											
Improve provision of information to disabled users			✓		✓	✓	✓			✓																				
Market transit service to non-users	✓	✓	✓	✓						✓												✓								
Attract higher-income customers to transit				✓						✓			✓	✓	✓	✓	✓	✓	✓				✓							
Improve availability of transit information	✓	✓			✓		✓	✓		✓																				
Improve accuracy of transit information								✓	✓		✓																			
Reduce reliance on costly information sources										✓														✓	✓	✓				
Reduce reliance on bus operators as information source	✓	✓			✓					✓	✓	✓																		

Table 4-6: Potential Goals and Relevant Evaluation Criteria

5. Case Studies

Every transit agency provides some level of customer information, and many agencies' experiences provide valuable knowledge for others to learn from. For this research, five cases were selected and studied, the results of which are presented in this chapter. Cases were selected for one or more of three reasons: as a state-of-the-art or otherwise interesting implementation, because of some commonality with the San Juan context, or as a demonstration of the type of evaluation that is both possible and appropriate.

The first two case studies are of real-time bus arrival time display systems. These were selected because detailed evaluation data is available and they represent the state of the art for wayside information for fixed-route bus transit. London Transport's Countdown system was the first large scale implementation of this technology, beginning in late 1992. STOPWATCH, part of the ROMANSE project in the county of Hampshire, UK is another well-established system that has been in operation for much of this decade. For both of these systems, a detailed review of the evaluations has been included, organized using the evaluation framework presented in Section 4.3.

The GoTIC Project in Gothenburg, Sweden was selected as an example of a well-integrated customer information system, using a common data bus to feed information collected from several sources to a variety of dissemination methods. A real-time vehicle departure time display system is one of several components of the project.

The fourth case covers four regional transit information projects for multiple independently administered and operated transit services in the San Francisco Bay Area. This serves as an example of customer information provided through the cooperation of a regional body and the individual transit agencies.

The final case is a summary of transit customer information provision in Hong Kong. Hong Kong is an example of a transit-dependent city – 90% of residents use public transportation (including taxis) as their primary means of transport, but like San Juan, jitneys (public light buses) play a substantial role in the regional transit system. Nearly half of the public light buses are tightly regulated in terms of schedules and fares – the government also provides some customer information about these “Green” buses. Some useful lessons for San Juan can be drawn from this example.

The chapter concludes with a summary of conclusions drawn from these five case studies, particularly those with some relevance to the San Juan Metropolitan Area.

5.1. Countdown – London Transport; UK

The Countdown real-time bus arrival time display system installed at bus stops in London is the first case study discussed. While London Transport (LT) provides customer information in many different ways, the Countdown system was selected as a state-of-the-art technology that is now being replicated in many other cities around the world. Countdown was first introduced in late 1992, and has been the subject of several surveys and evaluations. London Transport customers have generally been very positive about the displays, and as a result, LT has committed to extending Countdown network-wide.

5.1.1. Transit Context

London Transport (LT) is the primary provider of public transportation in Greater London. The agency performs a regional planning function for transit service. Through their operating subsidiary, London Underground Ltd., they are responsible for operating the Underground rail system (the “Tube”). LT also fulfills a planning, funding, and administrative responsibility for tendered bus services, which are operated by 31 private bus operators (ten of which were subsidiaries of London Buses Ltd. until privatization in 1994). Within this tendered environment, London Transport issues gross- or net-cost contracts for bus service on a per-route basis – these contracts explicitly specify the quality of service to be provided. LT is also responsible for the bus shelter and stop infrastructure, and the travel information provided at these stops.

Transit fares on both LT trains and buses are zonal based on distance from the central city. Underground fares range from £0.80 to £3.30 for adults, and bus fares from £0.60 to £1.20. A variety of travel cards and other pass options are also available.⁵⁶

Rail service is also a major mode of public transportation in Greater London. Local (what was formerly called Network Southeast) and inter-city services are now provided by 25 private Train Operating Companies. The rail infrastructure is owned and maintained by Railtrack, a private company which is also responsible for operating London’s eight major

⁵⁶ “Fares and Ticket Information,” London Transport WWW site, <http://www.londontransport.co.uk/travel/2_4.html>.

rail stations and six others outside London (the remaining 2,500 stations nationwide are owned by Railtrack but leased to the Train Operating Companies).⁵⁷

The Docklands Light Railway (DLR) provides light rail service in east London. DLR and London Transport services are well-integrated. The same zonal fare system and media are used for both companies' services. Customer information is also well-integrated – the DLR is indicated on the Underground system map and on signs in stations much as if it were another Underground route. Also, the LT Travel Information Service provides information about both LT and DLR services (and British Rail as well) by telephone or in person at travel information centers.

The London Underground operates 470 subway trains over 244 miles of route and 267 stations, carrying 2.5 million passengers on weekdays. London Buses oversees 5000 buses on 700 routes which carry an additional 4 million daily passengers.⁵⁸ An additional 30 light rail trains carry 87,000 people daily between 36 stations and along 14 miles of track on the Docklands Light Railway.⁵⁹

40% of all journeys to work in Greater London are made on transit, compared with 13% nationally. In 1997-98, over one million people traveled into Central London for work – of these 35% used the Underground, 41% used British Rail or the Docklands Light Railway, 6% used London Transport buses, and 2% used private coaches. Of the 16% using private transportation, 13% used their car, 2% bicycled, and 1% used taxis.⁶⁰

5.1.2. Customer Information Goals

London Transport has for many years had the objective to provide “clear, concise, visually-appealing printed material” to maintain the “passenger’s perception of [their] integrity.” A major part of this visual image are the trademarked London Transport “roundel” logo and the diagrammatic Underground map first introduced in the early 1930s. LT has placed a new focus on advanced customer information technologies – the Countdown real-time bus arrival display system at bus stops mirrors similar displays in Underground stations,

⁵⁷ “About Railtrack - The Heart of the Railway,” Railtrack WWW site, <<http://www.railtrack.co.uk/corporate/about/>>.

⁵⁸ “An Introduction to London Transport,” London Transport web site, <http://www.londontransport.co.uk/company/4_1_1_1.html>.

⁵⁹ “Facts and Figures,” Docklands Light Railway WWW site, <<http://www.dlr.co.uk/who/facts.htm>>.

⁶⁰ “An Introduction to London Transport,” London Transport WWW site, <http://www.londontransport.co.uk/company/4_1_1_1.html>.

replicating their function, design, and even the font used.⁶¹ Goals for the Countdown projects are:⁶²

- to improve waiting experience for customers by
 - reassuring customers that a bus is on its way,
 - reducing perceived waiting time,
 - allowing the use of waiting time for other purposes, and
 - allowing more informed travel decisions (both modal and route choice);
- to increase travel by existing users; and
- to attract non-users.

Short-term objectives for the initial Route 18 trial and subsequent deployments discussed below were to test the reliability and robustness of the equipment, to assess customer reactions to the system, and to measure patronage and revenue generation effects.⁶³

5.1.3. The Countdown System

The Countdown system is very similar to (and a predecessor to by just under a year) the ROMANSE STOPWATCH system discussed in the following case. Countdown provides real-time bus arrival time information at selected bus stops within London, and is modeled after the displays installed above many platforms of Underground stations which show sequence, destination and time until arrival for the next series of trains to stop at the platform.

5.1.3.1. Implementation

Countdown has been installed in several phases beginning in late 1992. By April 1998, 480 signs were in place at bus stops, mostly in north and west London, with 1900 buses outfitted with AVL on a total of 120 routes. More than 33 million passengers board at these Countdown stops annually. Over the next year, an additional 700 signs will be installed in south and southwest London.⁶⁴

Countdown depends upon roadside beacon-based automatic vehicle location (AVL) technology. The position of each bus is transmitted to a central computer every 30 seconds.

⁶¹ "Design in London Transport," London Transport WWW site, <http://www.londontransport.co.uk/4_1_1_14.html>.

⁶² Johnson and Crowther, "Countdown Monitoring," p. 1.

⁶³ Atkins, "Passenger Information at Bus Stops," p. 3.

⁶⁴ Johnson, "London's Buses," p. 5.

This location is represented as the identification code of the last beacon passed and the number of wheel rotations since.

Bus arrival time information is displayed at bus stops using 24-character per line dot-matrix LED displays. Most signs are mounted under shelters, although in some cases freestanding displays are used. The exact content of the displays varies by implementation phase. The initial Route 18 displays had room for three lines of text and would display information about the next bus to arrive on the first line, the second and third buses on the second line (by alternating between the two), and reserved the last line for text messages.

```

1 18 KINGS CROSS      due
2 18 KINGS CROSS      8m
  
```

Later displays are more flexible in content, and use a four-line LED panel. These displays can show information for up to 10 buses, using the 2nd and 3rd lines to scroll through the second through tenth buses.⁶⁵

```

1 207 UXBRIDGE STN    due
4 207 HAYES BY-PASS  10 mins
5  83 EALING HOSP     14 mins
  
```

The signs are used to display the five types of information listed in Table 5-1 below.⁶⁶

Type	Content	Example
Basic information	Route number, Direction of Travel	ROUTE 18 EASTBOUND
Real-time "countdown" information	Order of arrival, Route number , Destination, Minutes to arrival	1 18 BAKER STREET 2m 2 18 KINGS CROSS 6m
Other real-time messages	Special messages	LONGER JOURNEY TIMES DUE TO ROADWORKS IN MARYLEBONE ROAD
Messages associated with real-time events	Routine "tagged" messages triggered by real-time events	NO MORE BUSES BEYOND WEMBLEY TONIGHT FIRST ROUTE 18 BUS DUE AT 05.26
Non-real-time messages	Routine information on other routes	ROUTES 27 AND 30 ALSO STOP HERE

Table 5-1: Types of Information Provided on Countdown Displays

⁶⁵ Atkins, "Passenger Information at Bus Stops," p. 4.

⁶⁶ Balogh and Smith, "Real-time Bus Information," p. 5.

In September 1996, a case was made to separate the costs of AVL implementation from the Countdown customer information project. Additional benefits of AVL data include:

- service control tools for bus operating companies,
- selective bus priority at signals,
- in-vehicle next stop displays, and
- contract performance monitoring.

To support these services, London Transport will outfit all 6000+ vehicles operating on 600+ bus routes with AVL hardware over the next three to five years. In conjunction, Countdown will be expanded to 4000-4500 of the busiest bus stops network-wide over a seven to ten year period.⁶⁷ At a total cost of approximately £15 million, the completed Countdown system will reach 60% of all boarders.⁶⁸

5.1.3.2. Evaluation

Since its introduction in 1992, Countdown has been evaluated several times. Primarily, the initial Route 18 corridor has been studied, although two second phase deployments have also been evaluated. These three implementations are:

- Route 18 (Sudbury - King's Cross) – characterized by serious congestion in both Central London and suburban centers along the route, and little overlap with other routes
- Uxbridge Road (routes 207 and 607) – Route 207 is a frequent local service while 607 is a less frequent limited stop “express” service, thus Countdown was intended to help passengers choose between these routes
- Nag's Head (Islington) – a 12 square-mile area (the first non-corridor use of Countdown) served by six overlapping and intersecting routes, for which displays show up to ten buses at a time

The research has consisted of passenger surveys and monitoring customer behavior, with the hopes of assessing customer attitude toward, and valuation of, Countdown.⁶⁹ Consultants were contracted to monitor and evaluate the technical reliability of the Route 18 trial, measuring bus service regularity, bus arrival prediction accuracy, the displays' visibility and ease of comprehension, customer behavior at bus stops, customer attitudes, customer valuation of Countdown information, and effects on patronage and revenue. Short bus stop interviews were conducted in June-July 1992 and again in June 1993. More

⁶⁷ Johnson, Neil, electronic mail dated October 27, 1997.

⁶⁸ Johnson, “London's Buses,” p. 4.

⁶⁹ Johnson and Crowther, “Countdown Monitoring,” pp. 2-3.

detailed stated preference interviews were also conducted in July 1993 through “hall-based” tests conducted in rooms located nearby the bus stops.⁷⁰

In Nag’s Head, “Before” and “After” panel interviews were conducted, with the same 443 respondents contacted both in February-March 1995 and June-July 1995 (installation of Countdown in Nag’s Head was completed in March 1995). A third set of interviews is planned to follow up on this study.⁷¹

Evaluating Information Use

Using the Countdown displays requires little or no effort on the part of customers waiting at bus stops. Exposure is therefore not a significant issue, instead concerns with accuracy and credibility are most important.

Exposure

The Nag’s Head “Before” and “After” study asked respondents about their exposure to Countdown. The table below presents these results – before Countdown was completely installed in the area, there was some knowledge of the system resulting from experiences with it in the two prior trial corridors, from advanced marketing of the displays in Nag’s Head, and from the first signs that were installed before the survey was conducted. Interestingly, more respondents had seen the displays than knew the Countdown term – name recognition was not a strong point at that time. After complete installation of the displays, all respondents had heard of Countdown and the vast majority had seen and even used the system.⁷²

Percent of Respondents Who:	Before	After
could correctly identify Countdown	38 %	100 %
had seen a stop with a Countdown screen	71	90
had caught a bus at a Countdown stop	46	70

Table 5-2: Exposure to Nag’s Head Countdown

From the Route 18 behavior monitoring studies, LT found that 70% of customers look at the display when first approaching the stop. Some others approach the stop from the other side of the display and wait by the sign post, never seeing the information on the display. Some of these have already seen the bus approaching and thus have no need for

⁷⁰ Atkins, “Passenger Information at Bus Stops,” p. 3.
⁷¹ Johnson and Crowther, “Countdown Monitoring,” p. 6.
⁷² Johnson and Crowther, “Countdown Monitoring,” p. 6.

Countdown information, while others sit below the sign and thus are not able to read it. 90% of customers surveyed do observe the sign at least once during their wait – of these 60% say they view the information at least once per minute, 40% of whom look at it almost constantly. Elderly and infrequent transit riders looked at the displays least often.

The displays are mounted on the underside of and painted the same color as bus shelters, and it was often suggested that they be given greater visual prominence. Since the study was conducted, a sign has been posted on the reverse side of the displays instructing customers to look at the front to get Countdown information.⁷³

User Cost

The Countdown system is free of charge to users. Furthermore, as Countdown signs are located in plain view of customers waiting at bus stops, there is no time cost for use.

Accessibility

Only 4% of respondents had difficulty reading the displays – others found that the character size and overall readability was very favorable. Some had difficulty with the red text on a black background, so some future signs will use yellow-on-black as a trial.⁷⁴ Some criticisms were made about message wording. To some, the abbreviation “m” for minutes was confusing, and thus has been replaced with “mins” on newer displays. The use of “eastbound” and “westbound” directions was also difficult for many to understand. For signs displaying information about multiple buses, vertical scrolling between vehicles was considered too fast for some to distinguish between them.⁷⁵

System Quality

Reliability of the system from a technical standpoint was good on Route 18 trial. Overall, the system was available 99.2% of the time – this breaks down to 99.9% availability of AVL information and 98.8% for the Countdown displays.⁷⁶ A major challenge to reliability has been the proper registration of buses with the system. Drivers sometimes neglect to register both the route number and destination (in which case only the direction of travel is reported on signs), or fail to register the vehicle at all which results in the bus being omitted entirely from the displays. Up to 15% of vehicles do not show on signs because of this.⁷⁷

⁷³ Atkins, “Passenger Information at Bus Stops,” pp. 8-9.

⁷⁴ Atkins, “Passenger Information at Bus Stops,” p. 3.

⁷⁵ Atkins, “Passenger Information at Bus Stops,” p. 9.

⁷⁶ Atkins, “Passenger Information at Bus Stops,” pp. 4-5.

⁷⁷ Johnson, “London’s Buses,” p. 5.

Information Quality

The reliability studies define two measures of information quality. Accuracy rate is defined as the percentage of vehicles for which the prediction shown on a Countdown display is correct to within a specified range in minutes. Cleardown is the removal of a bus from the display – this should occur while the bus is at the stop, and is marked as inaccurate if it is removed either before arrival or after departure. Thus the cleardown rate is the percentage of cleardowns occurring within specified margins of bus presence at the stop.

The July 1993 reliability study found that when the predicted time until arrival was 5 minutes, the Countdown system was accurate to within ± 1 minute of arrival 50% of the time, ± 2 minutes 75% of the time, and ± 5 minutes 96% of the time. As would be expected, accuracy improves as the time to bus arrival decreases – the accuracy rates given above were for Countdown predictions of five minutes. These accuracy rates are significantly below the target values given in Table 5-3 below. The table gives the target percentage of trials meeting each forecast accuracy level at each of three stages as the vehicle approaches the stop.

Countdown mins. shown on signs	Accuracy of Forecast		
	± 5 mins.	± 2 mins.	± 1 mins.
> 10	95 %	75 %	60 %
6 - 10	98	90	75
< 6	100	98	90

Table 5-3: Target Accuracy for Countdown Forecasts⁷⁸

Prediction accuracy reflects hardware, the accuracy of the prediction algorithm, and the variance of bus travel times. After the study was performed, some vehicles were found to be operating with their odometer counters disconnected, thereby reducing the accuracy of the location information being received. This is thought to be a major cause in poor prediction performance. In addition, information at some stops tends to be more accurate than others, due to differences in the variations in road traffic and stop dwell times. Some stops come very close to their established target accuracy; however, most do not.⁷⁹

Cleardown accuracy was 66% within ± 30 seconds, 81% within ± 1 minute, and 92% within ± 2 mins. These results are summarized in the following table:

⁷⁸ Atkins, "Passenger Information at Bus Stops," p. 6.

⁷⁹ Atkins, "Passenger Information at Bus Stops," pp. 5-7.

Accuracy of Forecast	Accuracy Rate (5 minute prediction)	Cleardown Rate
± 30 sec	–	66 %
± 1 min	50 %	81
± 2 min	75	92
± 5 min	96	–

Table 5-4: Countdown Information Quality

Credibility

Passenger surveys asked respondents whether or not they trust the information displayed on Countdown screens. In the Route 18 trial, 82% said that the accuracy of the information was acceptable and 45% felt that it was improving.⁸⁰ At Uxbridge and Nag’s Head 79% and 81% of passengers, respectively, trusted Countdown information.⁸¹ These figures indicate that roughly one in five passengers do not trust the information provided to them – efforts should be taken to reduce this rate.

Evaluating Information Benefits

The second major emphasis of Countdown evaluations was to determine the value of the system to its users. In the Nag’s Head “Before” and “After” surveys, 90% of “Before” respondents made positive comments when initially asked what they thought of the concept, while 25% had some concern of whether or not it would work. In the “After” phase, the incidence of positive comments had decreased to 80% with exposure to the system. The primary issue was reliability – 20% of respondents had this concern. Only 9% were concerned if it would work at all.⁸²

The following table indicates survey responses about general customer attitudes towards the Countdown system. In all three trials, attitudes are quite positive.⁸³

⁸⁰ Atkins, “Passenger Information at Bus Stops,” p. 11.

⁸¹ Johnson and Crowther, “Countdown Monitoring,” p. 6.

⁸² Johnson and Crowther, “Countdown Monitoring,” pp. 6-7.

⁸³ Johnson and Crowther, “Countdown Monitoring,” p. 5.

	Route 18		Uxbridge Road		Nag's Head	
	Pct. Agree	Mean Score	Pct. Agree	Mean Score	Pct. Agree	Mean Score
The Countdown system should be introduced on all bus routes in London	93 %	4.2	90 %	4.4	83 %	4.2
Bus passengers deserve Countdown	93	4.1	88	4.3	82	4.1
The Countdown display makes waiting for a bus more acceptable	89	4.0	83	4.1	80	4.0

Table 5-5: Attitudes Toward Countdown⁸⁴

The decreasing trend in positive attitude (as the three implementations are shown in chronological order) is believed to be offset by a higher proportion agreeing strongly with the statements. Hence the results show a similar mean score for each statement over the three trials.

Table 5-6 below shows the change in attitude toward bus travel in general, resulting from the introduction of Countdown displays:⁸⁵

Attitude has:	Route 18	Uxbridge Road	Nag's Head
improved	68 %	57 %	53 %
not changed	31	39	44
worsened	1	4	3

Table 5-6: Attitudes Toward Bus Travel

Again there is a weakening effect over the three phases of implementation. This is possibly attributed to the increasing complexity of transit service in each area. More likely, it is indicative of a greater variability in type of stop location – at Nag's Head, for example, 65% of passengers using Countdown at residential or isolated stops felt that bus service had improved as a result of the system, compared with the 53% overall. This follows intuition, that the information is more important near homes where transit service is typically less frequent and stops are less-patronized. In the Nag's Head surveys,

⁸⁴ Respondents assigned a value from 1 to 5 where strongly disagree = 1, strongly agree = 5. Percentage agreeing is defined as the percentage of 4 and 5 responses, while mean scores is the average response value.

⁸⁵ Johnson and Crowther, "Countdown Monitoring," p. 5-6.

passengers were asked how important was the system, and 39% felt it was very important at stops near home versus 24% at high street stops (the numbers were 77% to 66% rating the system as important or very important).

In the hall-based interviews, respondents were asked their willingness to pay for such a service. The results were surprisingly high at 26p per trip, which was 53% of the average fare of 50p at the time. But based on other measures of the value of this information, it was believed that these results are well-substantiated. Also of note, respondents stated on average a willingness to pay a 20p fare increase for the Countdown system.⁸⁶

Real Passenger Benefits

The first form of benefit to customers is the real benefits gained through travel time savings or more efficient use of waiting time.

Travel time savings

23% of Route 18 survey respondents claimed to have waited for a bus at a Countdown stop when they would not have in the absence of real-time arrival information. This rate was 66% with the Uxbridge trial and 47% in Nag's Head. It is believed that because of the multiple transit routes serving stops in the latter two trials, Countdown is more likely to guide the rider toward using other route options when there are service delays on the preferred route. On Route 18, however, the customer would be given adverse information about only Route 18 buses, and would thus be more likely to choose a different mode.⁸⁷

Table 5-7 below presents a synopsis of customer behavior observed at stops. On Route 18, concealed cameras were used to monitor customers, while the Nag's Head study used human observers. The percentage of customers leaving the stop was calculated, as was the mean time before customers left. The minor differences in behavior at route 18 stops is attributed to differences in external conditions, including the weather and service disruptions. Nag's Head, however, shows a very significant difference in the mean time before leaving – 1.4 minutes at Countdown stops versus 9.0 minutes at normal stops. This indicates that customers with access to Countdown information make more informed decisions.⁸⁸

⁸⁶ Atkins, "Passenger Information at Bus Stops," pp. 11-13.

⁸⁷ Johnson and Crowther, "Countdown Monitoring," p. 3.

⁸⁸ Johnson and Crowther, "Countdown Monitoring," p. 1.

	Percentage Leaving Stop		Mean Time Before Leaving	
	Countdown	No Countdown	Countdown	No Countdown
Route 18	6 %	4 %	1.6 min	3.1 min
Nag's Head	4	4	1.4 min	9.0 min

Table 5-7: Customer Tendency to Leave Bus Stops

While only customers leaving the bus stop were observed, it is also expected that these “opt-outs” will be to some degree offset by travelers who would normally walk choosing to wait for the bus if Countdown shows that it is arriving very soon.

Travel time efficiency

During the same behavior monitoring studies, some “diversionary activity” was observed – that is, customers leaving the stop briefly to run a quick errand while waiting. For this to be possible, one needs opportunities, such as shops or banks, located close to the stop. Customers must also be confident of the predicted arrival time. However, in the behavior monitoring study it was impossible to distinguish between this “diversionary activity” and the “opt-outs” mentioned above.

Perceived Passenger Benefits

On Route 18, 65% of survey respondents felt that they waited a shorter time for the bus when compared to before introduction of Countdown, even though actual scheduled transit service had not changed. Mean waiting time as perceived by passengers on Route 18 fell from 11.9 minutes to 8.6 minutes.⁸⁹ This perception was substantially lower for the other two trials, with between 21% and 24% of respondents feeling that their waits had decreased. This difference could be due to different sampling methods used. A second explanation is that as Route 18 is the only transit service along that corridor, excessive waits in the absence of information are more noticeable and memorable.

83% of Route 18 respondents agreed that if you know when the bus is coming, the time seems to pass more quickly. 89% claimed that the display makes waiting more acceptable.⁹⁰

Psychological Passenger Benefits

Numerous psychological benefits were reported by subjects interviewed:

⁸⁹ Johnson and Crowther, “Countdown Monitoring,” p. 1.

⁹⁰ Atkins, “Passenger Information at Bus Stops,” p. 11.

Confidence and stress

At conventional bus stops, customers are typically seen to glance frequently down the street to see if a bus is approaching, even if they are reading or talking. They show visible signs of impatience or frustration in the case of an extended wait. Some will eventually leave the stop, taking a different mode or giving up entirely, and the bus often arrives shortly thereafter. Video surveys of Route 18 Countdown stops show customers much less likely to exhibit these signs of stress and frustration.⁹¹

Comfort

More than half the passengers surveyed reported to have at least once waited for a second bus arriving shortly after the first, to avoid crowding or a bus that was not continuing the length of the route. Specific response rates were 51% for Route 18, 68% for Uxbridge, and 47% for Nag's Head. Uxbridge had the highest incidence as two parallel transit services operate along the same corridor, thus increasing the chance of a second vehicle following soon behind. This observation demonstrates that among many customers there is sufficient confidence in the system to wait for the next bus.⁹²

Security

52% of Route 18 survey respondents felt more safe waiting at the bus stop at night, compared with 40% of respondents on the other two trials.⁹³

Service perception

64% believed that service reliability on Route 18 had improved since Countdown was installed. General attitudes toward transit service also improved for many customers, as indicated in the results presented in the following table.⁹⁴

⁹¹ Atkins, "Passenger Information at Bus Stops," pp. 9-10.

⁹² Johnson and Crowther, "Countdown Monitoring," p. 4.

⁹³ Johnson and Crowther, "Countdown Monitoring," p. 6.

⁹⁴ Atkins, "Passenger Information at Bus Stops," p. 11.

Since the introduction of Countdown has your attitude towards:	Improved	Not Changed	Worsened
Bus Travel	68 %	31 %	1 %
Bus Operator ⁹⁵	54	43	3
London Transport	45	50	4

Table 5-8: Attitude Towards Bus Service during Route 18 Trial

Table 5-9 below shows general attitudes of customers responding to the Nag’s Head “Before” and “After” surveys. The first three statements listed reflect negative attitudes towards transit, all three of which decreased after the introduction of Countdown, as should be expected. However, the last two statements describe increased transit use as a result of better service and better information – for both of these the number of respondents agreeing with the statements also decreased. This suggests either that Countdown has not fulfilled the expectations of some customers, or that they are now more realistic about their possible future behavior.

Pct. Respondents Who Said:	Before	After
Most buses are unreliable	47 %	36 %
Most bus services are not frequent enough	61	58
A major problem with traveling by bus is that you never know when the next bus is coming	77	61
If the bus service was better, I would travel by bus more often	62	50
If I knew how long I had to wait for the bus, I would catch the bus more often	63	55

Table 5-9: Attitudes Towards Bus Service and Nag’s Head Countdown⁹⁶

Agency/Regional Benefits

London Transport has concluded that while some customers will on a trip-by-trip basis leave bus stops to use different modes, the longer-term effect will be that customers are more satisfied with transit service in general and thus ridership will increase to some degree. To date, LT has seen revenue generation of approximately 1.5% on Countdown-equipped routes. Monitoring of this measure will continue as Countdown is extended systemwide.⁹⁷

⁹⁵ Route 18 service is operated by CentreWest Buses, Ltd.

⁹⁶ Johnson and Crowther, “Countdown Monitoring,” p. 7.

⁹⁷ Johnson and Crowther, “Countdown Monitoring,” p. 1.

Indirect benefits

In September, 1996, LT finalized the decision to separate AVL from the Countdown project, as AVL was found to be cost-effective on its own merits. Fleet wide AVL will be installed, and the system will be enhanced to support these functions (most of which are already in place, with the others currently in trial):⁹⁸

- contract and performance monitoring (service mileage and on time performance),
- bus operating companies' service control tools,
- Countdown,
- selective bus priority at signals,
- in-vehicle next-stop displays and annunciators (currently installed on four bus routes),
- bus lane enforcement (using on-bus cameras),
- low structure alarms, and
- automatic fare stage updating on the planned new electronic ticket machine (ETM).

The service control tools allow the operations control dispatcher to view which buses are running off schedule, from which he or she can make real-time control decisions. The operator can also display real-time messages on Countdown signs, as well as in-vehicle displays when installed.

Implementation Issues

While detailed cost information is not available for the Countdown system, the project is justified (when separated from the AVL system costs as mentioned above) at a customer willingness to pay of only 2p.⁹⁹ Nags Head interviews, as discussed above, found that customers were willing to pay on average 13 times this amount, and thus LT finds the project to be very worthwhile.

5.1.3.3. Conclusions

London Transport has chosen to continue expanding the Countdown system, bringing it to the 4000 busiest bus stops within the next decade. While only modest ridership gain has been demonstrated, this is not at all unexpected given the high use of buses as a mode of transportation. Of course, a 1.5% increase in ridership would amount to 60,000 new daily riders when the system is extended network-wide. The main accomplishment for

⁹⁸ Johnson, "London's Buses: Implementing Fleetwide AVL and Countdown."

⁹⁹ Johnson and Crowther, "Countdown Monitoring," p. 1.

Countdown is in improving customer satisfaction with transit – customer response to the system has been very positive, which for London Transport is enough justification for continuing and expanding the project.

LT has several future developments in mind for Countdown, in addition to the in-vehicle next stop displays mentioned earlier. The agency plans to integrate the bus radio, new electronic ticket machines (ETMs), and AVL system to simplify the bus registration process – doing so should reduce the rate of improper registrations resulting in buses missing from Countdown displays. In addition, LT will investigate increasing the bandwidth of data flow to and from stops by upgrading to ISDN technology, deploying a larger-format sign for providing Countdown information in bus stations, and improving the sign formats for providing more detailed departure and destination information at the start of a route. Finally, London Transport will encourage third-party dissemination of Countdown information via new technologies, including the Internet.¹⁰⁰

5.1.4. Other Customer Information Components

London Transport provides all the traditional printed information and signs one would expect from a well-established transit agency. Two items of note are worth mentioning: the Travel Information Service and the London Transport World Wide Web site.

5.1.4.1. Travel Information Service (TIS)

The London Transport Travel Information Service (TIS) provides information and advice about all forms of transit in London – bus, the Underground, British Rail, and the Docklands Light Railway. The service operates principally through a telephone information line and a network of 13 Travel Information Centres. Telephone inquiries are handled 24 hours a day (there is also a separate “Docklands Travel Hotline”). Regularly updated real-time information about bus and rail services is available via the London Travelcheck telephone system, as well as teletext services. Similar information is provided to local radio stations. The 13 Travel Information Centres are situated at various central London and suburban locations, as well at Heathrow Airport. Most are equipped with the TICTAC system which, through a panel of television screens, provides real-time travel details as well as tips on getting information about transit services. Written travel inquiries are also responded to by staff.

¹⁰⁰ Johnson, “London’s Buses,” p. 5.

More than three million calls are responded to annually by the TIS. Research has shown that over two-thirds of those callers make the trip they were inquiring about, and that 13% would not have if they had not received the desired information. This additional fare revenue is four times the cost of providing the information.¹⁰¹

The information provided by the TIS includes schedules, fares and trip planning assistance for all the four transit modes listed above. The TIS also responds to general inquiries on how to get to places of interest, as well as the real-time status of the transit network. The ROUTES computer system is being installed to improve efficiency and to allow the TIS to give impartial multimodal travel advice. The ROUTES system combines trip-planning algorithms, a comprehensive transit information database, and a geographic information system to provide automated responses to point-to-point trip queries. Use of the ROUTES system is expected to increase the call-handling capacity of the TIS by 17%, although similar systems installed in the U.S. have shown productivity improvements of 25% to 30% are possible.¹⁰²

5.1.4.2. London Transport World Wide Web site

Like many well-established Western transit agencies, London Transport has established a World Wide Web site at <<http://www.londontransport.co.uk/>>. This site provides basic transit service information, which is particularly targeted toward tourists (a tourist guide is available in electronic form on the site in several different languages). There is also a good amount of company information, including press releases, policies, budgets, and other such documents. The travel information portion includes service news (which is also available by electronic mail subscription, see below) station information, the times of the first and last Underground trains, the Underground map, a bus map of Central London, fare and ticket information, a guide to accessing airports by transit, and a list of all bus routes.

London Transport may have been the first transit agency to offer an electronic mail subscription service, which broadcasts service disruptions and changes to registered subscribers. A sample message follows:

¹⁰¹ "The Travel Information Service," London Transport WWW site, <http://www.londontransport.co.uk/4_1_1_13.html>.

¹⁰² Le Jeune, "Routes: London's Computerized Travel Enquiry System," pp. 95-99.

From: London_Transport@cm-net.co.uk
Date: Mon, 13 Jul 1998 15:55:30 +0100
To: "London Transport Subscribers"@cm-net.co.uk
Subject: Weekend travel changes for Sat 18th - Sun 19th July

London Transport : Travel News Bulletin
Date : 13th of July, 1998

On the Central line, all weekend, there will be no train service between North Acton and West Ruislip, due to engineering work in the North Acton area.

Two replacement bus services will operate, a service between North Acton and Northolt calling at Hanger Lane, Perivale and Greenford, and a second service operating between North Acton and West Ruislip calling at Northolt, South Ruislip and Ruislip Gardens.

Your journey time may be increased by up to 30 minutes.

On the District and Circle Lines, Westminster Station will be closed on Sunday to enable a new stairway to be installed. St. James's Park station is a short walk away.

This feature keeps frequent London Transport users informed about temporary and permanent service changes and disruptions, without the need to actively seek the information on the London Transport World Wide Web site. This active method of providing semi-static information has served as a model for other transit information web sites.

5.1.5. Summary

Customer information is a priority at London Transport. Traditional information is readily available, and in some cases, such as the LT "roundel" logo that adorns all bus stops and the Underground map, forms a key component of the agency's image and identity. Information at transit stops is abundant, with most bus stops labeled by route and many with current timetables and line maps posted. Similarly, information is widely distributed about the Underground system – particularly service changes resulting from station renovation projects and system expansion. LT has taken advantage of inexpensive yet rapid communication via the Internet to inform customers of these service changes, with an electronic mail subscription list available on the LT World Wide Web site. The Travel Information Service is further evidence of London Transit's commitment to improving transit service, providing comprehensive transit and trip-planning information at all hours of the day. Also impressive is the integration of the Docklands Light Railway and rail services into London Transport customer information, which will be enhanced further with the introduction of the ROUTES trip-planning system.

The Countdown real-time arrival time information system installed at 480 bus stops in London has been well-received by patrons. As a result, London Transport has committed to extending the system to well over 4000 major bus stops network-wide, indicating their firm belief that the system is of benefit. While ridership increases have been modest, the improvement in overall customer satisfaction cannot be overstated.

5.2. STOPWATCH – ROMANSE Project; Hampshire, UK

The ROMANSE (ROad MANagement System for Europe) project is a public/private partnership between the Hampshire County Council, Southampton City Council, and area consultants and academic institutions. The ROMANSE system is mostly based in the cities of Southampton and Winchester in the County of Hampshire, in the south of England. The project began in May 1992 as part of the European SCOPE (Southampton, Cologne, and Piraeus) project to investigate the promise of various advanced forms of travel and traffic information.¹⁰³

The initial ROMANSE phase (1992-1995) was directed towards development of the key components of the system. These, described in more detail later in this section, include:

- Traffic and Travel Information Centre (TTIC)
- Strategic Information System (SIS) strategic planning tool
- STOPWATCH real-time AVL-based bus arrival time system
- TRIPPlanner route-planning kiosks

Phase II of the project is currently underway, with the following objectives:

- to develop an in-vehicle (bus) real-time information system,
- to introduce a World Wide Web site, and
- to develop the SENTINEL inter-city rail in-vehicle information system.

The ROMANSE II project is part of the EUROSCOPE (Efficient Urban Transport Operation Services Cooperation of Port Cities in Europe) framework, with the goal of sharing and improving developed technologies over broader applications.¹⁰⁴

Some components of the project (such as closed-circuit television, roadside variable message signs, and real-time parking lot availability signs) are directed exclusively toward automobile users – these are omitted from this summary. Of the remaining components with some relevance to transit, the STOPWATCH real-time bus arrival system is the focus

¹⁰³ Brown, "ROMANSE," p. 1.

¹⁰⁴ Hampshire County Council, "ROMANSE II," pp. 1-9.

of this study. The STOPWATCH system, implemented for the most part on a trial corridor in Southampton, is the most developed of the transit information components, and consequently, has undergone the most detailed evaluation.

5.2.1. Transit Context

The County of Hampshire has a total population of over 1.5 million people, one of the larger non-metropolitan, “shire” counties in England.¹⁰⁵ In contrast to London, where bus service is contracted by the government to private operating companies, transportation service in the county is completely deregulated, provided by private operators in a competitive setting. After an initial period of instability in transit operators and routes, service has mostly settled and is currently provided by six bus companies along approximately 60 routes. The two largest, City Bus (150 vehicles) and Solent Blue Line (90 vehicles), operate a majority of the service, with the others providing local service into the city. Buses operate primarily along several corridors leading into the centers of Southampton and Winchester from surrounding residential and commercial districts.¹⁰⁶

Hampshire is also served by inter-city rail service provided by South West Trains, Ltd. Trains connect points in Hampshire with surrounding counties, with regular service to London (a one-way trip of 60-90 minutes, comparable to the travel time by automobile).

Southampton is the largest city in the county, with a District population of just over 200,000. The trial corridor in which STOPWATCH has been evaluated, the Portswood Corridor, sees an annual bus patronage of 3,800,000, approximately 15,000 trips per day. The corridor is just over 5 miles long, radiating north from the city center. Twelve routes operated by the two major carriers serve the corridor at a combined peak headway of approximately 5 minutes.¹⁰⁷

5.2.2. Customer Information Goals

The ROMANSE project has several specific goals. These include:

- influencing travel behavior by offering travelers the ability to make informed choices about route, time of journey, and method of travel, and to change routes dynamically in response to congestion or transport incidents,
- increasing the use of public transport,

¹⁰⁵ Population statistics are from the 1991 Census, as provided on the Hampshire County Council WWW site, <<http://www.hants.gov.uk/>>.

¹⁰⁶ Brown, “ROMANSE,” p. 2.

¹⁰⁷ Hampshire County Council WWW site, <<http://www.hants.gov.uk/>>.

- maximizing the efficiency of the transport system infrastructure and resources, and
- improving information provision, availability, and use by professionals and outside agencies.¹⁰⁸

The motivation for these goals is simple: road traffic is expected to double by the year 2020, and a better solution than doubling road and motorway capacity is desired.¹⁰⁹ Another goal results from the deregulated transit environment in Southampton. As transit services can change frequently with operators entering and exiting the market or revising their operating plans to maximize profit, customers are more likely to need current and comprehensive transit information.¹¹⁰

Providing transit information within the deregulated environment can be a significant challenge. Unlike London, where the public London Transport maintains responsibility for overseeing, subsidizing, and publicizing bus services, the public authority in Southampton has little influence on how service is provided. Here, cooperation between the local government and the private operators is a necessity, but cannot have any anticompetitive implications. In a deregulated transit environment like Southampton, at least four issues must be considered within the context of customer information:

- **Entry restrictions** – The public authority cannot restrict entry into the transit market, and therefore cannot make cooperation in a customer information effort a requirement for providing transit service.
- **Unfair public assistance** – Should an operator not want to participate in a cooperative information program, any public funding of information activities for other private operators could be viewed as unfair.
- **Collusion** – In working with existing private operators to design and implement a customer information plan, a case may be made that the public authority is in effect colluding with these operators. Such collusion may put other operators, especially those entering the market at a later time, at a competitive disadvantage.
- **The “free rider” syndrome** – An operator who chooses not to participate in a customer information program may be able to unfairly take advantage of information provided by its competitors, such as by running service immediately before a company providing real-time information at bus stops.

These are complex issues for which full consideration is beyond the scope of this research. However, it is clearly important that the public authority structure its customer information programs in such a way that private operators would willingly choose to participate. Minimizing or eliminating any direct financial implications on the operators is a first step in

¹⁰⁸ Brown, “ROMANSE,” p. 1.

¹⁰⁹ Hampshire County Council, “ROMANSE II,” p. 1.

¹¹⁰ Clowes, “Bus stop information: Experience in the deregulated environment,” pp. 95-99.

doing so. From the operating company's point of view, activities that will boost ridership are clearly in its best interests. Thus, provided that each operator's sovereignty in decision-making is respected and the basic principles of deregulation are preserved, cooperation should be expected.

5.2.3. The STOPWATCH System

STOPWATCH is a real-time bus arrival time information system positioned at bus stops. Using automatic vehicle location (AVL), the system displays on electronic signs the route number, destination, and time to arrival for each of the next five buses to arrive at a particular stop. Route numbers are specific to each bus operating company, the display does not explicitly indicate which companies are operating which buses. If the AVL component is not working, the system will display scheduled arrival data instead. The STOPWATCH displays also allow messages from the TTIC to be displayed, usually indicating delays or service rerouting, and recommending alternative routes if appropriate.



47	NEXT BUS APPROACHING	
14	CITY CENTRE	7MN
47	ESTIMATED TIME ONLY	20MN

The STOPWATCH system was developed to be compatible with both roadside beacon and global positioning system (GPS) based AVL technology. Regardless of the technology, the location information is fed to an onboard computer unit. Transmitters installed on each bus serving the corridor relay the vehicle's location to a radio base station at 15 second intervals. This information is then relayed via telephone wires to the TTIC. The arrival time at each successive stop is calculated from the vehicle's location and current and historic journey information stored in a database. Then, information about the next 5 buses to arrive is transmitted via a radio paging system to each stop where it is displayed on signs.

Three types of signs have been used in the STOPWATCH trial. Red light-emitting diode (LED) signs are mounted under the roofs of bus shelters, providing large, easy-to-read displays. At bus stops without shelters, liquid crystal display (LCD) and transfective LCD panels are installed on the bus stop posts. These displays are significantly smaller and require the customer to stand immediately next to the post for legibility. All three versions provide 3 rows of text, with 30 characters per row. The 2nd and 3rd rows can scroll to show information about a 4th and 5th bus if appropriate.¹¹¹

¹¹¹ Brown, "ROMANSE," p. 4.

Real-time information collected by the TTIC central computer is also relayed to each of the operators' bus depots. The operators use this information for dispatching support and performance monitoring. Again, because of the competitive environment in which the private bus companies operate, each is provided with information only about its own vehicles. AVL information is also used by the TTIC for active bus priority (ABP), as discussed later in this section.¹¹²

5.2.3.1. Implementation

As of 1995, STOPWATCH was installed at 43 bus stops in the city center and along the Portswood corridor.¹¹³ All vehicles used in service along this corridor have been outfitted with AVL systems. In Southampton, the AVL system is beacon-based. In Winchester, both beacon- and GPS-based systems are being installed to allow a field test comparison of the two technologies. The Winchester implementation will also provide bus arrival time information in different formats to identify the most effective format.

In 1995 the STOPWATCH system was extended to provide voice-synthesized audible messages for visually-impaired customers. The messages are triggered by pressing a button on a key chain trigger, and provide all the same information displayed on the STOPWATCH electronic signs. This feature is currently in place at three of the STOPWATCH-equipped bus stops.¹¹⁴

The ROMANSE project office plans on extending the STOPWATCH system to include all city-wide transit services. The additional cost for this is estimated to be £1.3 million in Southampton and £0.7 million in Winchester.¹¹⁵ All costs associated with STOPWATCH are covered by the funding sources for the ROMANSE project – the private bus operators do not bear any of the financial burden. Additional future plans include providing real-time messages within vehicles and further improvements to the system.¹¹⁶

5.2.3.2. Evaluation

Several studies of different types have been conducted to evaluate the performance of the STOPWATCH system and other ROMANSE components. These include:

¹¹² Cassidy and Jones, *ROMANSE: Recommended Programme*, p. 51.

¹¹³ This is out of a total of 460 bus stops in the city, 130 of which are along the corridor.

¹¹⁴ Hampshire County Council, "ROMANSE II," p. 3.

¹¹⁵ The foreign exchange rate was approximately \$1.63 = £1.00 as of June, 1998.

¹¹⁶ Brown, Steven, letter dated October 16, 1997.

- STOPWATCH “Before” and “After” Surveys of bus passengers along the trial corridor (conducted in August 1993 and October 1994, with the trial installation in January 1994),
- STOPWATCH Technical Evaluation Survey, June 1994,
- 1995 Panel Survey of both transit and private automobile travelers,
- Hall-based behavioral monitoring interviews conducted in nearby off-street locations such as community buildings, also of both transit and private automobile travelers, and
- Portswood and Bitterne Corridor Studies (March 1993, March 1994, and March 1995) of transportation use and demand,
- INSIGHT Simulation Model study of user response to real-time customer information.

The “Before” and “After” surveys were unfortunately conducted in a slightly different manner and at different times of the year. The surveys did show a significant change in trip purposes, likely due to seasonal changes, and thus any conclusions drawn from the results must be viewed with caution.

Evaluating Information Use

The surveys found that the bus arrival time information was used most by students and employed adults, and least by the elderly. The panel survey found that 16% of travelers had used it at least once.¹¹⁷

Exposure

Given the limited number of bus stops outfitted with STOPWATCH displays along only a single corridor, one would expect that not all subjects surveyed would be familiar with the system. This was indeed what the surveys found, with passengers traveling along the Portswood corridor more aware than other transit and non-transit users. Yet the results were encouraging, and it was expected that a significant increase in exposure level would result from a city-wide rollout.

Publicity

The STOPWATCH “Before” survey found that 10% of those surveyed had some knowledge of the system before it was installed, the result of advance publicity.¹¹⁸ The “After” survey found that a disappointing 60% had heard of the STOPWATCH name. This can largely be attributed to poor name recognition, as 90% did report having seen the

¹¹⁷ Cassidy and Jones, *ROMANSE: Recommended Programme*, p. x.

¹¹⁸ TRENDS, et. al., “The Southampton Before and After Survey Results,” p. 14.

displays. This is understandable as the name is not prominent on the displays and is therefore easily overlooked. However, it is indicative of a weakness in marketing the system.

This is further evidenced by the Hall Based Interviews, which again were conducted among both transit and non-transit users. Here only 37% of respondents had heard of the STOPWATCH system. According to the Panel Survey results, a similar percentage had seen the bus stop displays. One of the goals for the ROMANSE project is to increase the use of transit. For this to happen, the benefits of systems like STOPWATCH must be known to non-transit users, and thus a greater marketing effort should be directed toward them.¹¹⁹

Visibility

The STOPWATCH displays are situated quite prominently. In the case of bus shelter implementations, the LED signs are placed at the closed end of the shelter. Thus all customers within the shelter quickly become aware of the system. For stops without shelters, the smaller LCD displays are attached to the bus stop posts. This format is somewhat less obvious, and could result in infrequent transit users overlooking it entirely. This is indeed suggested by survey results which indicate that frequent transit users tend to be more knowledgeable about the STOPWATCH system than infrequent riders.¹²⁰

User Cost

The STOPWATCH system, like all components of the ROMANSE project, is free of charge to users. Furthermore, as STOPWATCH signs are located in plain view of customers waiting at bus stops, there is no time cost for use.

Accessibility

Provision of STOPWATCH real-time bus arrival information is currently limited to the displays installed at bus stops.¹²¹ Thus, the information can only be used once a customer has arrived at the stop. The displays are active during all hours that buses are in service. The larger LED displays mounted under the roof of bus shelters are located so that they are easily visible to most customers waiting at the stop. Consequently, these signs are preferred to, and looked at more frequently than, the smaller LCD displays mounted on bus

¹¹⁹ Cassidy and Jones, *ROMANSE: Recommended Programme*, p. viii.

¹²⁰ TRENDS, et. al., "The Southampton Before and After Survey Results," p. 8.

¹²¹ See the following case study of the GoTIC system for an example of the dissemination of real-time bus arrival information via the Internet.

stop posts. Customers must stand within arms reach of the sign to read the information on these LCD panels.¹²²

The “After” survey found that of customers waiting at bus stops outfitted with a display, 53% looked at the display several times. An additional 28% looked at it only once, while 9% ignored it completely and the remaining 10% did not see it at all.¹²³ One would expect these positive results as little or no effort is required to glance at a display, and nothing is lost by doing so. Whether or not the customer makes any use of the information provided is another question, to be looked at later in this evaluation.¹²⁴

Finally, 92% of those who had made use of the STOPWATCH displays found the system “very easy to use,” and the remaining 8% described it as “fairly easy to use”. This should be expected as, again, all that is required is simply to look at and read the display. 88% described the information as “very easy to comprehend” – the remainder as “fairly easy to comprehend.” These results are encouraging, and indicates that the simplicity of the display interface is successful at conveying the information.¹²⁵

System Quality

During the study period, there were no indications of any faults in the STOPWATCH system that caused it to be unavailable for any period of time. The system is designed so that in the case of a malfunction in the communication of AVL information to the arrival time prediction software, the displays will show scheduled arrival time instead of predicted times.

However, from Fall 1997 until late Spring 1998 the STOPWATCH system was not being used due to a significant deterioration in system reliability, resulting primarily from technical and operational issues. Complex technologies require substantial technical support, and with cutting edge efforts like STOPWATCH, the level of support required is both substantial and often underestimated.¹²⁶

The Technical Performance Survey also found some incidence of spurious information being displayed – this is discussed in the next subsection.

¹²² TRENDS, et. al., “The Southampton Before and After Survey Results,” p. 19.

¹²³ These figures were not available independently for LED- and LCD-type displays, however one would expect that the 10% who did not see the displays were at stops with the smaller LCD signs.

¹²⁴ TRENDS, et. al., “The Southampton Before and After Survey Results,” p. 12.

¹²⁵ Cassidy and Jones, *ROMANSE: Recommended Programme*, p. 104.

¹²⁶ Atkins, Steven, electronic mail dated July 31, 1998.

Information Quality

Two measures of information quality are relevance and accuracy. Relevance is not an issue with STOPWATCH – a specific type of information is provided for bus routes which use the particular stop the information is being provided for. Granted, real-time bus arrival information is only a small subset of all that the average transit user needs. Thus systems like STOPWATCH should be positioned as supplements to traditional static information – timetables and maps posted at stops, customer service telephone operators, etc.

Accuracy, on the other hand, is a critical issue with the STOPWATCH system. And the Technical Performance Survey conducted early in the trial phase shows that indeed accuracy is a significant concern. The survey categorized “technical performance” as the absence of unreliable and inaccurate information. Unreliability was measured as the prevalence of spurious information, while accuracy was measured as the extent to which buses arrive within two minutes of the time displayed by the system. The survey measured the proportion of unreliable and inaccurate information at 13% and 11% respectively, for a total of 24%.

This total varied from a low of 11% to a high of 40% for different bus stops, suggesting that external factors have a strong influence on the system’s performance. Possible factors include the unpredictability of traffic congestion or vehicle dwell times, and the impact of urban topography on the performance of the AVL system. Regardless, the 24% level is considered high and could jeopardize the long-term success of the system. However, it is hoped that the system’s technical performance will improve over time as problems are identified and corrected.¹²⁷

Credibility

Frequent transit users responding to the “After” survey were typically critical of the accuracy of information being provided to them and therefore wary of giving it too much importance. However, the survey found that while only 56% considered the information “very reliable,” 41% described it as “fairly reliable” and only 3% believed it “not reliable.” This implies that for many frequent users, “fairly reliable” is not adequate.¹²⁸

In trying to quantify the perceived accuracy better, the STOPWATCH Survey asked respondents how accurate they thought the information on the electronic displays was, in terms of when the bus actually arrives in relation to the estimate provided. 8% of

¹²⁷ Cassidy and Jones, *ROMANSE: Recommended Programme*, p. iv.

respondents thought the system gave the exact time, while 34% thought it was within 1-2 minutes, 25% within 3-5 minutes, 16% greater than 5 minutes, and 17% were not able to say.¹²⁹

Customer benefits

The hall-based interviews asked respondents to rate the usefulness of each of the ROMANSE components they had exposure to. The results of this survey are provided in the table below for the TRIPPlanner kiosks, the Intelligent Display Units (IDUs), and the STOPWATCH system.¹³⁰

	ROMANSE Component		
	TRIPPlanner	IDUs	STOPWATCH
Very useful	32 %	53 %	82 %
Fairly useful	35	36	17
Little or no use	33	12	1

Table 5-10: Comparison of Survey Responses About Project Utility

Users found STOPWATCH to be far more useful than the other two components – in fact, 99% rated the system as at least fairly useful.¹³¹ This result is to be expected as STOPWATCH is the most developed of the three. Furthermore, the type of information provided is of some use to most customers who are exposed to it, while incident messages on IDUs (which are largely traffic-related) and trip-planning assistance via the kiosks have a more limited appeal.

It is interesting to note that 82% of respondents found the system to be very useful even though, as was mentioned earlier, only 56% considered the information to be very reliable and 41% of respondents believed the arrival time information provided was more than 3 minutes different from actual arrival times. This can be interpreted in two ways – that somewhat flawed real-time data is still of some use to customers, and that the users believe the system has sufficient promise for providing valuable information.

¹²⁸ Cassidy and Jones, *ROMANSE: Recommended Programme*, p. 104.

¹²⁹ Cassidy and Jones, *ROMANSE: Recommended Programme*, p. v.

¹³⁰ The TRIPPlanner and IDU components are described in Section 5.2.4.

¹³¹ Cassidy and Jones, *ROMANSE: Recommended Programme*, p. 104.

Evaluating Information Benefits

The INSIGHT computer simulation exercise was conducted on passengers in the Portswood Corridor during 1993. The simulation provided similar information about bus arrival times as STOPWATCH, and asked the participants about their willingness to pay for this information. The results showed an average willingness to pay of 6.9p,¹³² with an average fare at the time of £0.55.¹³³ Increasing fares by this much would decrease ridership – typically in the Hampshire area a 3% ridership loss is expected for a 10% fare increase. However, because 50% of survey respondents indicated a willingness to pay of 6.7p for the STOPWATCH system, it is expected that a 10% fare increase would result in only a 1.5% decrease in ridership. Taking this ridership loss into account, revenue generated from a fare increase of 6.9p would cover the costs of the system.¹³⁴

Real Passenger Benefits

Real benefit is seen by customers who respond to the real-time information provided by STOPWATCH by changing their travel behavior to minimize the disutility of waiting. These “STOPWATCH switchers” either reduce their waiting time by choosing a different mode or route, or make better use of their time. The surveys show that young employed adults, ages 17-34, and students are most likely to switch.

The “After” survey found that 12.5% of respondents had changed their travel patterns during at least one journey in the 14-day period preceding the survey. Of these, 45% either walked or took a taxi to their destination, and 30% walked to a different stop. An additional 18% of the respondents who reported “switching” ran short errands, such as shopping or banking, during the time they were waiting, returning to the stop in time to catch their desired bus.¹³⁵

Perceived Passenger Benefits

Customers reported a relative decrease in waiting time at stops outfitted with the STOPWATCH system between the “Before” and “After” surveys. 77% said they waited less than 10 minutes, as compared to 67% in the “Before” case.¹³⁶ The mean perceived waiting time at STOPWATCH stops actually increased by 10 seconds, from 8 min. 15 sec. to 8 min. 25 sec. However, perceived waiting time at all bus stops city-wide increased an

¹³² Cassidy and Jones, *ROMANSE: Recommended Programme*, p. 90.

¹³³ Cassidy and Jones, *ROMANSE: Recommended Programme*, p. 85.

¹³⁴ Cassidy and Jones, *ROMANSE: Recommended Programme*, p. 87.

¹³⁵ TRENDS, et. al., “The Southampton Before and After Survey Results,” p. 10-11.

¹³⁶ TRENDS, et. al., “The Southampton Before and After Survey Results,” p. 14.

average of 1 min. 30 sec. Thus, there is some evidence that STOPWATCH helped maintain perceived waiting time relative to the rest of Southampton.¹³⁷

One can attribute this benefit not only to the actual waiting time savings resulting from changes in travel behavior as described under *Real Passenger Benefits* above, but also to the perception that waiting times are shorter when the customer is given an indication of how long he/she will have to wait. This effect was shown to be most significant for students, and least significant for the elderly for whom waiting time is perhaps less important.

Psychological Passenger Benefits

Passengers responding to the surveys and interviews also indicated that they had greater flexibility in responding to delays and other incidents when provided with accurate real time information. The customers thus felt more comfortable about making transit trips, and have a perception of improved service frequency and reliability.¹³⁸

Agency/Regional Benefits

A goal of the ROMANSE system is to increase the use of public transportation. There is some evidence of this from the survey evaluations, however given differences in external factors (such as season) between the survey periods, it is difficult to draw any firm conclusions on changes in ridership.

It was mentioned earlier that of the 12.5% of customers who had changed their trip itinerary in light of STOPWATCH information, 45% either walked or took a taxi to their destination instead of waiting for their bus (the “STOPWATCH switch effect”). This would in theory result in a short-term decrease in bus patronage. However, in the longer term one can expect ridership to increase as the benefits of STOPWATCH on customer satisfaction and confidence (due to increased control and flexibility in trip-making decisions) attract a wider customer base. This can be thought of as the result of an increase in utility (or decrease in disutility, as some prefer to view it) per transit trip.

The surveys found some evidence of car owners increasing their use of the bus, however this impact was very small. The “After” survey did show that 4.3% of respondents had increased the number of trips made by bus because of STOPWATCH. Interestingly, the

¹³⁷ Cassidy and Jones, *ROMANSE: Recommended Programme*, p. xiv-xvi.

¹³⁸ TRENDS, et. al., “The Southampton Before and After Survey Results,” p. 21.

“Before” survey had suggested that 17.9% had the intention of increasing transit use, well in line with the typical 3-4 times overstatement of behavioral intent.¹³⁹

Indirect benefits

The indirect benefits of STOPWATCH come primarily from other uses of the AVL system. AVL is already used by the Southampton bus operators for dispatching purposes – there is some evidence of decreased frequency of early arrivals at bus stops. The AVL system will also be used for bus prioritization at traffic signals, and as a data source for the SIS strategic planning tool. Furthermore, bus arrival time predictions will at some point be incorporated into the TRIPPlanner route-planning ROMANSE component.

STOPWATCH data is not currently used for service performance monitoring, even though the capability is there. Within the deregulated environment, local governing authorities (in this case the Southampton and Winchester City Councils) have little influence over bus operations, and thus would see little benefit from this function.¹⁴⁰ The local bus companies do not either, as it is not currently a business priority.¹⁴¹

The benefits from these various other functions are well beyond the scope of this evaluation. Thus in fairness, one should either allocate only a portion of the costs of the AVL system to the STOPWATCH real-time information component, or exclude the costs completely.

Implementation Issues

The key issues regarding implementation of the STOPWATCH system are the cost of developing, installing, and maintaining it, and its compatibility with other ROMANSE project components.

Agency/Regional Costs

Costs provided here are up to the end of the trial phase in August, 1995. The additional cost of a system-wide installation are £1.3 million for Southampton and £0.7 million for Winchester. The table below shows costs incurred for the trial phase, both including and

¹³⁹ TRENDS, et. al., “The Southampton Before and After Survey Results,” p. 14.

¹⁴⁰ Recently, policy-makers in the UK have suggested giving more authority to local government for requiring transit providers to meet service quality standards. If such a change is implemented, a performance-monitoring function would become more useful. See the UK Department of the Environment, Transport and the Regions white paper, “A New Deal for Transport: Better for Everyone. The Government's White Paper on the Future of Transport,” at <<http://www.detr.gov.uk/itwp/>>.

¹⁴¹ Atkins, Steven, electronic mail dated July 31, 1998.

excluding the costs of AVL technology. The present value is given in 1994 British Pounds, assuming a discount rate of 8% and a project life of 8 years.¹⁴²

	Cost (1994 Brit. Pounds)	
	incl. AVL	excl. AVL
Implementation		
• R&D	£ 242,500	£ 145,900
• Installation	588,000	258,000
Operation (annual)	10,000	3,300
Maintenance (annual)	37,800	16,600
Present Value ¹⁴³		
• incl. R&D	£ 1,069,200	£ 496,000
• excl. R&D	862,700	373,400

Table 5-11: Cost of STOPWATCH System, Trial Installation

The cost of the AVL system is more than half the total project cost. As the AVL information is also used for operational purposes, only a portion of these costs should be allocated to STOPWATCH.

The outdoor placement of STOPWATCH displays make it particularly susceptible to damage by both vandals and the elements. During the 14-month trial phase, the ROMANSE project team was pleased to find only two incidents of vandalism requiring repairs to the displays. The resulting expenses are included in the maintenance costs above. The displays are designed to withstand exposure to weather for their expected lives.¹⁴⁴

Compatibility

The STOPWATCH component is firmly integrated within the ROMANSE system. Both vehicle location data and bus arrival time predictions are relayed to and stored in the central TTIC database. As a result, this information can be readily used for other purposes, such as the SIS strategic planning tool.

¹⁴² Cassidy and Jones, *ROMANSE: Recommended Programme*, p. 63-64.
¹⁴³ Present value at the time of installation (January 1994), calculated assuming a project life of eight years and a discount rate of 8%.
¹⁴⁴ Brown, "ROMANSE," p. 4.

5.2.3.3. Conclusions

The ROMANSE evaluation of the STOPWATCH trial includes financial analyses which are summarized below. However, these analyses use only one or two components of benefit for simplicity. It is apparent that the system provides other benefits as described in the preceding text.

The real-time bus arrival information is easy to understand and of benefit to a relatively broad range of transit riders in the Portswood Corridor. Users generally had a very positive view of the system. The greatest concerns were about reliability of the information provided, and it is believed that this reliability will increase with time. As a result, the ROMANSE team has committed to a full-scale rollout of the system in the cities of Southampton and Winchester.

Financial and Cost-Benefit Analyses

The following table gives the benefit required of the STOPWATCH system to offset the project costs, in terms of savings in waiting time and increase in ridership.¹⁴⁵ This is again assuming an 8% discount rate and an 8 year life. It is believed that the benefits required for the system excluding AVL have been met in the trial phase.

	Required Benefit	
	incl. AVL	excl. AVL
Waiting Time Savings		
• incl. R&D	1 min 53 sec	52 sec
• excl. R&D	1 min 31 sec	39 sec
Passenger Growth		
• incl. R&D	8.8 %	4.1 %
• excl. R&D	7.1	3.1

Table 5-12: Required Benefit to Offset STOPWATCH Costs

Table 5-13 gives the benefit-cost ratios for STOPWATCH, using three different measures of benefit. The first assumes that the value of waiting time at a bus stop equipped with STOPWATCH is 1.75 times in-vehicle time, compared to the factor of two typically used. This decrease results in an economic benefit, which according to the table, exceeds costs by a factor of between 2.2 and 6.4. The second and third use willingness to pay as a measure of economic benefit. The second assumes additional revenue is generated from a fare

¹⁴⁵ Cassidy and Jones, *ROMANSE: Recommended Programme*, p. 77-78.

increase equal to the average willingness to pay for the system, and results in benefits of between 1.1 and 3.2 times the cost. This calculation does consider a small loss in ridership due to the increase in fare. The third calculates benefit as the increase in consumer surplus to those customers who would otherwise be willing to pay for the STOPWATCH system. This method of estimating benefit results in ratios between 1.4 and 4.0, which is somewhat greater than the second method as no loss in ridership is assumed.¹⁴⁶

	Benefit - Cost Ratio	
	incl. AVL	excl. AVL
Reduced Disutility of Waiting Time		
• including R&D	2.2	4.8
• excluding R&D	2.8	6.4
Fare Increase based on Willingness to Pay		
• including R&D	1.1	2.4
• excluding R&D	1.4	3.2
Increased Consumer Surplus based on Willingness to Pay		
• including R&D	1.4	3.0
• excluding R&D	1.7	4.0

Table 5-13: STOPWATCH Benefit-Cost Ratios For Various Benefit Measures

Five Key Groups of Users

The STOPWATCH evaluation found that five key groups of users play the biggest role in the success of the system, and thus should be considered carefully in future development and marketing. These groups (which are not mutually exclusive) are:¹⁴⁷

- **STOPWATCH switchers** are previous bus users who switch to different modes or routes in response to real-time information. They typically are young employed adults and students, and are most commonly frequent bus users with low level of car availability. They generally have positive opinions of the STOPWATCH displays, but are very critical of information accuracy, on which they place high value. Expansion of this group should be possible through active marketing.
- **Choice transit users** make up 18% of the survey sample – those who have a car available but chose instead to ride transit. With exposure to STOPWATCH, members of this group perceived that bus service reliability increased. As automobile owners, this is a key target group for reducing road congestion.

¹⁴⁶ Cassidy and Jones, *ROMANSE: Recommended Programme*, p. 87-91.

¹⁴⁷ TRENDS, et. al., “The Southampton Before and After Survey Results,” p. 10-11.

- **First-time transit** users responding to the surveys were predominantly employed male adults or students making leisure trips. They are frequently car users, for whom a high quality transit service is important to encourage repeat transit use. These users had very positive impressions of the STOPWATCH displays.
- **Frequent transit users** made up 40% of the survey sample. As regular riders, they generally had a high level of knowledge about STOPWATCH. However, because of their familiarity with local bus service, they were more likely to use their own experience rather than information shown on the displays. For these riders, service frequency and reliability is the most important concern – thus, if STOPWATCH can improve overall service quality, this group may increase transit use as a result.
- **Increased transit trip-makers** are predominantly newly generated trips rather than switches from other modes. These respondents were typically males under 34 with high level of knowledge about STOPWATCH. This is another key group for meeting the goal of increasing transit ridership.

5.2.4. Other ROMANSE Components

Following are brief descriptions of other components of the ROMANSE project providing transit information.

5.2.4.1. *Traffic and Travel Information Centre (TTIC)*

The TTIC was conceived as a central multimodal repository for traffic and travel information. The Centre is based around the ROMANSE Central Processor (RCP), which collects information provided by a variety of sources, including transit automatic vehicle location (AVL), closed-circuit television, and the Centre staff. The Centre disseminates transit information via four means:¹⁴⁸

- **Intelligent Display Units (IDUs)** – provide real-time traffic and travel information messages on television monitors installed in key locations (seven units were in place in June, 1997)
- **Travel Terminal** – a network of computer terminals enable the TTIC to relay travel information electronically to radio and television broadcasters, and teletext services
- **Videotron Videoway** – currently under development, the videoway will provide a teletext message service via cable television with a significantly more interactive interface, eventually with the capability of automated transit route-planning
- **Telephone Travel News** – via phone recorded message and FAX-on-demand being developed

¹⁴⁸ Hampshire County Council, “ROMANSE II,” pp. 1-5.

5.2.4.2. *TRIPPlanner*

The TRIPPlanner provides journey-planning assistance from kiosks placed at key locations such as transit centers, shopping centers, libraries, and a tourist information center. Via a touch screen and keyboard interface, the user inputs an origin, destination, and time of travel. The system then determines and displays the best route meeting these criteria. Information can be provided for both local and inter-city trips, using schedule data for local transit, inter-city rail, and some airline flights. Travelers can also choose to receive itineraries for travel by automobile, which are also displayed in map form on the screen. As of June, 1997, a total of 18 TRIPPlanner kiosks were in place in Hampshire.

Each kiosk is equipped with a printer, allowing the user to take a copy of the trip itinerary with them. Tourist information is included on the system from a database of points of interest and local events. A list of taxi companies is also provided. Instructions and information are provided in either English, French, or German. Most kiosks are located within public buildings, and thus are available during limited hours. Some, however, have been installed behind storefront windows, allowing their use 24 hours daily.

The second phase of the ROMANSE project will improve the TRIPPlanner design, adding a more intuitive multimedia interface to make the system easier to use. In addition, the kiosk hardware will be upgraded to be directly networked to the TTIC. This will extend the range of information available to include real-time traffic and transit conditions. It will also simplify the maintenance process, allowing information to be updated remotely and hardware problems, such as the printer running out of paper, to be detected from the central location.¹⁴⁹

5.2.4.3. *SENTINEL*

The SENTINEL system was introduced on a trial basis in May, 1997 to provide information, both scheduled and “real-time”, on inter-city South West trains. SENTINEL uses a global positioning system to determine the train’s position – an on-board computer can then identify and broadcast appropriate messages. When the second phase is complete, trains will be able to receive information from both South West Trains Control and the ROMANSE TTIC. Such information, including the status of the train itself as well as

¹⁴⁹ Hampshire County Council, “ROMANSE II,” p. 3.

intermodal information about connecting transportation services, will be provided as messages over the train's public address system.¹⁵⁰

5.2.4.4. World Wide Web Site

The final component for transit information is the ROMANSE project World Wide Web Site, at <<http://romanse.soton.ac.uk/>>. The site is currently in a prototype stage, consisting of a version of the TRIPPlanner route-planning system and some static bus schedules. On the automobile side, the site provides up-to-the-minute traffic reports and real-time car park occupancy statistics. The latter shows promise for eventually including real-time bus location information on the Internet site (see the following section on the GoTIC project for an example of this already in service). Further plans are under consideration for improving the web site based on responses from an on-line user survey.¹⁵¹

5.2.4.5. Strategic Information System (SIS)

An example of an indirect, or secondary, benefit of customer information, the SIS is a support system for strategic planning, integrating information collected from the various ROMANSE components with a geographic information system (GIS). From a transit planning perspective, information about road network congestion and delays, transit service scheduled and provided, and transit on-time performance can be used to make planning decisions. As the AVL system is extended to transit routes throughout the region, the SIS can become a valuable tool.¹⁵²

5.2.4.6. Active Bus Priority (ABP)

A second indirect benefit is the use of AVL data to provide bus priority at select signalized traffic intersections. Based on bus location information, a decision can be made either to:

- extend a green light to allow the bus to pass through, reducing bus travel time with little impact on other traffic, or
- recall a green light given to cross- or opposing traffic to give it to the bus, again reducing bus travel time, but in this case causing significant delay to other traffic.

¹⁵⁰ Laughlin, Ken. *ROMANSE Newsletter No. 1*. Hampshire County Council, June 1997, p. 2.

¹⁵¹ ROMANSE WWW site, <<http://romanse.soton.ac.uk/>>.

¹⁵² Hampshire County Council, "ROMANSE II," p. 1.

This decision, or whether to give priority at all, is determined based upon the current traffic load on the intersection and the current running status of the bus (i.e. priority is more likely to be given to a bus which is running behind schedule).¹⁵³

5.2.5. Summary

STOPWATCH was well-received by most groups of customers in its trial phase. From information gathered in a variety of passenger surveys, the project team has concluded that the STOPWATCH system is cost-effective. Based on these results, the ROMANSE project team has committed to expanding the system to the remainder of the cities of Southampton and Winchester. In addition, variations of the system are being developed in other cities in the EUROSCOPE project.

STOPWATCH is well-integrated with other components in the ROMANSE traffic and travel information project. As a result, common data sets are easily used by different components for a variety of purposes. The range of ROMANSE products, combined with traditional customer information provided by the transit operators, creates a total information strategy that meets the needs of most transit users.

The STOPWATCH system has been implemented in an area where transit service is provided by private companies operating in a competitive, deregulated environment. This has introduced new challenges in cooperation between the public sector and these private entities, and the system was designed with these considerations in mind. The financial costs are covered by ROMANSE project sources and thus operators have little reason not to participate. The trial corridor was selected in part because bus service along that route was relatively stable. And the system was designed such that one operator does not receive information about the locations of the other's vehicles.

There have been issues with the long-term reliability of the STOPWATCH system, with the system being inoperative for several months. Problems experienced have been attributed primarily to technical issues that have arisen and an underestimate of the need for support resources. The separation between project oversight by the ROMANSE office and the daily operating practices of the independent private operators is also likely to be a factor. The worst of the problems have been resolved and the system is back in operation, however more attention must be given to returning system reliability to a decent level.

¹⁵³ Brown, "ROMANSE," pp. 19-20.

Recently, policy-makers in the UK have suggested giving more authority to local government for requiring transit providers to meet service quality standards. It is possible that such a change would enable public authorities to make participation in a cooperative customer information project a requirement for operating transit services on public facilities, even if there were associated financial costs.¹⁵⁴

5.3. GoTIC – City of Gothenburg, Sweden

The Gothenburg Traffic Information Centre (GoTIC) is a system trying to bring sophisticated transit information to as many transit customers as possible. The City of Gothenburg Traffic and Public Transport Authority has, like London Transport, provided traditional forms of transit information for many years. Transit service in the Gothenburg area is well-established, with numerous light rail and bus routes forming an extensive transit network. GoTIC is an attempt to bring more sophisticated traveler information to all types of travelers and at all stages of their journeys. Little formal evaluation has been performed to date of the implemented system, therefore this case is predominantly a summary of the technologies that have been and are being developed within the GoTIC project.

5.3.1. Transit Context

Gothenburg, in west Sweden, has a metropolitan population of approximately 500,000. Public transportation is funded and administered by the Traffic and Public Transport Authority. Transit services have been privatized, with each route tendered competitively. Approximately 300 buses, 200 light rail vehicles, and several ferries are operated by the four bus companies (three private, one public), one public light rail company, and one public ferry operator. A new transportation authority for west Sweden (with a total population of 1.5 million including Gothenburg) was founded in 1998 and will be responsible for all public transport in the region, including both local transit and commuter rail service.

5.3.2. Customer Information

GoTIC is an example of a fully-integrated customer information system. The project, which formally began in 1994, is a collaboration between university research teams, manufacturers, and local government. The purpose of the project is to recommend how,

¹⁵⁴ See the UK Department of the Environment, Transport and the Regions white paper, "A New Deal for Transport: Better for Everyone. The Government's White Paper on the Future of Transport," at <http://www.detr.gov.uk/itwp/>.

when and where real-time information should be collected, processed, and made available to the public. The decisions are based largely on scientific research being performed within the project umbrella by the Departments of Consumer Technology and Transportation and Logistics at the Chalmers University of Technology in Sweden. For use as both a source of real data and to test the project's research results, the Traffic Information Centre is being developed as an "all-encompassing" system for transit information. An extensive evaluation of the system as implemented to date is planned to start in late 1998.

The heart of the GoTIC project is the KomFram ("Gets There") decentralized information network. The system consists of four groups of components:¹⁵⁵

- the communications network,
- protocols for communications,
- databases for public transport and traffic flow information, and
- travel information applications and services.

Because of the integrated nature of the KomFram system, the various components of the project will be summarized in the remainder of this case by their role in the three-step process of providing information: collection, processing, and dissemination.

5.3.2.1. Collection

The transit function of KomFram uses both scheduled service information and real-time data. Scheduled information is transmitted to, and stored in, the system as it is altered. This predominantly consists of transit route trajectory and schedule data.

Real-time information is collected from the vehicles in service. All light rail vehicles and buses are equipped with AVL hardware and report their location after passing radio beacons at each stop and inductive loops buried in the pavement at traffic signals. This location data is communicated to regional computers via both radio and loop modems embedded in the roadway. The regional computers, in turn, transmit the information to a central computer within the Traffic Information Centre (TIC) via an ethernet-based communications line.

¹⁵⁵ Kåbjörn, "Real-time Information In Gothenburg," pp. 1-2.

The traffic information officer situated with the TIC collects additional information about the real-time status of the transportation network and inputs it into the KomFram system. This information is gathered from many sources, including radio communications with transit employees, traffic control center operators, police, and the general public.

5.3.2.2. Processing

As with the collection, raw data is processed into more useful forms via both automated and manual procedures. The KomFram system automatically processes and stores data into four primary databases:¹⁵⁶

- **Scheduled traffic** – transit service as scheduled, in terms of routes, stops and timetables
- **Present situation** – the real-time status for each vehicle: its position on the route and deviation from schedule
- **Forecasts** – based on the present situation and trajectories of previous vehicles, the KomFram computer forecasts the estimated times of arrival and departure of each vehicle for each stop
- **Historical information** – the system continuously archives the real-time status of the transit network for use in performance monitoring and service planning

Messages about service delays and disruptions are generated in real-time by TIC staff. The GoTIC team learned from their own experience and that of others that during an incident, operators in a traffic control center are consumed with making operational decisions, and are thus unable to take the time to alert and advise travelers. They therefore created the position of Traffic Information Officer who works alongside the traffic control staff. While the controllers are concerned with maintaining traffic flow, the information officer is aligned with the interests of the customer, and thus keeps customers continually informed of the real-time status of the transportation system.

To assist the Traffic Information Officer with his or her duties, four types of decision and information support systems are being studied and developed – the first two have been implemented, while the second two are still being researched and designed:¹⁵⁷

- **Message generation system** – contains preprogrammed messages responding to different scenarios, which the information officer can select and customize as needed

¹⁵⁶ Kåbjörn, "Real-time Information In Gothenburg," pp. 1-2.

¹⁵⁷ Gothenburg Traffic Information Center, *Design Of An Information Centre*, pp. 6-7.

- **Forecasting tool** – monitors incoming real-time data to draw the officer's attention to possible problems areas, allowing his or her work to be preventative rather than reactionary
- **Procedural checklist** – a detailed classification of procedures that the information officer should follow in different scenarios, electronically integrated with and triggered by procedures followed and actions taken by the traffic control center
- **Vehicle drivers** – serve as a proxy for the information officer in the field, and can thus be an important role in alerting the information officer about situations as they arise, suggesting what needs to be done on behalf of the customers in response, and providing key information to handle the event correctly

Of these, the message generation system is the most developed. The system is located at a workstation with two computer monitors. One display provides the information officer with an interactive map with which he or she can select which message signs (described in the next section) will broadcast the message, as well as quickly input the relevant geographical locations and transit routes. The second display is used to monitor vehicle location and status, and to review and customize the real-time messages being displayed to customers.¹⁵⁸

5.3.2.3. *Dissemination*

Real-time information from the KomFram system is provided to customers through a variety of media:

- LED displays at transit shelters and LCD displays on stop posts,
- Kiosk-based display monitors at stops where many routes converge,
- LED displays inside vehicles,
- Personal computers at home or office via the World Wide Web, and
- Telephones, handheld computers and pagers.

Each of these is discussed further below. In addition to these customer information uses, KomFram information is used by traffic controllers in making real-time operation decisions, and for transit vehicle priority at traffic signals.

Displays at shelters and stops

Real-time vehicle information is provided at transit stops via LED displays mounted under passenger shelters and LCD displays mounted on stop posts. GoTIC research found that red text on a black background was the preferred LED format in terms of readability. They also determined that real-time information is complementary to, rather than a substitute for,

¹⁵⁸ Gothenburg Traffic Information Center, *Creating Messages*, pp. 6-7.

printed information such as maps and timetables. The displays are therefore usually located above or beside an information board with these items.¹⁵⁹

When the transit system is operating normally, the LED and LCD displays provide the route number, destination, and number of minutes until the next departure for each route serving the stop, as illustrated here.

2	Frölunda	2 min
7	Tynnered	6 min
40	Nils Ericssonspl.	7 min

However, information about all significant delays and disruptions are provided on the displays. This is done in three consecutive stages, with the display rotating through multiple “pages” of text to communicate all that is necessary. The three types of information provided, which GoTIC identified through research with test groups of customers, are:¹⁶⁰

- the cause of the delay,
- which routes are affected and any suggested alternatives, and
- the expected duration of the disruption.

The customer is thereby given all information he or she needs to decide how to proceed, yet the message is still clear and easy to understand. Feeling in control, the customer is not faced with the anxiety or confusion that would result if he or she were only told that service was disrupted. The sequence of display screens illustrated in demonstrates this type of message:

¹⁵⁹ Gothenburg Traffic Information Center, *Recommendations For Real-time Information*, p. 9.

¹⁶⁰ Gothenburg Traffic Information Center, *Requirements For Design Of Real-time Display Signs*, p. 9.

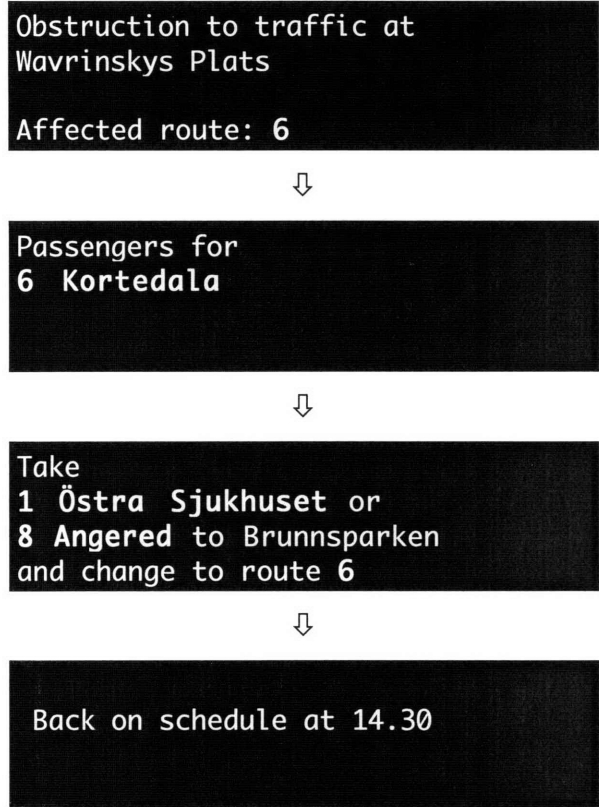


Figure 5-1: In-vehicle Incident Message



Figure 5-2: Fixed KomFram Real-time Vehicle Arrival Time Sign

Kiosk-based display monitors

At major transfer points served by many different routes, GoTIC chose to use television display monitors to list all routes. Similar monitors are also located within certain city buildings and shopping centers. The capability of the television monitors to display more information at once, rather than scrolling through multiple routes on the LED displays, was seen as a strong advantage in this scenario. The types of information provided is similar to the LED displays, as represented in Figure 5-3 below.

The GoTIC team quickly learned that using outdoor television monitors for real-time information should be avoided whenever possible. There are two main reasons for this.¹⁶¹ First, the monitors are bulky and thus difficult to install where customers most need them. If they are situated elsewhere, however, customers are reluctant to leave the stop to view them. This is one of the advantages of the LED transit stop display – that it is visible by most waiting customers with no effort. Second, television screens are difficult to read when any amount of glare is present. Finding an ideal spot outdoors, hidden from sunlight and glare, can be difficult or impossible.

Departing from Brunnsparcken				
Line	Destination	Min	Min next	Berth
1	Östra Sjukhuset	8	14	D
1	Marklandsgaten	0	13	C
2	Frölunda	10		E
2	Biskopsgården	6	16	F
3	Högbotorp	7		E
3	Kålltorp	6	14	F
4	Saltholmen	10	26	H
4	Möln dal	1	13	G
5	Torp	4	14	A
5	Länsmansgården	18		B
Current time: 13.46				

Figure 5-3: Representation of KomFram Television Display Monitors

GoTIC found techniques to minimize these negative impacts. First, they installed static signs to direct customers to the information kiosks when they were located away from the waiting areas. Second, monitors were built into kiosk enclosures which provided as much shade as possible. When this was not possible, monitors were installed underneath canopies which offered at least some protection from glare. As an ideal solution, GoTIC

¹⁶¹ Gothenburg Traffic Information Center, *Recommendations For Real-time Information*, pp. 3-4.

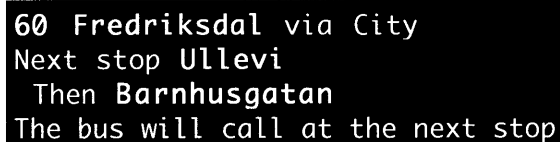
has proposed using monitor kiosks at these major stops, but also include LED or LCD displays at each individual vehicle stop displaying only information pertaining to the routes stopping there.

In-vehicle displays

A sophisticated in-vehicle display system has been developed as part of the GoTIC project, which is currently in a trial phase to select the final hardware and software design. It was decided to provide both spoken messages and electronic displays – the former is usable by the hearing impaired and also attracts the attention of other customers, while the latter is always available even if a customer boards the vehicle after an announcement has been made. Participants in the trial focus groups ranked the following pieces of information as the most important:¹⁶²

- name of next stop
- information about changes in schedule and disruptions (delay should be stated in minutes)
- services and departure times from next transfer point
- line maps should supplement dynamic displays

Travel time to the next stop and the name of the stop following the next stop were of secondary importance to the participants.



60 Fredriksdal via City
Next stop Ullevi
Then Barnhusgatan
The bus will call at the next stop

GoTIC displays are being installed above the center aisle at the front of the vehicle. They will operate in two modes, as with the transit stop displays described earlier. The normal operating mode displays four lines of text with the route number of the vehicle, its immediate destination and through destination (if applicable), the next two stops (to give passengers with children or excess baggage sufficient warning), and whether or not it will be stopping at the next stop. Spoken announcements will accompany this information, indicating the name of the next stop.

At the end of the route, the last two lines of the display will indicate if the vehicle will be interlined to operate as a different route, or if it will be going out of service:

¹⁶² Gothenburg Traffic Information Center, *Visual Information Onboard Public Transport Vehicles*, p. 3.

92 Frölunda Torg
Next stop Frölunda Torg
This bus will then continue as:
19 Eketräkatan via City

In the case of service disruptions, the travel information officer creates a message with relevant information for the customers. The typeface used is narrower, both allowing more text to be displayed at one time and making the information distinguishable from that displayed during normal operation. An audible signal alerts passengers to the message, and in the case of significant incidents, the message is announced over the vehicle's loudspeaker.

Collision at Brunnsparcken
No tram routes passing
Kungssportsplatsen.
Buses replacing

As with the transit stop and shelter displays, the message can be shown in multiple "pages" to provide more detail. This is ideal for providing passengers with recommendations on how to proceed. In the case where transfer connections will be guaranteed despite delays in service, this information will also be passed on to passengers to ease their worries:

This bus is 3 mins late.
Connecting buses are waiting
at Frölunda Torg.
You will not miss your bus!

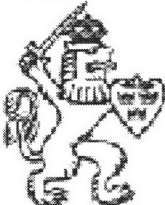
Information about travel time to next stop was omitted from the system as the time between stops averages only about one minute through much of the service area. Indicating transfer connections was also left out, except in the case of service delays and disruptions as illustrated above, as the large number of transfer possibilities at many locations would be impossible to display concisely.

World Wide Web site





Information from the KomFram real-time information are available via the Internet on the Traffic and Transport Authority's World Wide Web site at <<http://www.tkgbg.se:280/>>. In addition to general information about the Authority and research information about the GoTIC project, users can access real-time departure information and transit schedules. Information is provided mostly in Swedish, but some information is also given in English and other languages.

The user can select a transit stop from a list of possibilities, and is returned a table of all routes serving that stop. The table includes a symbol indicating the type of service (light rail or bus), route number, destination, and minutes until the next two vehicles depart from the stop. Colors indicate the route (light rail lines have unique colors, while buses are shown in blue). Figure 5-4 shows a sample of the output presented to the user.

By clicking on the correct icons and links, the user can access current schedules for the desired route. Unfortunately, the process for accessing this information is not intuitive. A schematic map of the region is also available on the site – clicking on a particular stop on this map brings up the same real-time arrival information shown above.



**TRAFIK
KONTORET** Allhelgonakyrkan
GÖTEBORGS STAD

to City				
FS	Line:	Destination:	Next departure in:	Subsequent departure:
	6	Guldheden	at the stop	16
	7	Tynnered	08	23
from City				
FS	Line:	Destination:	Next departure in:	Subsequent departure:
	6	Kortedala	05	19
	7	Bergsjön	13	25

This page was last updated 8:50

Figure 5-4: KomFram via the World Wide Web

Through focus groups, the GoTIC team has collected many suggestions on how the service can be improved. Common complaints include:

- the lack of trip-planning assistance (which is available for regional trip-making on a different site, <<http://www.glab.se/>>),
- downloading times are often too long (in excess of 50 seconds), and
- poor organization and lack of graphics make the site difficult to use.¹⁶³

All comments that have been received will be considered as the site is upgraded in the future.

Telephones, handheld computers, and pagers

Automated systems offer a compromise between having to search through printed materials for information and having to wait on the telephone to be connected to an operator. Thus GoTIC is looking at providing static and real-time information to people who are outside the public transport system via the telecommunications network.

An initial attempt at providing travel information via a portable electronic system was the PROMISE system tested in 1995-96. Consisting of a portable terminal (a PSION pocket computer) linked to a mobile telephone, the system allowed users to query the KomFram database remotely. Functions, including itinerary planning and querying real-time departure time information, were selected through a series of menus. Trial users found numerous faults with the system:

- **Complex inquiry procedure** – too many steps were required to input the needed information, and information entered could not be stored for use in later queries
- **Poor system reliability** – the system would frequently return an “OUT OF TIME” message indicating a communications failure, so subjects would have to repeat the full inquiry procedure several times before getting a response
- **Awkward to carry** – the two piece structure made it necessary to sit down when using the PROMISE system, and it was also quite bulky and heavy
- **Response times** – when the system did return information in response to queries, the response time was often quite lengthy and there was no feedback during the wait that anything was happening¹⁶⁴

¹⁶³ Gothenburg Traffic Information Center, *Requirements For Information On Public Transport Via the Internet*, pp. 4-6.

¹⁶⁴ Gothenburg Traffic Information Center, *Requirements Of A Portable Passenger Information System*, pp. 4-6.

The common verdict among participants in the trial was that it was an interesting concept, but only as long as it was available free of charge, which is not possible with this form of technology.

Learning from this trial, GoTIC now proposes three ways of accessing real-time KomFram transit information remotely, which are being investigated in a new project:

- via push-button telephone,
- via mobile telephones, and
- via pagers.

Push-button and mobile telephones require the user to query the system by navigating a series of voice menus or, in the case of select mobile phones, entering a string of text using the digital display. This input will indicate the route number, and origin and destination stops. Users may also immediately enter a numerical code to access the desired information directly. The output, provided as digitized voice or a text message on the mobile phone's digital display, will provide information about the number of minutes remaining until each of the next two vehicles depart from the origin.

A personal pager technology project, INFOBUS, is already implemented in several locations in France. This system, to be introduced within the GoTIC framework, allows the user to enter route and stop information into the handheld pager, and returns on the pager's display the same real-time information as the telephone system mentioned above.¹⁶⁵

5.3.3. Summary

The GoTIC project is founded on thorough research of the information needs of transit riders and the transit agency's role in providing this information. The KomFram system that has resulted is a well-designed integrated system that provides real-time transit information to many different users over a variety of media. The system is still in the early stages of development, and the GoTIC team is soon to begin a detailed evaluation of all that has been implemented thus far. Further research and development of the components summarized in this section will continue as the project technology will be transferred to other communities in Europe.

¹⁶⁵ Gothenburg Traffic Information Center, "Real-time information via the telecommunications network."

5.4. San Francisco Bay Area, California, US

Transit in the San Francisco Bay Area is provided as more than 40 distinctly marketed services. With inter-county trip-making increasing, there is an increasing need for cooperation between, and integration of, various aspects of transit service. The region's metropolitan planning organization (MPO), the Metropolitan Transportation Commission, plays a major role in regional coordination and cooperation. From a customer information perspective, MTC manages four operational projects: the TravInfo traveler information system, the TranStar transit trip-planning system, the TransitInfo World Wide Web site, and the Regional Transit Database. These four projects are reviewed in this case study.

5.4.1. Transit Context

The nine-county San Francisco Bay Area is home to more than 6.5 million people in 6,915 square miles.¹⁶⁶ More than 3 million people commute to work in the region – in 1990 more than a quarter of these commutes crossed county lines, a percentage which has been growing steadily over time (see Figure 5-5). An additional estimated 50,000 commute trips originate from counties outside the region. Much of the region's population is geographically constrained, in terms of both land use and travel patterns, by a ring of foothills, the Pacific Ocean, the Sacramento River, and the San Francisco and San Pablo Bays. As a result, most inter-county trips are constrained to a handful of corridors, including the region's eight bridges, tunnels, and mountain passes.

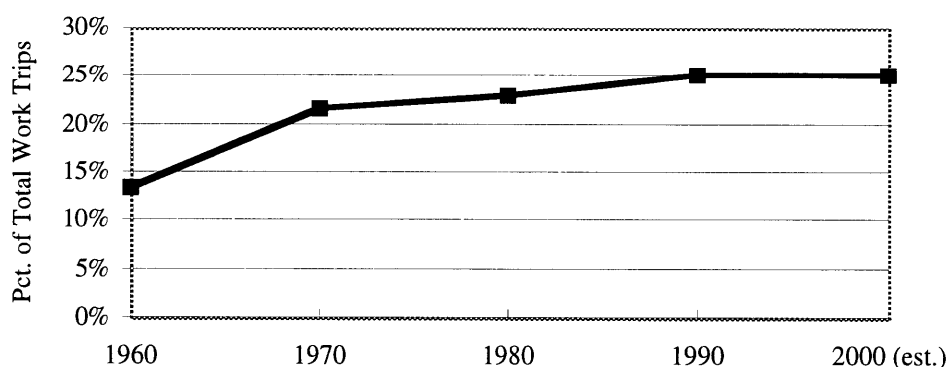


Figure 5-5: Growth in Bay Area Inter-county Work Trips¹⁶⁷

¹⁶⁶ State of California, Department of Finance, Demographic Research Unit WWW site <<http://www.dof.ca.gov/>>.

¹⁶⁷ Sources: *County-to-County Commuters in the San Francisco Bay Area: 1960 - 2010* and *San Francisco Bay Area Regional Demographic and Travel Characteristics*, Metropolitan Transportation Commission (both based on US Decennial Census and Association of Bay Area Governments projections).

Transit provides 6.8% of all trips made in the region, although this varies by county from a low of 1.1% for Napa County to 37.3% for the City and County of San Francisco. Transit serves a greater 9.9% of work trips in the region – however, this has been decreasing since the 1960s (see Figure 5-6). Again, there is a large variance by county (from 1.8% for Sonoma County to 23.1% for San Francisco).

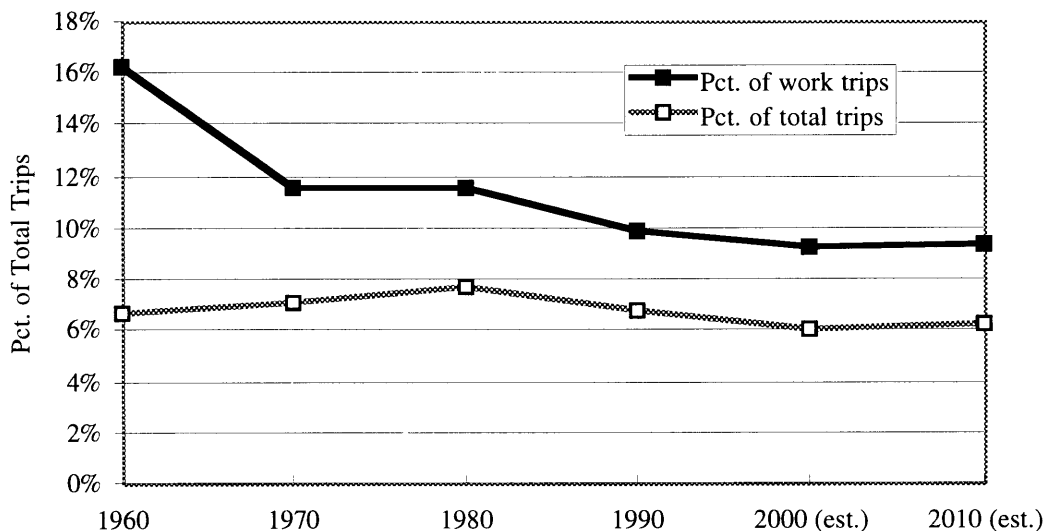


Figure 5-6: Trends in Bay Area Transit Mode Share¹⁶⁸

The region is served by 27 public transit agencies and a handful of private operators. Transit is provided in the form of more than 40 distinctly marketed services, carrying approximately 1.5 million weekday trips with an annual public operating budget of \$1 billion. Transit agencies in the Bay Area come in all shapes and sizes, with the largest six operators, San Francisco Municipal Railway (Muni), Bay Area Rapid Transit District (BART), Alameda-Contra Costa Transit District (AC Transit), Santa Clara Valley Transportation Authority (VTA), San Mateo County Transportation Authority (SamTrans), and Golden Gate Transit providing more than 95% of annual passenger trips. Service is provided via a full range of transit modes, including: commuter, heavy, and light rail; diesel, trolley, and electric bus; and passenger ferry. In 1990, 41.2% of work-based transit

¹⁶⁸ Sources: *San Francisco Bay Area Regional Demographic and Travel Characteristics*, Metropolitan Transportation Commission (based on US Decennial Census and Association of Bay Area Governments projections).

trips crossed county lines,¹⁶⁹ and an estimated 10-20% of transit trips use services provided by multiple agencies.

The Metropolitan Transportation Commission

The Metropolitan Transportation Commission (MTC) is the transportation planning, financing and coordinating agency for the nine-county Bay Area. MTC, formed by the California State Legislature in 1970, functions both as the regional transportation planning agency required under state law and in a federal capacity as the region's metropolitan planning organization (MPO). MTC plays a significant role in Bay Area public transit, a role which continues to evolve over time. Currently MTC interacts with Bay Area transit on five levels:

- **Operational Projects** – MTC manages several operational transit projects that benefit multiple transit agencies and their passengers. Four of these projects form the basis for this case.
- **Regional Transportation Plan** – MTC develops a Regional Transportation Plan for the development of transit, highway, and other transportation facilities.
- **Fiscal Duties** – MTC receives and distributes federal, state and regional funds, in the process monitoring transit agency budgets, conducting performance audits and developing an annual productivity and transit coordination improvement program.
- **Regional Transit Coordinating Council (RTCC)** – MTC oversees a regional transit coordinating council (RTCC) to “adopt rules and regulations to promote the coordination of fares and schedules for all public transit systems.” Subcommittees of the RTCC develop joint-marketing programs and are integral to the development of MTC-managed operational projects.¹⁷⁰
- **Senate Bill 1474 Committee** – MTC was recently empowered to identify functions performed by individual transit agencies that, if consolidated, would improve the efficiency of regional transit service, recommend plans for providing these identified functions through inter-operator agreements or under contract with a single-entity, and improve service efficiency and effectiveness along regional transit corridors by making recommendations not limited to eliminating redundant services and coordinating service across system boundaries.¹⁷¹

5.4.2. Customer Information

Customer information is provided in some form by each of the transit operators in the Bay Area. All agencies print and distribute schedules and, in most cases, system and route maps, available usually in vehicles although in some cases only from stations or their

¹⁶⁹ Metropolitan Transportation Commission, *San Francisco Bay Area 1990 Regional Travel Characteristics*.

¹⁷⁰ Metropolitan Transportation Commission, *Citizen's Guide*, p. 26.

¹⁷¹ Alvarado, Catalina. “New Law Helps Mesh Transit Services.”

administrative offices. Each agency offers information via telephone, although only two (BART and AC Transit) currently make regular use of a trip-planning support tool. All of the major operators have developed World Wide Web sites which provide information at varying levels of detail. Several operators are also planning to deploy computer terminal kiosks at major transit centers and public facilities.¹⁷²

There is little direct coordination between agencies for the provision of customer information although agencies routinely exchange static information with each other for use in their telephone information centers. The Regional Transit Coordinating Council (RTCC) mentioned earlier provides a forum for some interaction, primarily through its marketing subcommittee. However, the significant regional customer information projects are managed by the MTC, with agency participation through the RTCC and Technical Advisory Committees (TACs). Four of these projects, all of which are interrelated to some degree, are described in the remainder of this section.

5.4.2.1. TravInfo Traveler Information System

TravInfo is a multimodal real-time and static traveler information system, designed to collect, process, and disseminate information via a variety of sources, including those offered by private “value-added resellers” (VARs). It operates under the general goals of helping motorists avoid congestion and encouraging public transit use and ridesharing by providing travelers with sufficient information to choose the most appropriate modes, times and routes of travel.¹⁷³

Implementation

TravInfo is a comprehensive information system for San Francisco Bay Area traffic and road conditions, road construction and closures, carpools, public transit routes and schedules, paratransit services for disabled travelers, park-and-ride facilities, and bikeways. Information is provided free-of-charge (in most areas) to travelers via a single phone number (817-1717), which is available 24 hours a day, seven days a week. Besides recorded messages about traffic and transit conditions, the service provides direct connections to 24 public transit operators and 20 paratransit services.

TravInfo is a U.S. Department of Transportation (USDOT) intelligent transportation systems (ITS) field operational test, one of 16 projects so designated nationwide. It is

¹⁷² Much of this information has been gathered during the author’s four years experience with Bay Area transit customer information.

¹⁷³ TravInfo WWW site, <<http://www.travinfo.org/>>.

implemented by a partnership of public agencies, research institutions and private businesses. The public sector provides open access to the TravInfo database of traffic and transit information. Private participation is aimed to offer products and services that repackage and provide this information in convenient and innovative forms. The total public sector project budget is \$9.7 million to implement, operate, and evaluate the system over the two-year field test from 1996 to 1998.¹⁷⁴

Information is stored in an Oracle SQL database at the TravInfo offices in Oakland, California. The information is collected and updated by both automated and manual input from a network of Sun Microsystems workstations at the offices. The information is accessible to the public via the regional telephone number, and by remote connections from resellers via either dial-up modems or through the Internet using the TCP/IP Telnet protocol.

Traffic information is collected from speed-detection sensors embedded in highway pavement, from closed-circuit television cameras, California Highway Patrol (CHP) incident reports, AVL information about Freeway Service Patrol vehicles, and other sources. Daily transit delay and disruption reports are provided by the individual agencies, although the TravInfo office staff call the BART heavy rail and Caltrain commuter rail public information offices at 15 minute intervals during the day for the latest news. Information about longer-term transit service changes and events are collected from transit agency press releases and from broadcast announcements from the TransitInfo World Wide Web site (see the description of this project later in this review). Transit schedule, fare, and other static information is also collected from the TransitInfo site.

In addition to being available via the regional 817-1717 telephone number, transit information contained within the TravInfo system is publicly available on the TransitInfo World Wide Web site – again, see that project description for details.

Evaluation

As a USDOT field operation test, TravInfo is subject to a detailed, comprehensive evaluation, performed by the California Partners for Advanced Transportation and Highways (PATH) research division of the University of California. This evaluation consists of four major components: institutional, technology, traveler response and

¹⁷⁴ TravInfo WWW site, <<http://www.travinfo.org/>>.

network performance. For each component, a detailed evaluation plan has been specified and the first stages have been carried out.¹⁷⁵

The Traveler Information Center (TIC) study is one part of the technology component of the evaluation. This study has four main elements: system reliability, communications interface for the public and private sector “resellers”, operator interface, and response time analysis. This study was conducted from September 1996 to June 1997, examining system reliability, communications interface, and operator interface issues. During this period, the vast majority of problems occurred with the main data processing software, and most were either major or critical errors.¹⁷⁶ These issues have largely been resolved, but the TravInfo database continues to suffer some problems with reliability.

During the survey period, the number of calls to the Traveler Advisory Telephone System (TATS) via the regional telephone number was fairly constant at between 50,000 and 60,000 calls per month requesting information about both traffic and transit. An advertising campaign was launched from January to March 1997, but had only minor effects on the number of calls made. On the other hand, the telephone number saw some 100,000 calls during the first few days of a week-long BART strike in September 1997.¹⁷⁷ The area with the highest call volume was Oakland, with a monthly average of 47,450 calls, compared with 5,836 for San Francisco and 2,518 for San Jose. This is mostly because AC Transit, a major transit provider serving Oakland and its surrounding communities, uses the 817-1717 number as its only customer information number. Calls to AC Transit alone amounted to approximately 55% of total calls during the reporting period.¹⁷⁸

Private sector access of TravInfo data, which is via the Landline Data System (LDS) by either modem or the Internet, has been very limited. During the evaluation period, 25 of the 40 registered participants (62%) accessed data, mostly in small trial-size amounts. Only three downloaded data on a continuous or regular basis – of these, one accounted for 95% of all data downloaded during the period. Again, as mentioned earlier, private sector access of transit-related information has been negligible. Only the TransitInfo WWW site makes regular use of the LDS for transit purposes.

¹⁷⁵ Yim, et. al., *Summary, TravInfo Evaluation Plan*, pp. 2-4.

¹⁷⁶ Miller and Loukakos, “TravInfo Evaluation, Traveler Information Center.”

¹⁷⁷ Metropolitan Transportation Commission, “Traveler Information Telephone Number.”

¹⁷⁸ Miller and Loukakos, “TravInfo Evaluation, Traveler Information Center.”

Conclusions

The majority of mode-specific investment in the TravInfo system architecture has been traffic-related, including highway sensors and closed circuit television, direct links with the California Highway Patrol dispatching system, and location information about freeway service vehicles. This implies that the current focus of TravInfo is on automobile use, which makes up the majority traveling. Transit information is gathered through far more primitive means, either from printed press releases or by telephone with the transit agencies (static information is also collected from the TransitInfo web site). As a result, transit information is relatively poor, in terms of quantity, accuracy, and detail.

There is little evidence of this improving in the short-term, however, as with little public and private sector use of the transit information, the motivation is not there. It is also not a priority for transit agencies, who see little value in actively participating in the TravInfo project, to provide the information. This is unfortunately a chicken-and-egg problem – there is little point to using the information if it is of poor quality, and little point to providing information if it is not used. For agencies to see more value, they must benefit from the service – either through increased dissemination of the information to the public, or a reduction in the time and cost of providing information at the current level.

One hope for the latter gains in efficiency is the news media, a targeted user of TravInfo information. TravInfo is intended to be a one-stop source for the latest information about travel information, where the media could get the latest news without having to contact the transit agencies directly. The idea is to reduce the number of calls to an agency from a dozen different news broadcasters to a single call from the TravInfo office. However, even with TravInfo information available to them, in the case of a major transit incident the media are still likely to go directly to the agencies, hoping for exclusive news that will outdo their competitors.

The 817-1717 number for accessing transit customer service staff is a nice idea, but only if agencies other than AC Transit make it their main point of access. As it is now, the vast majority of transit agency calls are for AC Transit – most callers to other agencies use the agencies' direct numbers. The number will not catch on, and thus will not significantly improve the integration of information about the various Bay Area transit services.

One promising use of transit information from the TravInfo database is the TransitInfo World Wide Web site. The dedicated TravInfo travel information staff, available 24 hours a day, can collect real-time information for distribution via the Internet, which the part-time

web site staff could not effectively collect on their own. This use of TravInfo information is again discussed in further detail in the section on the TransitInfo project.

5.4.2.2. TranStar Transit Trip Planning System

TranStar is a transit trip-planning support package developed by Southern California Rideshare (formerly Commuter Transportation Services, CTS), a department of the Southern California Association of Governments (SCAG). The TranStar system was developed for use in Southern California with federal funding support, and was introduced in the San Francisco Bay Area in 1995. It is currently used by two operators in the Bay Area, with information maintained within the database for four transit services. The system and the number of agencies participating are being expanded through a current ongoing MTC project (contractually a subproject of the Regional Transit Database project discussed later). One such expansion is a World Wide Web interface, similar to the one currently available in the Southern California implementation, that will be accessible through the TransitInfo World Wide Web site.

Implementation

The TranStar software is currently used to provide transit trip-planning assistance for a five-county region in Southern California. Using a geographic information system (GIS) basemap,¹⁷⁹ the system can locate geographical points as landmarks, street addresses, or from cross streets. Based on the origin, destination, and desired departure or arrival time, TranStar determines the “best” itinerary option based on minimizing trip time, the number of transfers (it finds trips of up to seven), walking distance, or cost. The system displays local walking maps at the origin, destination, and any intermediate transfer points, as well as a route map of the transit portion of the trip. The system is generally used by telephone operators, who access the information on screen and can also mail or FAX printed copies in either English or Spanish.¹⁸⁰

TranStar uses a proprietary database format to store information about routes, schedules, and fares. The system is very flexible, handling:

- multiple transit providers,
- different modes of service,
- route deviations (such as for supplementary school trips),
- multiple schedule variations (for weekday, weekend, and holiday service),

¹⁷⁹ The Southern California system currently uses a Thomas Bros. Maps basemap.

¹⁸⁰ Southern California Association of Governments, “TranStar Features.”

- multiple fare categories (such as senior, student, etc.),
- peak hour and zonal fare structures,
- intra- and inter-agency transfer fares, and
- short-term detour information.

Information can be changed both interactively by individual telephone operators and other agency staff, or automatically through a batch process to repopulate large portions of the database. The system can also be used to collect customer complaint and commendation feedback, and will generate regular statistical reports on system use.

TranStar was first operational in the Bay Area in 1995, as a BART demonstration project. The TranStar server, a DEC Alpha running the VMS operating system, is housed within BART's headquarters in Oakland.¹⁸¹ The system currently contains information about AC Transit, BART, Central Contra Costa Transit Authority (County Connection), San Francisco Muni, and Santa Clara VTA transit services. It is actively used only by telephone operators in the BART Telephone Information Center, and by some telephone operators at AC Transit. The Bay Area implementation uses the U.S. Census Bureau's TIGER basemap data.

Further development of TranStar in the Bay Area is underway as a new MTC Trip-planning Implementation Project, which is contractually part of the larger Regional Transit Database project described later in this section. Several short-term enhancements planned, which are already implemented in Southern California. These include:

- a Microsoft Windows-based graphical user interface (GUI),
- the World Wide Web Internet interface,
- a new commercial digital basemap (likely from Thomas Bros.), and
- to expand data collection to include other regional transit operators.

A longer-term plan will be developed during the next phase of the project.

Plans are underway to introduce the TranStar system in San Diego and Sacramento. In the longer-term, SCAG hopes to integrate all California implementations of TranStar to allow state-wide trip planning. This conceivably would incorporate inter-regional transportation services such as Greyhound Bus Lines, Amtrak California inter-city rail, Southwest Airlines, and the United Airlines Shuttle.

¹⁸¹ The Southern California implementation runs on a DEC VAX server, which means that all improvements and updates made to the system must later be ported to the Alpha platform for use in the Bay Area.

Evaluation

The primary shortcoming of the TranStar system is the difficulty in inputting schedule and route data in the system. TranStar requires information to be in the correct format, and rejects any data that is not logically correct. It does not, however, provide much feedback when information is rejected and therefore the process can be frustrating. Automated data entry has also been very problematic – MTC in the past has had to hire part-time data entry clerks to enter schedule data by hand. With experience though, the process is becoming somewhat less onerous. It is hoped that future improvements to the TranStar system will further ease data entry, and that the Regional Transit Database system, described later, will also be of help.

The system is currently deployed in the transit information centers at AC Transit and BART. It is not certain how often the telephone operators at these agencies use the system, however. This is particularly the case at AC Transit – some operators refuse to give detailed schedule information about trips that require BART train service, telling the customer to call BART directly for information about that portion of the trip. This reluctance can be attributed to two factors. First, the current TranStar interface is not very intuitive and therefore is cumbersome to use. Second, telephone operators are hired under a job description that does not require the use of computers, and thus may not use them even if these systems make the work easier.¹⁸²

The procurement of TranStar from SCAG, a public sector agency, instead of a product offered by a commercial business, has several benefits. First, the cost is significantly lower – in fact, the cost of TranStar to Bay Area organizations is limited to the labor costs of installing and maintaining the server hardware and software. Furthermore, through a cooperative relationship with SCAG, it is possible to request modifications and improvements to the software to meet specific needs of the region, again performed for only the labor costs involved. This will be taken advantage of in both the short- and long-term improvements to the Bay Area implementation. On the downside, however, these benefits come at the expense of slower implementation and response time, as well as the difficulties in using the system, both for data entry and trip-planning queries.

¹⁸² This has been dubbed the “fingernail factor” by some – that the mismatch between telephone operator staff and the TranStar computers is illustrated by the long fingernails on some operators that make efficient use of a computer keyboard impossible.

Conclusions

TranStar serves a very useful function in providing trip-planning assistance to telephone operators, and directly to the public through the World Wide Web. This is particularly valuable in regions served by multiple transit operators, where it is unreasonable to expect an agency's telephone information staff to have sufficient familiarity with other agencies' services to provide this function without computer assistance. Use of the TranStar system has been disappointing thus far, however the level of participation of transit agencies in the current project is encouraging. The system has thus far been costly from a data collection, support, and maintenance standpoint. However, with the coming enhancements, particularly the improved graphical interface, World Wide Web interface, and inclusion of data for additional transit agencies, TranStar should function more effectively.

5.4.2.3. TransitInfo World Wide Web site

The TransitInfo World Wide Web site was one of the first Internet sites devoted to public transportation information. It remains one of few sites providing information about multiple transit operators, and is also the only source of comprehensive regional transit information for the San Francisco Bay Area. The site has developed gradually since May 1994, and as of July 1998 serves approximately 4,500 users each day.

Implementation

The Bay Area Transit Information Project began in May 1994 as an independent, volunteer effort to make Bay Area transit information available on World Wide Web. The site was at that time located on donated computer space. In June 1996, the Bay Area Transit Information Project was contracted by the Metropolitan Transportation Commission to continue the effort and expand information to include all public transit services in the nine-county San Francisco Bay Area. This contract was funded by a grant from the Bay Area Air Quality Management District. Maintenance of the site will continue from July 1998 under a new contract as part of the Regional Transit Database project, funded through various MTC funds.

In January 1997, the Project adopted the Uniform Resource Locator (URL)¹⁸³ <<http://www.transitinfo.org/>>, and the informal *TransitInfo* name, to provide a more recognizable and permanent location. In addition, the Project was physically relocated to server space donated by the Bay Area Rapid Transit District (BART). The site now resides

¹⁸³ The universal addressing specification for Internet-based resources.

on a dedicated Sun UltraSparc server purchased with project funds, located within the same building as MTC offices.

A wide variety of comprehensive transit information is available on the site. This information can be categorized as follows:

- Static transit agency information
 - General customer information
 - Schedule information (including route maps)
 - System maps
- Static regional transit information
- Real-time transit information

The site's information content is provided in two ways, from static text HTML¹⁸⁴ files and from a variety of custom-developed software programs. The programs are, with few exceptions, written in Perl¹⁸⁵ and thus can be ported easily between platforms. As the developers were initially unsure of what the expected end product would be, the internal data structure of the Transit Information Project evolved as the site grew. While this enabled the site to grow quickly as new information was gathered, it has resulted in a very loosely organized data set.

The schedule information and system maps are presented to the user by a number of Perl scripts. Schedule data is collected from each transit agency in their own internal format and processed by conversion scripts customized for each agency's format. The result is a consistent filename structure and data format between agencies, which the presentation scripts can use. System maps are collected in their native illustration software formats, and are converted manually into the appropriate image format and at the necessary magnifications for on-screen legibility. Proprietary software is then used to cut the images into usable (in terms of both physical and file sizes) pieces and presentation scripts are used to provide the images and associated navigation functions to the end user.

The remaining information, including general transit agency information (fares, transfer policy, holiday service, etc.) and regional transit information (guides for using bicycles on transit, transit access to regional parks, etc.) is presented as static HTML pages. This

¹⁸⁴ HTML (HyperText Markup Language) is the document formatting language used for World Wide Web content.

¹⁸⁵ A scripting language similar in structure to C, and the language of choice for World Wide Web scripting. The primary advantage Perl has over other languages is a quick development cycle, due to a very flexible syntax and the lack of a compilation step.

information is largely unstructured, with file-naming and content variable from page to page. The administrators of the Transit Information Project plan to improve the organization of this information in the near future.

Several features of the site are particularly interesting, and therefore quite popular with users:

- interactive maps for BART and Caltrain rail services allow users visually to select origin and destination stations to get a schedule of trains for that trip and the appropriate fare,
- a search engine that allows users to search through all textual content by keyword, making the location of information easier,
- comment forms to receive feedback from users about both the site and individual agencies' transit service (agency comments are forwarded by electronic mail to the appropriate recipient),
- an announcement posting and management system allowing the TransitInfo staff and individual transit agencies to post announcements on the site,¹⁸⁶
- a "what's new?" feature that allows users to check historical records of all announcements posted, and
- an electronic mail registration system which automatically sends announcements to registered users (users can select which transit topics and agencies are of interest) – this adds an active mode to the site, stopping users from having to regularly check the site for new or updated information.

The newest addition to the TransitInfo site is an interface to the TravInfo traveler information database, which currently functions in two ways. First, general information about transit agencies, which typically includes bulletins about service changes and special events, is automatically downloaded every hour. Any changes to this information are sent to the TransitInfo staff, who post announcements as appropriate. Second, the TransitInfo site polls the TravInfo database every minute for real-time transit service delay or incident reports. These updates are processed automatically, and are both posted on the web site and sent by electronic mail to registered users.

This second feature has been taken out of service until some technical issues are resolved. The issues involve both communications problems with accessing the TravInfo database and performance concerns with sending the electronic mail (it can take as long as 15 minutes to send a delay report to all registered BART subscribers, which is useless if the delay was estimated to be only 15 minutes in length). Both of these problems should be solved in the near future.

¹⁸⁶ Currently, only one transit agency, County Connection, takes advantage of this capability.

The next phase planned for the TravInfo interface will send road traffic reports by electronic mail to registered subscribers. These reports will include links to the appropriate places on the TransitInfo web site to suggest transit alternatives for avoiding road congestion. For example, a user interested in reports for U.S. Route 101 in San Mateo County will get electronic mail about all incidents taking place on that stretch of road. That report would be prefaced with a message suggesting the traveler consider the Caltrain commuter rail that parallels this particular highway, with a direct link to Caltrain information at <http://www.transitinfo.org/Caltrain/>. To further tune the relevance of information received, the user shall be able to specify only the portion of the road he or she uses by giving the freeway entrance and exit used, as well as the times of the day when he or she usually travels.

The TransitInfo site will continue to be improved as the project continues. The next major enhancement will be an interface to the TranStar trip-planning system, allowing users to circumvent the telephone operator and access the automated trip-planning service 24 hours-a-day. This interface is already available as a component of the Southern California TranStar implementation at <http://www.scag.ca.gov/transit/>.

Evaluation

Information about the use of the TransitInfo site is collected in three ways. Each of these are summarized here with some interesting results given. The fourth subsection discusses the cost of providing the service.

Usage Statistics

The World Wide Web server software records each query in access logs. In its raw form, this data tells what information has been accessed, when, and how many times. However, because of the anonymity of the World Wide Web, one cannot directly translate this information into the number of different people accessing the site. However, the logs do track which computer on the Internet the query is coming from, and with that information one can estimate the number of users.¹⁸⁷ This statistic is far more useful than the raw number of queries (or “hits” as they are typically called) that the server receives.

Use of the site has been climbing steadily since the project began in 1995. Growth in usage is most likely related to the growth in number of people with Internet access. As is evident

¹⁸⁷ A detailed explanation of this methodology is presented on the site at <http://www.transitinfo.org/Other/Survey/count.html>.

in Figure 5-7 below, the number of daily sessions drops during the winter holidays, when people are typically away from their computers at work or school for several days in a row. Two union strikes disrupting transit service have resulted in peaks in usage. Most noticeably, a September 1997 BART strike stopped service for approximately a week, resulting in a weekly average of 4,900 daily users (with approximately 9,800 on the busiest day) compared to a monthly average of 2,500. The TransitInfo site worked actively with MTC and other transit agencies to distribute information about supplementary strike service.

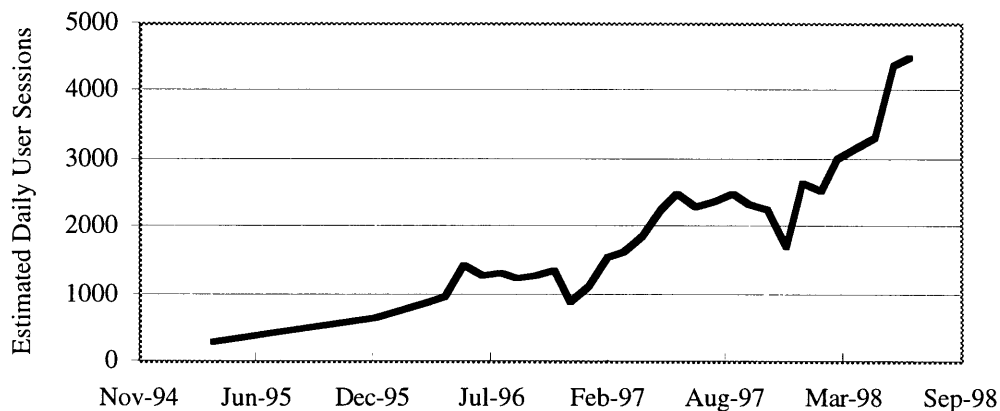


Figure 5-7: Estimated Daily User Sessions of TransitInfo WWW Site

As of July 1998, approximately 4,500 users access the site daily, with a weekday average of more than 5,000. The average user views eight pages of information per session.

User Comments

As mentioned earlier, the TransitInfo site collects feedback from users about both the site and individual agencies' transit service. Approximately 10 comments about the web site are received per day. These are generally questions about transit service or suggestions for improving the site, with the occasional report of incorrect or out-of-date information. Some are compliments on the service, while very few are negative comments. It is generally felt that users have a positive attitude to the site. More than 2,500 agency comments have been collected and forwarded to transit agencies in the nearly four years that this service has been offered. The site currently averages about 5 such comments per day.

User Survey Results

To get a more detailed picture of who uses the site, and for what purposes, the TransitInfo team has conducted three on-line user surveys in May 1995, July 1996, and March 1998 (a fourth will be conducted at the beginning of 1999). These surveys randomly select users for the survey, who are presented with the survey form when they first begin a session. The user is given the option of refusing to participate, or indicating that he or she has already completed and submitted the form. Some of the more interesting results from the most recent survey follow, with some comparisons made to results from the first survey in 1995.¹⁸⁸

Of 9,738 surveys presented to users, 1466 were completed. A further 966 respondents indicated that they had already completed the form, with the remainder refusing to complete it or not responding at all. Of those responding, 83.1% live in the Bay Area. This proportion has increased since 1995, when 68% of respondents were Bay Area residents.

The survey asked respondents to indicate how often they use transit, with the results shown in Table 5-14. The percentage of regular transit patrons using the TransitInfo site is high when compared to the population at large, as should be expected. Compared to 1995, the percentage of frequent users has increased.

How often do you use transit?	Percent
At least once a day	34.3 %
At least once a week	19.3
At least once a month	14.0
Less than once a month	23.8
Never	8.6

Table 5-14: Frequency of Transit Use

When asked how often respondents use the TransitInfo site, the results, in Table 5-15, show that most use the site less than once a week. Given the limited amount of real-time information on the site and the subscription feature for semi-static information, the 4.8% proportion of daily site users is remarkably high. The “first time” rate has fallen substantially from 67% in 1995 – to be expected as the site has been available for much longer.

¹⁸⁸ A detailed explanation of the survey procedure and a review of results from all three surveys is available on the site at <<http://www.transitinfo.org/Other/Survey/>>.

How often do you use this site?	Percent
At least once a day	4.8 %
At least once a week	19.5
At least once a month	36.3
This is my first time	39.4

Table 5-15: Frequency of TransitInfo Site Use

To gain a general understanding of customer need, the survey asked “what do you use this site for most often?” The results show that a large number of people, 58.6%, use the service to check times on the routes they use regularly. As regular transit patrons presumably have printed schedules for their regular routes, this result suggests that people find electronic information more convenient to use or more up-to-date. 30.3% use the site for planning a trip to a new destination, while the remaining 11.1% marked “other”. Some interesting “other” responses included “coming to visit the area” and “planning on relocating to/within the area.” The latter shows the value of having comprehensive regional information in one location.

Students form a significant but not overwhelming percentage of site users, as shown in Table 5-16. The 13.5% responding in 1998 is significantly lower than the 18.4% in 1995. This is most likely due to the growth in Internet access from locations other than school. Indeed, for the first eight months of the site’s existence, users at educational institutions were the majority. A higher proportion of retired users responded to the survey than in 1995, but the number is still quite small.

Are you...	Percent
Employed?	80.1 %
A Student?	13.5
Retired?	2.3
Other	4.0

Table 5-16: Occupation Status

The survey asked why respondents use transit , for which they could check more than one of the answers. The results, in Table 5-17, indicate that all trip purposes were commonplace. Interestingly, 11.4% commute to school via transit, definitely a majority of the 13.5% who are students. The most common “other” response to this question was for going to the airport.

For what purposes do you use transit?	Percent
Commute to Work?	56.4 %
Commute to School?	11.4
Social/recreational/sightseeing trips?	55.9
Errands/appointments/business trips?	40.4
Other	7.4

Table 5-17: Purpose of Transit Trips

Table 5-18 presents the results of the question “how did you discover this site?” The majority of respondents found out about it from other World Wide Web sites, either sites having direct links to it, or search engines that catalog documents on the Web. Links from other Web sites was the dominant source in 1995 – search engines today are far more developed and prevalent. Other sources include bus schedules and “just guessed it” – both of these likely involve people who followed links from other transit agency sites, such as sites for BART (<<http://www.bart.org/>>) and Caltrain (<<http://www.caltrain.com/>>).

How did you discover this Web site?	Percent
From a link on the Web	23.7 %
From a Web search engine	50.4
From a Usenet newsgroup	1.4
From a friend	11.4
Other	13.1

Table 5-18: How Users Discovered TransitInfo

New to the third survey was the question, “if you have visited this site before, has information we have provided resulted in your using transit for a trip you would have otherwise made by automobile?” Out of the survey responses, 985 answered this question. Note that only 955 had responded that they had visited the site before, reflecting some level of inaccuracy in the survey results. Of those answering this question, 626 (63.6%) responded “yes”, a surprisingly positive result.

The following question asked, “If so, how often do you make these new transit trips?” Responses from those answering “yes” to the first question were as follows:

How often do you make these new trips?	Percent
At least once a day	7.0 %
At least once a week	14.5
At least once a month	32.6
Less than once a month	41.5
No response	4.3

Table 5-19: Frequency of New Transit Trips

These response percentages are along the lines of what one would expect. A user only needs to find out how to make a daily commute trip once, whereas he or she may need information about many different one-time trips. Still, 7% of these respondents making new daily trips is quite significant – this corresponds to 4.5% of those answering the first “new trip” question.

The major differences in the results from this and the 1995 surveys likely reflect the increased integration of the Internet into people’s everyday lives. For many, the Web is now more a tool than merely novelty. While in 1998 the question “are you currently trying to find a specific piece of information or just browsing?” was omitted, the increased use of the site for practical purposes is shown by a number of other responses. Users are more likely to be Bay Area residents, more likely to use transit frequently, and more likely to use the TransitInfo site regularly. These trends also likely reflect the information and features added to the site in the interim.

Project Expenses

During the first two years, the project was provided as a volunteer effort, and it is therefore difficult to estimate the number of hours spent initially developing it. The subsequent two year contract with the MTC had a total project cost of \$166,500. This does not include administrative time and costs on the part of MTC, nor the time spent by local transit agencies in transmitting information to the web site administrators. It is believed that the latter costs are relatively small, as information is for the most part accepted in the internal formats used by the operators. The direct project costs can be broken down as follows:

Expense Item	Approximate Cost
Collection, processing, and updating of transit information	\$ 70,000
Site administration (including software development and system administration)	68,000
General project administration	12,000
<i>Work Subtotal</i>	<i>\$ 150,000</i>
Equipment (dedicated web server, computer workstations, etc.)	\$ 16,500
<i>Project Total</i>	<i>\$ 166,500</i>

Table 5-20: TransitInfo Project Direct Costs, June 1996 to June 1998

The estimated cost of continued development and maintenance of the site is approximately \$80,000 per year, reflecting a decrease in development effort but corresponding increases in maintenance effort and wage rates. It is presumed that as data becomes available via the Regional Transit Database, costs for data collection incurred directly by the TransitInfo project will decrease further.

As a rough cost comparison, a human transit information telephone operator can handle no more than 150 calls per day. The annual cost per operator, in the Bay Area at least, typically exceeds \$50K in pay, benefits, and administrative overhead. The TransitInfo site serves a daily average of 4,500 users, the equivalent of 30 telephone operators who would cost transit agencies approximately \$1.5 million annually. It is evident that not all of those 4,500 daily users are actually looking for particular information, and also that not all users find the information they are looking for on the site. However, the costs of providing the web site are less than 6% of the costs associated with 30 telephone operators, and it is certain that more than 6% of TransitInfo users find what they need.

Conclusions

The TransitInfo World Wide Web site is unique within the San Francisco Bay Area as the only source of current, comprehensive regional transit information. The project has been well received by the Internet community, as is demonstrated by the site's usage statistics, user feedback, and survey results. The Bay Area is possibly the ideal location for a public transportation web site, both in terms of the proportion of residents with Internet access and the number of those with access who use transit (this is especially the case with patrons of higher-quality transit services, such as Caltrain, County Connection, Golden Gate Transit, and SamTrans express services).

The rough cost comparison shows that the TransitInfo project is very worthwhile from a cost-benefit standpoint. The cost of providing the service, approximately \$80K per year, amounts to roughly five cents per user session at today's usage levels which, when compared to the cost of a toll-free call that some agencies provide, is very small. The project expenses can be broken down to an average of \$2,000 per transit service per year. Obviously more information is necessary and available for some transit services than others, and therefore more resources are spent on some than others.

The Metropolitan Transportation Commission has clearly seen value in the TransitInfo project, electing to continue supporting it for at least another year. Most transit agencies in the region also see it as beneficial, willingly cooperating with and supplying information to the project staff.

5.4.2.4. Regional Transit Database

The Regional Transit Database (RTD) was first established in 1993, primarily to collect data needed for the TranStar trip-planning package. In this first form, the database held schedule and geocoded route and stop data for AC Transit, BART, and County Connection transit services. With MTC committing to further both the TranStar project and the TransitInfo web site, it was determined that the Regional Transit Database should be expanded in scope to meet the common data needs of these and other regional projects. The goals of the project are:

- to ensure the success of the TranStar and TransitInfo projects,
- to develop a database management system enabling the exchange of information between the TranStar and TransitInfo projects, and
- to develop regional standards for data collection to facilitate the integration and exchange of data between these and other projects.¹⁸⁹

The first phase of this RTD project began in August 1997 and was completed in Summer 1998. This phase determined the information needs of the TranStar, TransitInfo, and other MTC projects. From this, the functionality of the RTD system was defined and some preliminary specifications were identified. The RTD will consist of four primary elements: a geographic basemap, a geographic information system (GIS) engine with mapping capabilities, an Internet-based mapping server, and a relational database management system. Integrated with these four components will be a variety of tools for maintaining and using information within the database.¹⁹⁰

¹⁸⁹ Metropolitan Transportation Commission, *Regional Transit Database (RTD) Project*, p. 3.

¹⁹⁰ GIS/Trans, Ltd., *Regional Transit Database Functionality*, pp. 3-6.

The next phase of the project is to design and develop the RTD database, database management system, supporting GIS, and related project components. Incorporated within this project is the further development and continued maintenance of the TranStar trip-planning system and the TransitInfo web site, as were discussed earlier.

5.4.3. Summary

As was mentioned in the project descriptions, each of these four projects are related in various ways (see Figure 5-8 for a schematic representation of these relationships). The TransitInfo web site will have an interface to the trip-planning capabilities of TranStar in the near future. It also uses real-time information retrieved from the TravInfo database, in return providing announcements and schedule data to TravInfo. The Regional Transit Database is being developed to meet the information needs of these and other projects. This integration will reduce the costs of data collection, both to the four projects themselves and the transit agencies supplying the information, as well as share functionality between projects.

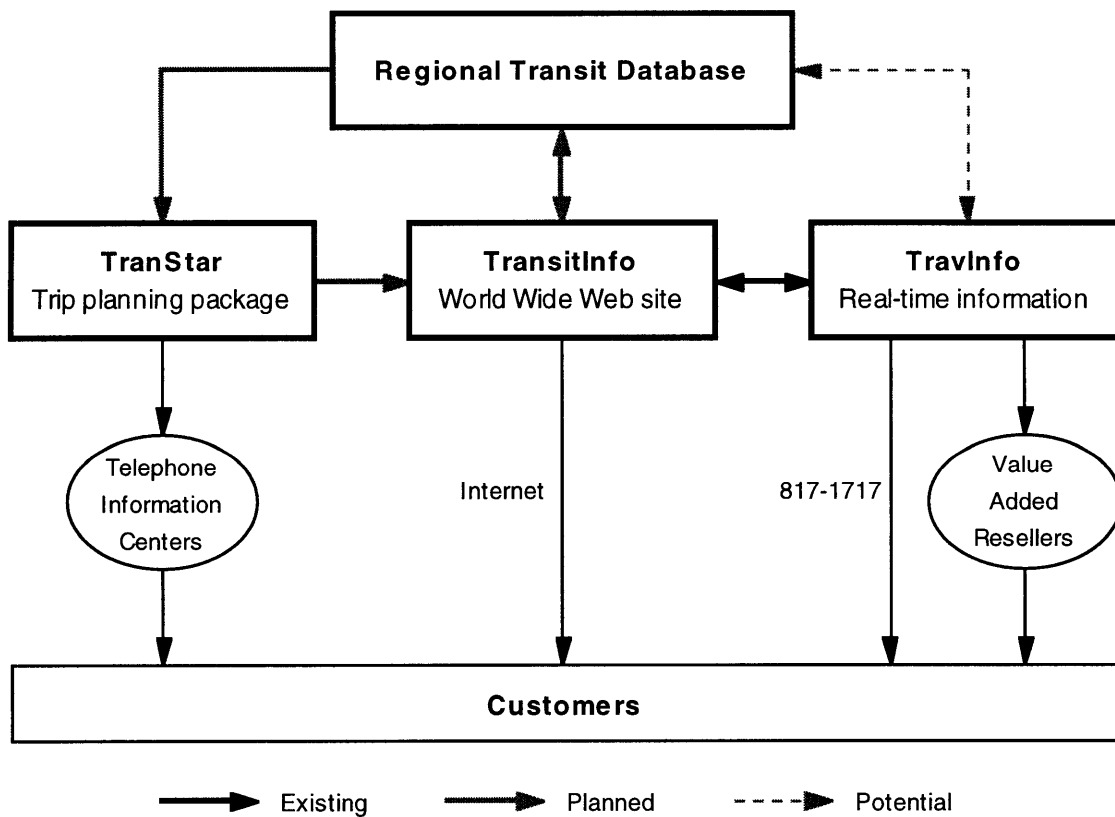


Figure 5-8: Relationships Between MTC Transit Information Projects

5.5. Hong Kong

Hong Kong is one of few places where public transportation is profitable, due primarily to strict geographical constraints resulting in a high population density and a 90% rate of transit dependency. The government is therefore less concerned with increasing transit ridership, instead focusing on maintaining current users and improving the quality of service they receive. Transit is provided by both government-owned corporations and private operators under varying levels of regulation. There is some competition between modes, with fixed-route buses, jitney-style public light buses, rail services, and taxicabs all serving overlapping geographical areas. This competition provides some incentive for providing customer information as a means of increasing market share.

5.5.1. Transit Context

Hong Kong covers an area of only 430 sq. miles, only 15% of which is urbanized.¹⁹¹ It was home to over 6.5 million people in 1997, yet only 315,000 private cars are registered.¹⁹² Thus, 90% of the population rely on public transportation in their daily lives, amounting to nearly 12 million daily trips and an estimated 4 billion transit trips per year.

Transit service is provided in Hong Kong by franchised buses, public light buses, three types of rail, electric trams, ferries, and taxis. The Government of Hong Kong Transport Department has responsibility over strategic transit planning, regulation of transit services, and some operations planning. Five franchised private bus companies, serving different geographical regions, provide fixed-route bus service on more than 550 routes using over 5,000 vehicles. These bus services carry approximately 3.75 million daily passengers. Fares range from HK\$1.1 to HK\$23, based on distance and service quality (mostly in terms of travel time and air-conditioning).¹⁹³

Transit service is also provided by smaller public light buses (PLBs), which generally seat sixteen passengers. The 4,350 light buses, a number fixed by government regulation, carry a total of 1.8 million daily passengers. PLBs are divided into two categories. *Red* minibuses, of which there are 2296, operate with very little government intervention, and carry 840,000 passengers each day. These buses do not operate on fixed routes or schedules, although they typically do operate reasonably well-defined routes between

¹⁹¹ "Background Information Overview," Hong Kong Government Information WWW site, <<http://www.info.gov.hk/hkbi/enghkbi/>>.

¹⁹² "Hong Kong in Figures: Transport and Communications," Hong Kong Government Information WWW site, <<http://www.info.gov.hk/censtatd/hkstat/hkinf/tx-comm.htm>>.

¹⁹³ HK\$8 = approximately US\$1.

established terminals. *Red* bus operators determine their own fares and hours of operation, although the government, through regulated licensing, does require minimum vehicle quality standards and a consistent color scheme. To minimize the impacts on traffic congestion and increase the profitability of franchised bus and tram services, *Red* buses are prohibited from traveling in some downtown areas and restricted in where they can pick up and drop off passengers.

To improve the quality of PLB service and encourage service along less-profitable routes where franchised bus service is not warranted, the government introduced the *Green* minibuses in the early 1980s. There are currently 2054 vehicles operating on 287 route and carrying 930,000 passengers. These buses operate on exclusive routes serving designated stops as determined by the government, typically avoiding major bus corridors and often serving as feeder services for the rail systems. The government also sets fares and schedules for the service. *Green* PLBs are permitted to enter curb zones in which *Red* PLBs are prohibited. *Green* PLBs are largely operated by multi-vehicle companies, and serve a good proportion of white-collar, middle class passengers. *Red* PLBs, on the other hand, are often owner-operated and are more likely to serve blue-collar workers.

All three rail services are owned and operated by government-owned corporations. The Mass Transit Railway, which opened in 1980, is one of the busiest underground railways in the world, carrying 2.3 million passengers daily on three lines over 27 miles and 38 stations. In June 1998, a fourth line was opened, providing both local service and express service to the new Chek Lap Kok airport, adding an additional 19 miles and 7 stations to the system. Local fares range from HK\$4 to HK\$20, with express service to the airport ranging from HK\$40 to HK\$70, with a 25% discount for round-trip travel. Kowloon-Canton Railway's (KCR) East Rail provides service to suburban areas northeast of Hong Kong Island. The electrified heavy rail network covers 21 miles and 15 stations, and carries 680,000 passengers daily. One-way fares range between HK\$3.5 and HK\$32.9, based on distance traveled. KCR also operates a light rail network in the northwestern New Territories, over 20 miles and 57 stops. This LRT system, including a network of feeder buses, carries 446,000 passengers each day. Fares range from HK\$4.0 to HK\$5.8 each way, again based on distance.¹⁹⁴

A system of electric trams have operated on Hong Kong Island since 1904. Eight routes cover 10 miles of track, carrying 277,000 passengers each day for HK\$1.6 per trip. Ferry

¹⁹⁴ "Hong Kong Fact Sheet: Transport," Hong Kong Government Information WWW site, <<http://www.info.gov.hk/hkfacts/transpt.pdf>>.

service is operated by two major companies, the Star Ferry and Hong Kong and Yaumati Ferry. These ferries provide a cross-harbor link between Hong Kong and the Kowloon Peninsula, as well as services to towns in the northwestern New Territories and to outlying islands. Ferries transport approximately 186,800 passengers daily, with fares between HK\$1.7 and HK\$32. Over 18,000 taxis carry an additional 1.3 million passenger trips each day.

Mode shares for these different services are illustrated in Figure 6-2.¹⁹⁵

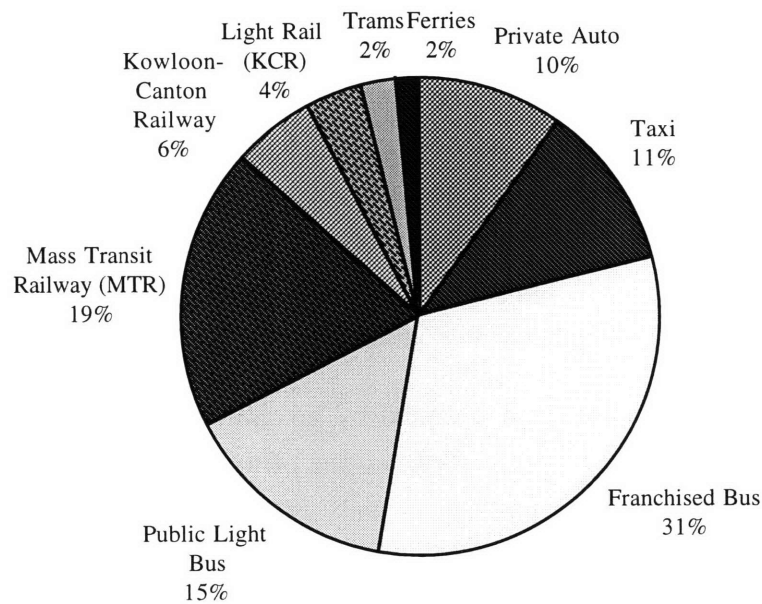


Figure 5-9: Transportation Mode Split in Hong Kong, 1998

The Hong Kong Transport Department has a varying level of regulatory control over all of these transit services. As a result, the Department is able to implement projects integrated across modes. An example of this is the “Octopus” contact-less smart card, which provides single-ticket fare media for rail and franchised bus services. The card which is accepted on all rail services and many bus routes, deducts the cost of each ride from the value stored in it. Use of the card also gives a small discount (approximately 10%) off regular adult fares on some of the services. To date, the Transport Department has not implemented any such integration projects for customer information.

¹⁹⁵ “Hong Kong Fact Sheet: Transport,” Hong Kong Government Information WWW site, <<http://www.info.gov.hk/hkfacts/transpt.pdf>>.

5.5.2. Customer Information

For the most part, transit customer information in Hong Kong is provided by the individual operators. Information is usually presented in both English and Chinese – especially printed brochures and signs within stations and vehicles.

The Transport Department does assume some responsibility for providing customer information, particularly when this involves multiple operators' services. For example, the Department issues publications outlining transit services to key attractions. When the Chek Lap Kok airport opened in July 1998, they developed a pamphlet with the airport office on transportation to the new facility, which included fare and route information for all bus, rail, and ferry services. This pamphlet was distributed from the main government offices and at vehicle licensing offices around the region.¹⁹⁶ In addition, the Department develops and distributes information about its few operational projects, including the "Octopus" fare card mentioned earlier, and maintains a World Wide Web site which contains some regional transit information as well as links and telephone numbers for the different transit operators.

Public Light Bus

The most interesting aspect of customer information provision in Hong Kong is that for the public light buses (PLB). Here the Transport Department plays an important role in publishing information about *Green* PLBs. The government designates fixed stops for these services, which are indicated with signs mounted on posts similar to traditional bus stop signs – these include the route number and a brief description of the route. Printed information is not available inside the PLB vehicles, however, and even though fixed schedules are determined by the government, these are not made available to the public, in part because of the relatively high frequency of service. Private companies do sell transit guides which include a list of all *Green* PLB routes, their destinations, basic fares, and approximate frequencies, as well as regional maps with the routes indicated.

In contrast, the *Red* PLB services have little information provided about them. The Transport Department has an informal policy to encourage *Red* routes to convert to *Green* ones, and thus has no incentive to take on this responsibility. The operators of *Red* vans have little motivation to do so – any funds spent on customer information comes from their profit, and thus they must be guaranteed a positive return in terms of ridership gains from

¹⁹⁶ "Transport Department Press Release," Hong Kong Government Information WWW site, <<http://www.info.gov.hk/td/pressrel.htm>>.

any such expenditures. In addition, *Red* PLBs do not operate fixed routes nor do they stop at designated stops, and thus providing this information would be difficult. Typically the only information available are small signs on the vehicles themselves which indicate where these vehicles operate.

No information about either type of public light bus service is provided by telephone.¹⁹⁷

Franchised Bus Service

The franchised bus operators typically provide customer information about their own services. Most bus stops are designated with signs, which usually indicate the route number and destination. Specific route schedules and maps are typically not published as services are very frequent. Most travel information is passed by word-of-mouth – residents just “come to know” which routes to take, and bus routes are used as commonly as highway route numbers in the United States. An exception is special services, such as those to the airport, for which frequencies are lower, reliability is that much more important, and fares are usually somewhat higher. Printed publications with at least general information about services, including maps and lists of the routes, are available from each operator, although finding them can be difficult.¹⁹⁸

All five companies have telephone information centers for customer queries. Some have recorded messages about service information (per route) that are available 24 hours a day – all have human operators available to answer specific questions during office hours. The three largest bus operators each have World Wide Web sites in both English and Chinese. One of the sites has route maps showing each service, while all at least list route numbers and brief route descriptions, plus fare and other general information.¹⁹⁹

The level of customer information integration between different bus companies is quite poor. Each primarily concentrates on its own services, and telephone operators are often unwilling to provide information about others. Instead, privately published transit guides fulfill this role, providing general information about all bus services (and usually rail as well), within a single book.

¹⁹⁷ Chow, Andrew, electronic mail dated July 2, 1998.

¹⁹⁸ Chow, Andrew, telephone conversation on August 18, 1998.

¹⁹⁹ Kowloon Motor Bus Co. Ltd. WWW site, <<http://www.hkstar.com/netmarket/kmb/>>, China Motor Bus Co. Ltd. WWW site, <<http://www.great-china.net/cmb/>>, and Citybus Ltd. WWW site, <<http://www.citybus.com.hk/>>.

Rail Modes

Information provided about the three rail services is similar to what is provided for most modern rail systems in the United States. System maps are posted in all stations, and are usually also available in printed form for the customer to take. Again, detailed schedules are not published because of the high frequency of service – only hours of operation and service frequencies are given.²⁰⁰ Information is available by telephone from both operating companies, staffed by human operators business hours although recorded announcements are available 24 hours. All trains have recorded next-stop announcements, and plans are underway for installing LCD displays for use by the hearing impaired. The two rail providers have web sites in both English and Chinese (interestingly, the Mass Transit Railway site was only recently expanded into Chinese). These sites have similar information to what is available in printed form – system maps, fare information, service frequencies, and other general information.²⁰¹

5.5.3. Summary

Because transit service in Hong Kong is generally of high frequency, detailed customer information is not necessary. In addition, as 90% of the population is transit-dependent, most residents learn quickly about the services they need to use, generally through word-of-mouth. However, a basic level of customer information is always necessary, and this is provided. Because Hong Kong is a bilingual state, most transit information is provided in both English and Chinese. The use of the Internet is also prevalent – the major rail and bus operators have World Wide Web sites, that are targeted to both residents and visiting tourists.

Information is generally provided by the operators themselves, although the Transport Department does assume responsibility for providing some multimodal information, especially about services to key attractions. The Department is also responsible for promoting the privately-operated *Green* public light buses, for which they install signposts with route information at stops. Private companies publish transit guides which include route descriptions and maps for these buses. On the other hand, no information is provided for the mostly unregulated *Red* public light buses.

²⁰⁰ Chow, Andrew, electronic mail dated August 1, 1998.

²⁰¹ Mass Transit Railway WWW site, <<http://www.mtrcorp.com/>>, and Kowloon-Canton Railway WWW site, <<http://www.kcrc.com/>>.

5.6. Conclusions

Many lessons can be learned from the experiences described in the five case studies. These are useful in considering customer information alternatives for the San Juan Metropolitan Area.

The Roles of Government and the Private Sector

The case studies include a variety of relationships between the government and private sector operators providing customer information. In London and Gothenburg, where transit service is operated under tendered contracts, the private bus companies provide service but the public authority retains the responsibility for providing most information about them. In Southampton, where transit service is completely deregulated, private operators promote their own services under competitive pressure. The public authority, however, remains concerned with providing integrated information about all routes to encourage the use of the public transportation in general.

In the San Francisco Bay Area, individual transit providers, mostly public with a handful of private companies, provide information about their own services. The Metropolitan Transportation Commission has taken an active role in managing regional projects, developed and in some cases operated by private consultants, to provide integrated information. In Hong Kong, rail service operators provide information about their own services, while a limited amount of franchised bus service information is provided by both the Public Transport Authority and the five major bus companies. The Authority also provides some information about the sanctioned but privately operated “Green” public light buses (PLBs). The unregulated “Red” PLBs, however, are not assisted by the government, and thus little information is available about them.

From strictly a customer information standpoint, it is generally best if a public entity is responsible for providing information about all transit services. However, in many cases this is not possible. Thus, each scenario has developed around each region’s particular transit environment. The priority for private sector operators, particularly in a fully competitive environment, is typically to promote their own services with little regard for total societal benefit. As is the case in Hampshire, the public authority must step in if the public’s best interests requires it.

Real-time Customer Information at Bus Stops

London Countdown and Southampton's STOPWATCH are similar systems to provide real-time vehicle arrival time information at bus stops. Both systems have been well-received by customers during their respective evaluation periods. A small but nonetheless significant ridership gain of approximately 1.5% on affected routes has been attributed to London Countdown. Survey respondents valued the service at as much as 26p, more than half the average fare at the time. The GoTIC project also includes a real-time component, displaying departure times for both buses and light-rail trams at transit stops, as well as via the Internet. A detailed evaluation of GoTIC is expected to begin in late 1998.

The psychological benefits to customers from this real-time information are definite, even if they are difficult to value. The systems reduce stress and increase passengers' confidence in the transit services, as well as improving their image. Between the two systems, the real-time displays have been installed in a variety of situations, including stops served by a single route, by local and express services, and by many routes in a denser network. Generally, the most value was seen by customers waiting at stops served by several routes, where passengers have a greater range of trip choices.

However, the reliability of these systems is a concern. In the London Countdown case, while accuracy has been improving, approximately 15% of buses are not displayed due to driver error in registering the vehicle with the system. The situation with STOPWATCH is substantially worse – problems with reliability of system components put the system out of service for several months. Technical issues and insufficient support resources were cited as major causes. It is hoped in both cases that reliability will improve as the technology is further developed.

Effects of the Project Environment

While both Countdown and STOPWATCH have had problems with reliability, the STOPWATCH experiences have been far more severe. This difference in experience is potentially the result of fundamental differences between the environments in which these projects were implemented. The following table outlines these key differences:

	Countdown	STOPWATCH
Project type	stand alone	integrated
Funding source	local	local and external
Research focus	no	yes
Transit environment	tendered	deregulated

Table 5-21: Key Differences Between Countdown and STOPWATCH

The Countdown project has one primary purpose – providing real-time information to London Transport customers. It is funded entirely by London Transport for this purpose, and was developed independently of other projects, reducing the technical complexity (only after the initial trials were AVL and Countdown data put to other use). STOPWATCH, on the other hand, is integrated within the larger ROMANSE system architecture and is funded by a variety of sources, including the European EUROSCOPE and DRIVE II projects. Participants include local government, various private-sector firms, and several research institutions. The project has a primary goal of developing technologies with partner cities for wide-scale deployment. It is possible that this environment is less focused on the end product.

More significant, however, are the differences in transit environment between the two regions. Bus service in London is provided through tendered contracts with private operating companies. London Transport retains authority over most details of transit service and can require cooperation from these operators through the contract documents. Transit service in Hampshire however, like all other cities in the UK, is completely deregulated and thus regional customer information initiatives like STOPWATCH require voluntary cooperation from the private operators. The government has little if any authority to pressure operators to comply.

Integrated Technologies

Three of the cases involved technologies integrated within a system architecture. With a goal of maximizing the efficiency of the collection, processing, and dissemination processes. The ROMANSE and GoTIC projects are designed to collect data from a variety of sources, process it in a central location, and then provide it to the public via different methods. GoTIC uses the KomFram system to collect information about service disruptions and real-time vehicle locations, which is then used in providing information via displays at transit stops, television monitors in public buildings, displays in vehicles, the

broadcast media, and the Internet. Again, evaluation of this system is planned, which should produce some interesting results.

In the San Francisco Bay Area, the issue is not collecting information from different data sources but rather from different transit agencies. The Metropolitan Transportation Commission manages several projects that integrate multi-agency customer information. A new project, the Regional Transit Database, is being designed to avoid duplicate effort and reduce demands on transit agency staff in collecting this information. This system will divide responsibility between the transit agencies, responsible for supplying and maintaining their information in the database, and the information providers. It will also develop data collection standards and procedures to allow easier and better integration of the information.

Use of the Internet

All five of the cases studied employ the Internet in providing customer information. London Transport uses its World Wide Web site to broadcast service interruption notices to patrons via electronic mail. The ROMANSE TRIPPlanner has a World Wide Web interface, allowing customers to plan their transit trips from home or office. GoTIC provides real-time vehicle departure information for all transit stops via its web site – passengers can make trip choices before leaving for the bus stop. In Hong Kong, web sites for the franchised bus and rail transit companies are targeted primarily for tourists, as 90% of the resident population are transit-dependent. And the TransitInfo site in the San Francisco Bay Area provides information about more than 40 different transit services in one place – this site also incorporates real-time information from the TravInfo project and will soon include an interface to the TranStar trip-planning system. It is clear that these agencies see the Internet as an important tool for providing customer information, and is interesting that each uses it for different purposes.

Providing Regional Information

The San Francisco Bay Area offers experiences with the challenges in providing information about transit services offered by numerous different operators. Each transit agency has complete authority over its activities. The Regional Transit Coordinating Council fosters some level of cooperation between neighboring agencies. However, the four regional projects overseen by the Metropolitan Transportation Commission form a starting point for true regional integration. The TransitInfo web site was the first source of current, comprehensive transit information. The other three are still being developed – their success will be determined in the years to come.

Customer Information for Jitneys

In selecting these case studies, some effort was made to find other examples of regions in which substantial information is provided about these privately-operated jitney-type services. In most cases, however, the situation is very similar to that in San Juan, where these services are exclusively advertised by word-of-mouth.²⁰² Hong Kong, however, is an exception. The Public Transport Authority plays a large role in the higher-quality “Green” public light buses (PLBs), including route, schedule, and fare planning, and therefore seeks to promote these services. The vehicles use designated stops with signs indicating route numbers and descriptions – these stops are created by the Authority. Some Authority publications include route and schedule information about the “Green” PLBs – this information is also provided to, or at least obtained by, third-party map publishers.

²⁰² Lau, *Strategies for Improving Jitneys*, p. 20.

6. The San Juan Metropolitan Area

The 13 municipalities of the San Juan Metropolitan Area (SJMA) form an area of 400 square miles, approximately 1/3 of which are urban, constrained by the Atlantic Ocean to the north and a range of mountains to the south. The region is among the most densely populated in United States, with a 1990 population of 1.3 million people (of the 3.5 million residents of the entire Puerto Rican island).²⁰³

As a foundation for the analysis which follows in Chapter 7, this chapter provides a description of the local San Juan context. This includes a discussion of the demographics of San Juan and the local public transportation system. In addition, the chapter summarizes current and previous attempts at providing transit information. Finally, it reviews existing plans to improve customer information.

6.1. Demographics

The residents of the SJMA are experiencing a growing automobile-based culture which is evident in local travel patterns. The automobile plays an important part in a person's image, perhaps more so than in other parts of the United States. In contrast, public transportation has a typically poor image which is reflected in its customers. This section discusses these issues, as well as the cultural implications on how customer information is obtained and interpreted by the public.

Demographic profiles of transit riders are included with the descriptions of transit services by mode in the next section.

6.1.1. Travel Patterns

The Puerto Rican people have developed a strong reliance on the automobile. Car ownership is increasing, from 0.141 vehicles per person in 1964 to 0.405 in 1990. Consequently, automobile mode share is increasing while public transportation's share is decreasing as shown in Figure 6-1. The result is an insatiable demand on the region's roadways – in 1990, 90% of work trips were made by automobile and 50% of inbound roadway lanes are heavily congested in the A.M. peak period.²⁰⁴

²⁰³ Federal Transit Administration, et. al, *Tren Urbano Transit Project*, pp. 1-1 - 1-2.

²⁰⁴ Federal Transit Administration, et. al, *Tren Urbano Transit Project*, p. 1-7.

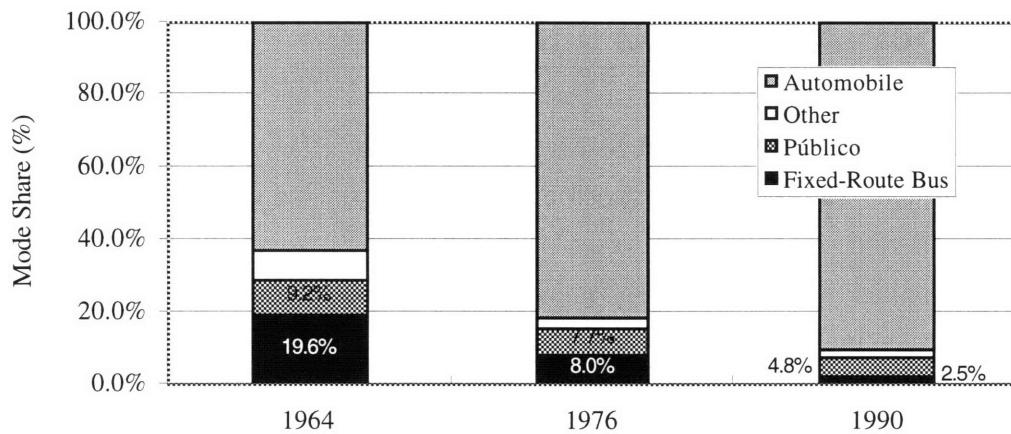


Figure 6-1: Declining Public Transportation Mode Share

6.1.2. The Importance of Image

In many societies, mode of transportation reflects on a person's image. The San Juan Metropolitan Area is no exception. In Hoffman's study of marketing transit in San Juan, he found that the participants in his focus groups viewed owning a car as a status symbol, and a key ingredient to a man's "machismo". Conversely, transit had a poor image. Participants felt that the "economically very disadvantaged" use públicos, and público service is associated with physical discomfort.²⁰⁵ And "so long as the same kind of people" used the bus, the group members would not.²⁰⁶ On the other hand, Metrobús was viewed as having a better image, which meant better, higher quality service.

For transit to regain some of its lost mode share, the customers must no longer view it as a second class service which people of their socioeconomic class do not use. Thus, creating a positive image for public transportation is a priority for the SJMA.

6.1.3. Local Culture and Information

It is a common belief that there is a cultural tendency for Puerto Ricans to prefer obtaining information by asking a human rather than reading a sign or television monitor. This is presumably at least partially a matter of habit rather than culture – as little or no information has been available to date, people have learned not to rely on printed information and instead depend on humans. This can be plainly witnessed at bus stops, where boarding

²⁰⁵ Hoffman, *Toward a Positioning Strategy*, pp. 82-4.

²⁰⁶ Hoffman, *Toward a Positioning Strategy*, pp. 62-3.

passengers will ask the driver where the bus is going, despite correct destination information on the vehicle's headsign.²⁰⁷

An obstacle to providing information via transit route maps is that many Puerto Ricans are not familiar with maps and local geography. For these residents, maps of bus routes would be of little use. However, it is believed that these cultural or habitual issues will change as more information and accurate information is made available to local residents. Once customers notice that the schedules posted are reasonably accurate, they will learn to trust the information. This evolution is essential to the success of the bus system and transit in general in San Juan.

6.2. The Public Transportation System

There are currently three modes of public transportation provided in the SJMA: fixed-route bus services, the "Acuaexpreso" ferry, and "públicos", also referred to as jitneys.²⁰⁸ In late 2001, Tren Urbano heavy rail will begin operation, adding a fourth mode to the transit system. As mentioned earlier in this chapter, public transportation has been suffering a declining mode share since its peak in the 1950s (see Figure 6-1). It is of note that the público mode share has decreased more slowly than fixed-route bus mode share. This can be attributed to a strong decline in fixed-route bus service in terms of both quantity and quality, and the predominantly transit-captive público patronage.

Figure 6-2 below shows the average daily ridership for the three public transportation modes. Públicos provide just about 2/3 of all transit trips, while Acuaexpreso provides less than 2% of the total.

²⁰⁷ Toledo, Freya, personal interview on January 19, 1996 and Edgar Figueroa, personal interview on January 22, 1996.

²⁰⁸ A fourth mode, paratransit service, is also provided by AMA, but serves a relatively small portion of the population. Because of this limited scope, paratransit service has not been considered in this analysis.

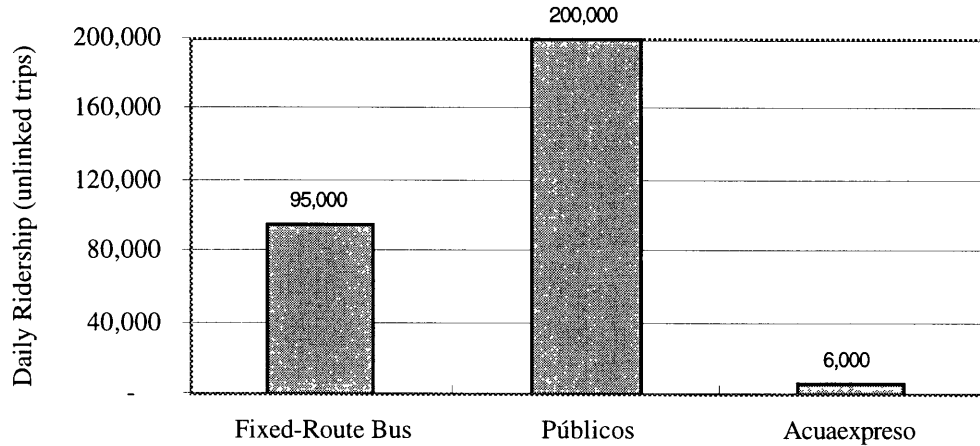


Figure 6-2: Average Weekday Public Transportation Ridership (Unlinked Trips)²⁰⁹

Individual services within each of these modes are determined, regulated, administered, and provided by a variety of public and private entities. Table 6-1 identifies the key players involved – the roles of each are discussed in the descriptions of each mode that follows.

Service	Public	Private
Fixed-Route Bus: AMA public service	Metropolitan Bus Authority (AMA) [†]	
Fixed-Route Bus: Metrobús contracted service	Highway and Transportation Authority (PRHTA) [†] AMA ^{†,‡}	Metrobús operator(s) [‡]
Públicos	Public Services Commission (PSC) PRHTA [†] Driver Services Directorate [†]	Público operators Público organizations
Acuaexpreso	Puerto Rico Port Authority Department of Transportation and Public Works (DTOP)	
Tren Urbano	PRHTA [†]	Siemens team [†]

[†] a division of the Department of Transportation and Public Works (DTOP)

[‡] operating under contract to a public agency

Table 6-1: Public Transportation Providers in San Juan

²⁰⁹ Attanucci and Wensley, “Enhancing Public Transportation in San Juan.”

6.2.1. Fixed-Route Bus Service

Fixed-route bus service is provided primarily by the Metropolitan Bus Authority (AMA) and contracted Metrobús services. A handful of privately operated bus services provide longer-distance inter-city trips.

6.2.1.1. Metropolitan Bus Authority (AMA)

The Metropolitan Bus Authority (Autoridad Metropolitana de Autobuses, or AMA), a division of the Department of Transportation and Public Works (DTOP), is the public provider of most fixed-route bus service in the SJMA. AMA has faced a decline in service quality and consequently, ridership since its peak in 1957. Before 1995, service was provided on 43 routes using 159 scheduled buses (typically more than a quarter of these would not actually make it to revenue service). Headways ranged from 15 to 75 minutes, although very few routes operated headways shorter than 30 minutes. Service was considered unreliable and inefficient, characterized by poor frequency, low speed, circuitry, and terrible schedule adherence.²¹⁰

Following a thorough evaluation of AMA service with the anticipated introduction of Tren Urbano rail service in mind, the DTOP, AMA, and PRHTA began a two-phase restructuring of fixed-route service, incorporating AMA service and the higher-quality Metrobús routes (see the next subsection) into a transit center network structure. The first phase was implemented in December 1995, and the second in December 1997. Following this restructuring, there are now only 29 routes using a roughly similar 157 scheduled buses. An additional 42 vehicles are used to provide service on the 3 Metrobús routes.²¹¹

AMA charges a \$0.25 fare for each bus ride. Headways range from 6 to 60 minutes, and on weekdays most are under 30 minutes. A letter code system has been developed to allow customers quickly to identify a route's service frequency. Codes "A" and "M" (Metrobús) designate trunk routes between the 12 transit centers (an example of such a route is the A3). Codes "B" and "C" designate lower frequency local routes, while "E" routes are single-trip commute services. Table 6-2 gives approximate headways for each route category:

²¹⁰ Multisystems, *Short-range Transit Center Plan*, p. 3.

²¹¹ Wensley, Jim, electronic mail dated July 23, 1998.

Type	Weekday Headway	Sunday Headway	No. of Routes
M (Metrobús trunk)	< 10 mins.	< 20 mins.	3
A (trunk)	< 15 mins.	< 30 mins.	4
B	< 20 mins.	< 60 mins.	10
C	< 30 mins.	< 60 mins.	13
E (commute)	n/a	n/a	2

Table 6-2: Fixed-Route Bus Service in San Juan, January 1998

With the Phase II restructuring, surveys were performed in early December 1997, February, 1998, and June, 1998. Among the data collected from these surveys was some basic demographic information about AMA customers. Figure 6-3 and Figure 6-4 provide the occupation and age breakdown of survey respondents (the February 1998 survey results are given as this is a period when most students are attending school). Nearly half of all respondents are employed, with students making up an additional third. Also, riders tend to be young, with 44% of respondents under the age of 25.

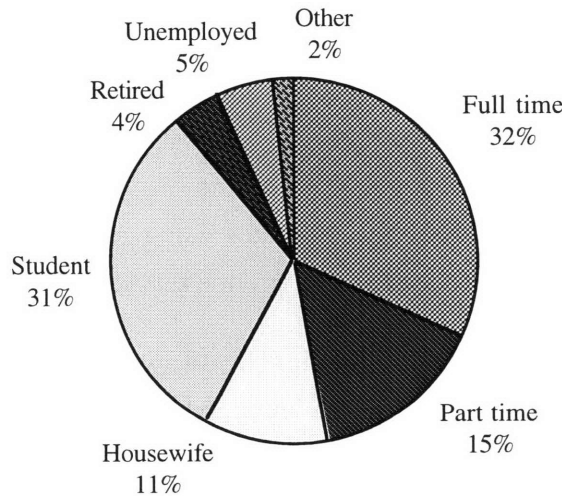


Figure 6-3: Occupation of AMA Bus Users in SJMA, Feb. 1998²¹²

²¹² Multisystems, "AMA Passenger Survey Results."

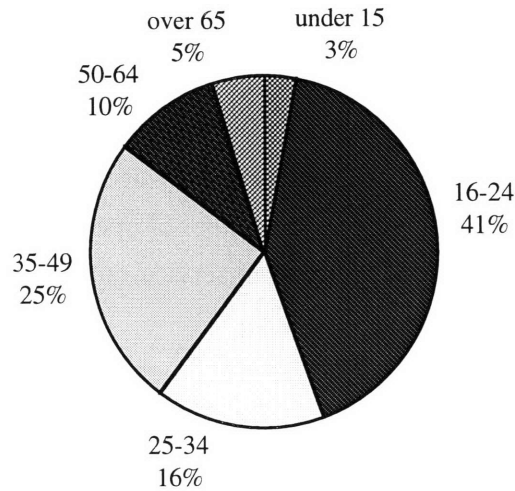


Figure 6-4: Age of AMA Bus Users in SJMA, Feb. 1998²¹³

6.2.1.2. *Metrobús*

Metrobús service was initiated in 1991 as a higher quality bus service, in terms of frequency, reliability, and comfort. The service is contracted out by the Puerto Rico Highway and Transportation Authority (PRHTA), and consists of three trunk routes:

- **Metrobús I (M1):** Río Piedras – Hato Rey – Santurce – Old San Juan
- **Metrobús Expreso (ME):** Río Piedras – Hato Rey – Old San Juan
- **Metrobús II (M2):** Santurce – Hato Rey – San Patricio – Bayamón

M1 and ME are operated by a private company, while the M2 route is operated by AMA, under contract with the PRHTA. The fare on these routes is \$0.50 to reflect the higher quality service. Service headways are 10 minutes or less on weekdays, and as low as 6 minutes during peak periods. 42 buses are scheduled to provide service on the three routes.

6.2.2. **Públicos**

Públicos are the dominant form of public transportation in Puerto Rico. This demand-responsive service typically uses passenger vans or sedans to provide transportation along fixed routes, although route deviations are generally made at the customer's request. Vehicles typically depart the originating terminal only when they are full, and thus there is no fixed schedule. Públicos carry roughly two-thirds of all transit trips in the SJMA.

²¹³ Multisystems, "AMA Passenger Survey Results."

Service is generally quite frequent, particularly during the morning peak, and is provided to lower-density neighborhoods where fixed-route bus service is not cost-effective. Público service typically operates Monday to Saturday, from roughly 6 a.m. to 6 p.m. each day. Vans are mostly operated by self-employed persons, and receive no public subsidy. Over the past few decades, públicos have experienced a declining mode share (again refer to Figure 6-1) and a corresponding decline in number of operators and vehicle fleet size. This trend can in part be attributed to a decrease in service quality, increasing road congestion, and an increased level of automobile ownership.²¹⁴

Público routes are classified as either local (within a single municipality) or inter-city. Inter-city routes operate both within the SJMA and to the SJMA from locations outside the region. The mean trip fare is \$0.76, with the lowest fare only \$0.35.²¹⁵ Section 15 data from FY 1994 reports the following statistics for público service:

Service Type	No. of Routes	Pct. of Trips	Avg. Route Length	Avg. Trip Time	Avg. Speed	Mean Headway
Inter-city	26	42 %	10.5 mi.	36 mins.	17 mph	10.5 min.
Local	79	58	5.6 mi.	20 mins.	18 mph	24.2 min.

Table 6-3: Público Service in San Juan, FY 94²¹⁶

An additional 18 routes provide service into the SJMA from outside the region. In 1995, there were a total of 2,230 público vehicles in service,²¹⁷ although 5,480 total vehicles were registered (as not all registered vehicles are operated due to insufficient demand).²¹⁸

Most público operators are organized into associations, cooperatives, federations, or unions. These organizations informally govern service operations, provide benefits (such as insurance) to members, and collectively negotiate with the government. Public oversight is performed by several government bodies:

- Public Services Commission (PSC) – regulates fares and route franchises,
- Puerto Rico Highway and Transportation Authority (PRHTA) – responsible for regional transportation planning, including público service,

²¹⁴ Lau, *Strategies for Improving Jitneys*, pp. 18-20.

²¹⁵ Federal Transit Administration, et. al, *Tren Urbano Transit Project*, p. 3-35.

²¹⁶ Lau, *Strategies for Improving Jitneys*, p. 25, citing: Federal Transit Administration. *National Transit Database*. 1994.

²¹⁷ Lau, *Strategies for Improving Jitneys*, pp. 18, citing: Federal Transit Administration. *National Transit Database*. 1997.

²¹⁸ Lau, *Strategies for Improving Jitneys*, p. 23, citing: Management and Technical Consulting Group, Inc. *Draft Final Report: Capital Assistance Program for Públicos*. Río Piedras, September, 1996.

- DTOP Driver Services Directorate – handles vehicle licensing and the location and design of terminals and stops along state facilities, and
- Individual Municipalities – responsible for the location and design of terminals and stops along local roads.

The PSC is currently the only agency actively and directly involved with público service. With a staff of only 4 or 5 allocated to público concerns, the PSC is considered too small to oversee operations effectively.²¹⁹ As a result, público organizations have assumed greater, albeit unofficial, power in controlling which operators provide service on which routes. Público licenses are renewed every 5 years.

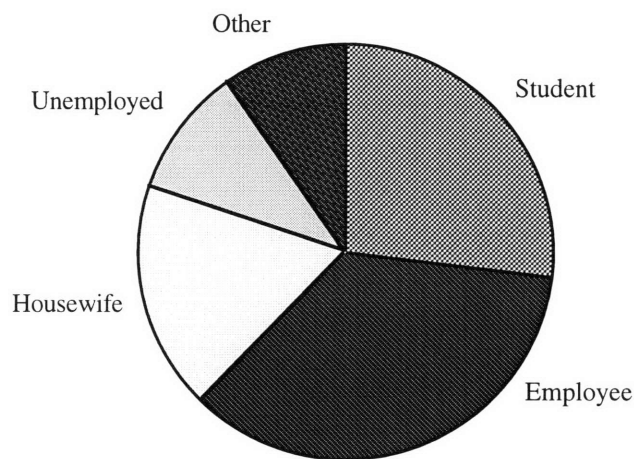


Figure 6-5: Occupation of Público Users in SJMA²²⁰

Three out of every four público riders are captive (i.e. they have no access to an automobile or other form of transportation).²²¹ Riders fall into four major categories: employees, students, housewives, and the unemployed. The relative proportions of each group is shown in Figure 6-5. 42% of público riders are under 25 years of age.²²² Many people avoid riding públicos because of the negative image it carries – issues of comfort, composure, and safety are also significant.²²³

²¹⁹ Lau, *Strategies for Improving Jitneys*, pp. 21-22.

²²⁰ Luyanda and Gandhi, “Characterization Of the ‘Público’ System Of Puerto Rico,” pp. 107-115.

²²¹ Lau, *Strategies for Improving Jitneys*, pp. 30, citing: conversation with Felipe Luyanda, University of Puerto Rico Mayaguez Civil Engineering, January 1996.

²²² Luyanda and Gandhi, “Characterization of the ‘Público’ System Of Puerto Rico,” pp. 107-115.

²²³ Hoffman, *Toward a Positioning Strategy*, pp. 80-4.

6.2.3. Acuaexpreso (Ferry)

“Acuaexpreso” ferry service is operated by the Puerto Rico Port Authority, a public entity. Service began on March 30, 1991, replacing existing ferry service that was also publicly operated with new terminals and vessels. Service is provided between three terminals at Cataño, Hato Rey, and Old San Juan via two routes:

- Cataño – Old San Juan: fare of \$0.50
- Cataño – Hato Rey – Old San Juan: fare of \$0.75

Current service headways and levels of ridership are listed in the following table.²²⁴ It is of note that more than 95% of ridership is on the Cataño – Old San Juan route.

Route	Peak Frequency	Off-peak Frequency	Hours of Operation	Daily Trips	FY 97 Ridership
Cataño - San Juan	15 mins	30 mins	6am to 10pm	87	1,208,980
Cataño - Hato Rey	30 mins	n/a	peak only	8	53,738 (combined)
Hato Rey - San Juan	30 mins	60 mins	6am to 7pm	58	

Table 6-4: Acuaexpreso Ferry Service in San Juan, December 1997

The ridership on the ferry has been far less than the 5 million annual passengers that was predicted. In fact, ridership has dropped below the levels seen prior to the introduction of the “improved” Acuaexpreso service in 1991. Perhaps the most significant explanation for this is the substantial increase in fare, from \$0.10 to the current levels.²²⁵

Figure 6-6 shows annual ridership that has fallen from a high point during the first year (especially the Hato Rey – Old San Juan route), but has shown some gain since FY 95.²²⁶ In FY 95 and FY 96, service to Hato Rey was disrupted for 8 months due to dredging of the channel the ferry uses and mechanical problems with the vessels. This service is once again suspended this year.

²²⁴ Randall, *An Assessment of Acuaexpreso*, pp. 39-41.

²²⁵ Randall, *An Assessment of Acuaexpreso*, p. 131.

²²⁶ Randall, *An Assessment of Acuaexpreso*, pp. 41-42.

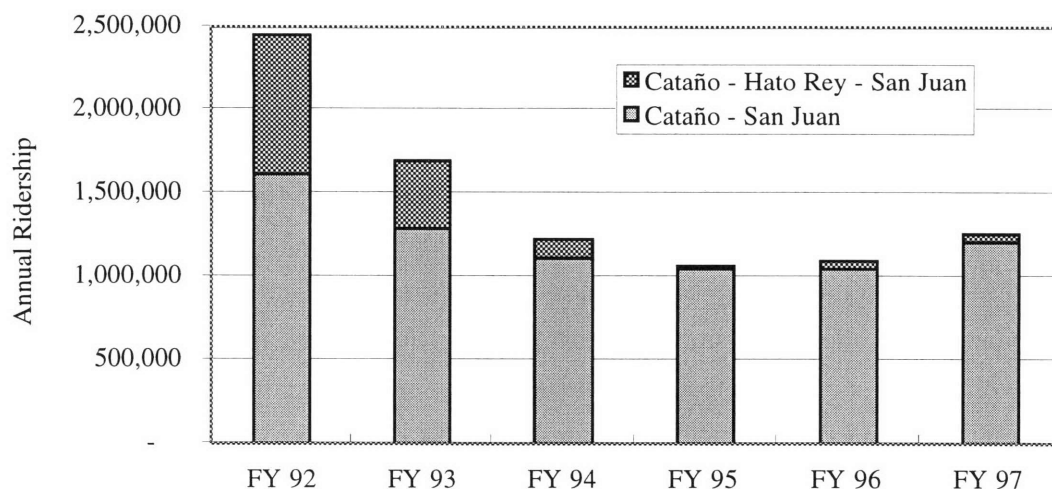


Figure 6-6: Annual Acuaexpreso Ridership

Each terminal is located within walking distance of the surrounding neighborhoods and connecting transit service:

- **Cataño** – Located on the waterfront, near a few small businesses and the residential area. AMA routes A3 (to Hato Rey and Río Piedras via San Patricio) and C37 (to Levittown) stop nearby. A público terminal is several hundred feet away.
- **Hato Rey** – Situated just west of the Nuevo Centro district of Hato Rey, the urban core. Several AMA routes stop at the terminal: C10, C11, B15, B16, B17, and C41. Other routes operate along Avenidas Fernández Juncos and Ponce de León approximately a quarter mile to the east.
- **Old San Juan** – On the south shore of the Isleta de San Juan, within walking distance of the old city, the free San Juan trolley service, and AMA’s Covadonga bus terminal where service to Santurce and points south originates.

Daily ridership on the Cataño – Old San Juan route is 3,300, slightly higher on the weekends than weekdays. Three main customer groups make use of this service: predominantly lower-income commuters, travelers accessing business and government services in Old San Juan, and leisure travelers (both tourists and locals). There is also a sizable reverse-commute market from San Juan to Bayamón and Cataño on weekdays.²²⁷

On the Cataño – Hato Rey – Old San Juan route, daily ridership is less evenly spread between weekdays and weekends. In 1997, the weekday ridership average was only 83 passengers per day, more than doubling to 205 on weekends. The relatively high weekend ridership on both routes can be attributed to a higher recreational demand for transportation

²²⁷ Randall, *An Assessment of Acuaexpreso*, pp. 125-6.

to Old San Juan on weekends, combined with poorer weekend service provided by other transit modes.²²⁸

6.2.4. Tren Urbano

The Tren Urbano heavy rail system will bring a new standard in transit service quality to San Juan when it begins operations in November, 2001. The system will be 11 miles in length with 16 stations linking the business and residential districts of Bayamón, the Medical Center area, the University of Puerto Rico in Río Piedras, the Hato Rey business district (with a ferry connection from the Nuevo Centro station area to Old San Juan), and Santurce. Service will operate at four minute headways during peak hours, decreasing to 10-12 minutes at night and on weekends.

Final design and construction of the system is being performed in segments under seven different contracts. Ridership is expected to reach 114,000 daily passengers by 2010, of which 55% are expected to transfer to the train from other transit modes.²²⁹ Several extension phases are currently in various stages of planning.

6.3. Experiences with Customer Information

The various transit services in the San Juan Metropolitan Area (SJMA) currently provide some level of customer information. In addition, several previous attempts have resulted in some valuable lessons. This section summarizes these efforts.²³⁰

6.3.1. Fixed-Route Bus

Before 1991, virtually no customer information was provided about bus service in the SJMA. At the time, AMA was receiving little funding and providing very poor quality transit service – the agency was therefore unable and unwilling to provide information about the service to its customers. As conceptual planning for Tren Urbano began, it was quickly evident that success of the rail system would require the development of an effective complimentary feeder system of buses and públicos. An emphasis was then placed on improving bus and público service in San Juan – one such improvement being in customer information.

²²⁸ Randall, *An Assessment of Acuaexpreso*, p. 44, citing: Puerto Rico Port Authority figures.

²²⁹ Federal Transit Administration, et. al, *Tren Urbano Transit Project*, pp. ES-24 - ES-25.

²³⁰ Much of this information was gathered from the author's personal visit to San Juan in January, 1996, personal interviews with Freya Toledo on January 19, 1996 and Edgar Figueroa on January 22, 1996, and a telephone conversation with Freya Toledo on June 29, 1998.

6.3.1.1. Pre-trip information

Pre-trip information about fixed-route service in the SJMA has been available in printed form in limited runs, from telephone information agents, and most recently, via the World Wide Web.

Printed information

Information about bus service has been made available in recent years as part of marketing efforts to communicate changes resulting from the transit center route restructuring. These two campaigns, which were run for several weeks before and after the changes took place, are discussed below:

Phase I: “Conoce Tu Ruta”

The “Conoce tu ruta” (Know your route) publication was printed and distributed at key Metrobús stops during the weeks before and after Phase I changes in December, 1995.²³¹ The guide was developed and distributed by the PRHTA to promote the Metrobús services as well as AMA routes. Printed entirely in Spanish, it provided a description of changes, a schematic route map and a summary schedule for each new or changed route. In this phase of the restructuring, changes were made to 5 routes, including the original Metrobús I route. In addition, a new local route was created, as were the Metrobús Expreso and Metrobús II routes.

Each page of the guide provided information about one route, with the route map and description of changes on one side and the schedule on the other. It was intended that the customer tear off the page(s) for the routes he or she used and carry them with him or her. The route maps showed major cross streets and key landmarks along the route. The summary schedules provided information about headways and hours of operation. The final page lists the seven transit centers that had been established at that time, with the routes (and route frequencies) serving each.

In conjunction with this guide, similar information was published in the three main San Juan newspapers about the changes to existing AMA routes and the new Metrobús services.

²³¹ Toledo, Freya, personal interview on January 19, 1996.

Phase II: “Guía oficial de las nuevas rutas”

The Phase II changes of December, 1997 were more significant than the first phase of the restructuring – many routes were modified and several were eliminated. The new A/B/C route coding scheme mentioned earlier was introduced, and the number of transit centers was increased to 12. As a result, a greater marketing effort was undertaken to promote these changes. For a period of six weeks, PRHTA hired 110 part-time information agents who manned small information stands at transit centers and major stops.

These agents distributed printed guides to the new route network and provided trip-planning assistance using a specially designed tear-off system map. These two printed materials are described further in the remainder of this subsection.

Consultants to the PRHTA conducted surveys both before (in early December, 1997) and after (late February, 1998) the changes were implemented, as well as a follow-up survey in June, 1998. The surveys asked passengers where they got information about the new service. Figure 6-7 below shows the results of this survey question (note that respondents were allowed to select more than one source, so totals do not add up to 100%). Between the first two surveys, the percentage of passengers using maps at transit terminals, printed maps/schedules, and asking at the terminals all increased as a result of the information campaign. All other sources decreased in use.

Between the second and third, the only significant change was the use of printed maps/schedules – this percentage dropped from 34% in February to 20% of passengers surveyed in June. This is because of the way these materials were distributed. During the six-week information campaign, the publications were available from information agents at major stops, transit centers, and on vehicles. After that period, however, the publications were no longer available, and thus only those who had received and kept a copy could continue to use them.

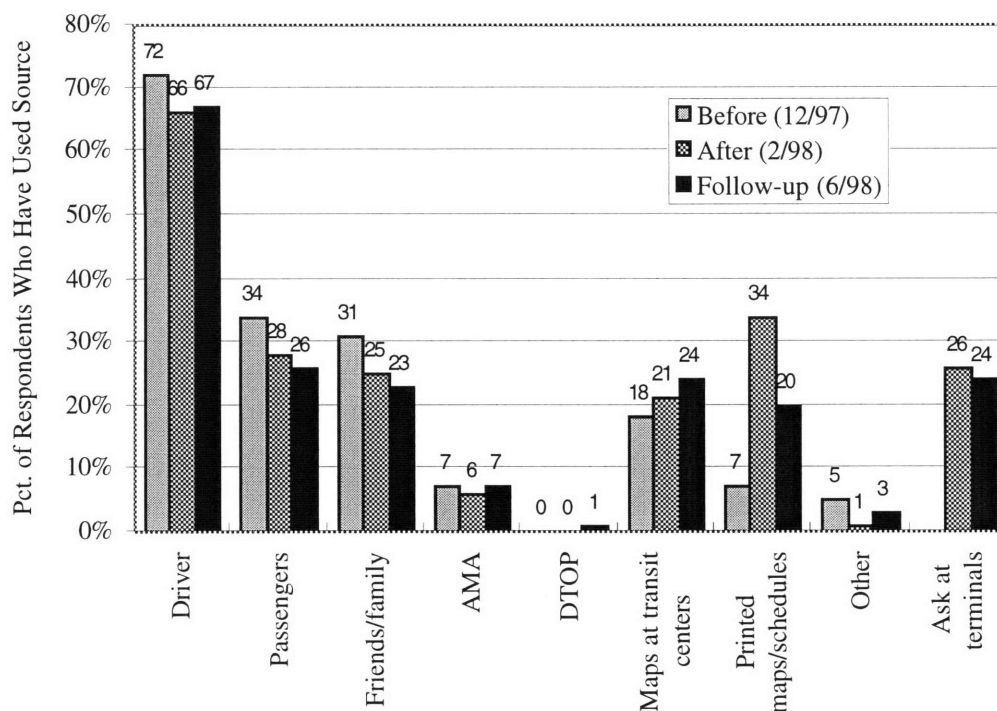


Figure 6-7: Survey Results for Source of Information Question

The most striking observation from these survey results is the dominance of oral means of getting information, both before, during, and after the availability of printed information from the Phase II information campaign. Roughly two-thirds of passengers surveyed asked bus drivers for information. Fellow passengers, friends and family, and staff at bus terminals were also important sources of customer information. This is clearly a key way that travelers in San Juan find answers to their travel questions and should certainly be incorporated into any decision-making about customer information. An important consideration, however, is the impact on service performance of the vehicle driver as an information source. It is likely that dwell time at stops is increased because of this extra demand on the driver.

The printed guide “Guía oficial de las nuevas rutas” (official guide to the new routes) contained seven area maps, one system map, and a trunk route map, in both Spanish and English. Below each of the area maps were descriptions of each route serving each area, with hours of service and frequencies listed. The guide also contains fare and other miscellaneous information. 500,000 of these guides were printed and distributed to the

public.²³² From comments received by passengers, it appears that most customers only used the centerfold system map in the guide. The area maps were not found to be very helpful. In addition, customers wanted more detail about route schedules – rather than the summary information (hours and frequencies), they wanted to see actual times at key timepoints for each run. Finally, there was some indication that older customers were often unable to follow the small print and subtle colors.

The tear-off sheet, titled “Planifica tu viaje en guagua” (plan your trip in the bus) was intended to be used by the information agents to show customers how to make a single specific trip on the new routes. The legal-size sheet, shown in Figure 6-8, was intended to be marked up by the agent, torn off the pad, and given to the customer to take with him or her. The sheet contained a map at the top left, a list of the routes on the right, and a table at the lower left to indicate the itinerary. This itinerary section contained three sets of boxes for the routes, separated by two lists of the transfer centers. By circling a route, a transfer center, and a second route (and optionally a second transfer center and third route) the information agent had identified the trip itinerary. What seemed like a good idea was not – riders thought the sheet was useless. They did not read the circles at the bottom, instead wanting to see the information represented on the map. However, highlighting routes on the map did not work well because it interfered with the different colors used.

Telephone information

AMA has a telephone number connecting the public with a receptionist or the dispatcher’s room for information about routes, schedules, and other aspects about service. This number has not been publicized and has been poorly operated. A different telephone number, staffed from 8am to 5pm, is provided by the PRHTA as a comprehensive information center about highways, motor vehicles, traffic safety, and mass transit. This center answered questions about the Phase 2 route changes, and was used quite heavily during that time.²³³

²³² Pérez Díaz, Lourdes, electronic mail dated July 28, 1998.

²³³ Pérez Díaz, Lourdes, electronic mail dated July 28, 1998.



- ### Rutas Troncales
- Metrobús I:** • Río Piedras • Hato Rey • Santurce • Viejo San Juan
- Metrobús III:** • Pda. 18 • Hato Rey • Roosevelt • San Patricio
- PR-2 • Bayamón
- Metrobús Expreso:** • Río Piedras • Hato Rey • San Juan
- A3** • Río Piedras • Hato Rey • FD Roosevelt • San Patricio • Cataño
- A5** • Viejo San Juan • Pda. 18 • Calle Loíza • Isla Verde
- Los Angeles • Iturregui
- A6** • Río Piedras • PR-3 • Ave. Campo Rico • Iturregui
- Plaza Carolina • Carolina
- A9** • Río Piedras • Ave. Barbosa • Ave. Borinquen • Pda. 18
- Viejo San Juan
- ### Rutas Locales
- B4** • Río Piedras • Centro Médico • Ave. San Patricio • San Patricio
- B8** • Viejo San Juan • Pda. 18 • Ave. Kennedy • San Patricio
- C10** • Acuaexpreso • Hato Rey • Ave. Borinquen • Eduardo Conde
- Calle Loíza • Condado • Isla Grande • Pda. 18
- C11** • Acuaexpreso • Hato Rey • Ave. Borinquen • Eduardo Conde
- Lloréns Torres
- B15** • Río Piedras • San José • Hato Rey • Acuaexpreso
- B16** • Acuaexpreso • Hato Rey • Eduardo Conde • Pda. 18
- B17** • Acuaexpreso • Hato Rey • Baldrich • Plaza Las Américas
- Ave. Piñero • Ave. San Patricio • Centro Médico
- C18** • Río Piedras • El Señorial • Cupey
- B19** • San Patricio • De Diego • Americo Miranda • Centro Médico
- B21** • Viejo San Juan • Condado • Pda. 18
- Fernández Juncos • Plaza Las Américas
- C26** • Río Piedras • Venus Gardens
- C27** • San Patricio • Ave. Escorial • Santiago Iglesias
- Muñoz Rivera • Guaynabo
- B28** • Río Piedras • Ave. Piñero • Ave. San Patricio • San Patricio
- C29** • Río Piedras • San Francisco-College Park • Muñoz Rivera
- Guaynabo
- C31** • Río Piedras • Calle Paraná • Carr. #1 • Ave. Las Cumbres
- Ave. Emiliano Pol
- C37** • Cataño • Ave. Comerío • Ave. Sabana Seca • Levittown
- B40** • Río Piedras • Puente Moscosa • Aeropuerto • Isla Verde
- Piñones
- C41** • Acuaexpreso • Hato Rey • Río Piedras • Villa Prades
- Campo Rico • Iturregui
- C42** • Iturregui • Ramal Este • Sabana Abajo • Plaza Carolina
- Villa Carolina • Carolina
- C43** • Iturregui • Vistamar • Sánchez Osorio • Plaza Carolina
- PR-887 • Carolina
- C44** • Iturregui • Ave. Campo Rico (este) • Roberto Clemente
- Plaza Carolina • Carolina
- C45** • Iturregui • Los Angeles • Aeropuerto • Isla Verde
- B52** • Río Piedras • Villa Nevárez • Centro Médico
- Santiago Iglesias • Ave. Los Filtrros • Bayamón
- ### Rutas Expreso
- E91** • Santa Juanita • PR-2 • San Patricio
- E92** • Magnolia Gardens • PR-2 • San Patricio

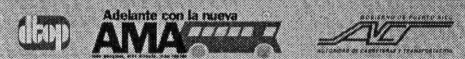


Figure 6-8: Planifica Tu Viaje en Guagua

World Wide Web site

Fixed route bus information for the SJMA has been available on the World Wide Web since 1997. The site is aimed at tourists planning to visit San Juan, and is also part of a marketing effort to introduce higher income patrons to public transportation. The site, at <<http://www.dtop.pr.gov/english/AMA/AMAHOMPG.HTM>> is part of the DTOP's web site, and administered by the DTOP's public information office. It is provided in both Spanish and English, and includes general information about AMA, its transit services, and each specific route including Metrobús (with a route map, operating hours and frequencies for each). The English version of the site has not been updated to include the Phase II changes from December, 1997, and is thus very out-of-date.

6.3.1.2. Wayside information

Some amount of customer information is available at bus stops and transit centers:

Bus stop signs

Traditional signs are in place at all bus stops and transit centers, however, many of these do not indicate which routes serve the stops, and some indicate old routes that no longer serve the stop. AMA plans to update these signs now that the major route restructuring is complete. Large, easy-to-read signs have been installed at the transit centers. These signs provide a list of route numbers and their corresponding destinations for buses stopping at the stop. The signs use vinyl lettering on a reflective metal plate – the signs can then be customized in-house, reducing costs. However, the vinyl lettering was peeled off the signs by vandals at several locations within the first three weeks installation. AMA therefore needs to identify a vandal proof (but probably more expensive) solution.

Staff at transit terminals

Terminal management staff are located in booths at AMA's major bus terminals, and will answer schedule and route questions. While it is known that they are asked questions, no statistics are available about how many questions they answer each day. There is also no indication to customers that these staff members are available for this purpose. On a more temporary basis, part-time information agents were stationed at major stops and transit centers for a six-week period to provide information about the Phase II route changes (see above for more details).

Maps and schedules at bus stops

In mid-1995, AMA installed route maps at most key bus stops. For stops served by only one route, schedules were also included. Maps were printed in house to reduce costs. However, there were problems with the color ink fading in the sunlight, making the information quickly illegible. This effort was suspended pending the route restructuring – the investment of time in developing route maps and installing them at stops has been halted until all route changes have been implemented.

Variable Message Signs

Some of the AMA bus terminals use variable message signs to guide the customer to the appropriate loading bay. The Capetillo Terminal in Río Piedras and Covadonga Terminal in Old San Juan use LED displays which display the route numbers serving each platform, as well as some public service messages. The signs serve to attract customers to the information, but do not display real-time information.

6.3.1.3. *In-vehicle information*

Information provided within the buses is very primitive, in most cases consisting of basic fare information. Metrobús vehicles also provide information about hours of operation and service frequencies.

6.3.2. Públicos

No form of public information is provided about the públicos. Information about fares, routes, stops, and hours of operation is learned only by word-of-mouth. In addition, the demand-responsive service and unpredictable hours of operation strongly limit the ability to provide detailed information.²³⁴

6.3.3. Acuaexpreso

Printed Acuaexpreso schedules are posted at the ferry terminals, and are sometimes also available for the customer to take with him or her at the ticket sales booths at the terminals and onboard the vessels. The ferry schedules have been frequently changing over the past few years because of numerous service changes and disruptions. In addition, reliability problems have been common with both missed or late trips, and as a result, the actual schedule operated often differs from the printed schedule.²³⁵

²³⁴ Lau, *Strategies for Improving Jitneys*, p. 27.

²³⁵ Randall, *An Assessment of Acuaexpreso*, p. 39.

6.4. Existing Plans for Improving Customer Information

The previous section listed customer information provided to date about the various transit services in the SJMA. This section identifies plans the various agencies have for improving this information as well as the plan for providing information to Tren Urbano customers.

6.4.1. Fixed-Route Bus

An effort is underway to provide better information about fixed-route bus services, particularly the historically poorly promoted AMA routes.

6.4.1.1. Printed information

Coinciding with service adjustments at the end of Summer 1998, a folding system map and individual route timetables will be developed and distributed by the PRHTA and AMA for all Metrobús and AMA routes. These new publications are being developed based on feedback from customers about the Phase II restructuring information campaign. The folding system map will be designed and printed locally, and will include some advertising to help cover costs. Individual route timetables, similar to those traditionally used by other bus transit agencies, will contain a route map and detailed schedules showing arrival times at key timepoints for each bus run.²³⁶

6.4.1.2. Bus stop signage

Signs indicating specific bus routes will be installed at all bus stops and terminals now that the route restructuring is complete.

6.4.1.3. TeleViewer

The TeleViewer automated vehicle location system installed on AMA vehicles was developed by Teleride-Sage of Canada and is currently used for dispatching and operations purposes. The system scans the fleet once per minute (polling five buses per second), and collects odometer, oil pressure, temperature, and air pressure readings. The odometer reading is used by computer software to determine the vehicle's location along its route. The system also serves as a basis for a driver-garage communications system

²³⁶ Amador, Maria, telephone conversation on June 29, 1998.

Plans have been considered for using this location information for a “TeleViewer” customer information system. The system would display bus arrival time information on television displays at major stops and transit centers, where it is easier to provide security from vandalism guaranteed. Prototypes have been tested at the Capetillo terminal in Río Piedras and at the Hato Rey Acuaexpreso terminal, with limited success. It was hoped that the system would be operational by mid-1996, however, in the two years since that date, no progress has been made.

6.4.2. Públicos

Providing information about transit services requires knowledge of where and when the services operate. The Public Services Commission (PSC), as the regulatory body of públicos in the SJMA, should theoretically have this information – however, due to their insufficient staff, the five-year period between license renewals, and the unofficial determination of público route operations at the público association level, the information the PSC has is incomplete and out-of-date.

The PRHTA is trying to push for increased público information, and efforts to this end have included talks with operators to persuade them that cooperating in supplying this information to customers will increase ridership, and subsequently, income. Obstacles to success in this area include the politics of the público organizations and the sheer number of individual público operators. The PRHTA is currently discussing designing a new project to collect and maintain information about público routes as a first step in providing information to customers.

6.4.3. Tren Urbano

With opening day for Tren Urbano approximately three and a half years away, plans are beginning to be developed for customer information, particularly the design of station signage. Information for Tren Urbano will be quite similar to that provided for contemporary North American rail transit systems. However, the issue of language has made development of plans for Tren Urbano unique. Clearly all signage and other information must be in Spanish, however English will also be included on critical pieces such as warning and exit signs. Similarly, Braille signs for the visually impaired must also be bilingual as appropriate.²³⁷

²³⁷ Ferretti, Joseph, telephone conversation on July 9, 1998.

A major concern with signage and other information is overload – efforts have been made to provide sufficient information using the minimal number of signs or displays, and to make each clear and understandable.²³⁸

6.4.3.1. Pre-trip information

Pre-trip information for Tren Urbano will be provided via telephone and printed information. It is also expected that a World Wide Web site will be created, likely as part of the DTOP site, as well.

Telephone information center

The telephone information line will use a standard toll-free number to connect the customer with telephone operators. These operators will assist customers with all aspects of using the system. The Tren Urbano operating contract requires the center to be staffed during all service operating hours (5 am to 1 am, 7 days a week). Calls must be answered within five rings and addressed by a human within two minutes (written inquiries must be responded to within three days).²³⁹ A real-time “report line” is also being considered, which would provide recorded information about the current status of Tren Urbano and other transportation modes (including highway, bus, ferry, etc.).²⁴⁰

Printed information

Printed information will consist of a standard guide to the system, complete with route map, fares, and station information including connecting transit services. The Tren Urbano operating contract requires that these materials be available from racks within each station at all times of operation.²⁴¹

6.4.3.2. Wayside information

Wayside information will be provided in and around the sixteen Tren Urbano stations:

Static signage

Standard guidelines have been developed for station signage and this is now being applied to specific stations. The guidelines assure consistency throughout Phase I and future phases, which is important due to the contractually independent final design and

²³⁸ Kerr-Adler, Susannah, telephone conversation on July 9, 1998.

²³⁹ Barber, John, “Tren Urbano Systems Criteria.”

²⁴⁰ Ferretti, Joseph, telephone conversation on July 9, 1998.

²⁴¹ Barber, John, “Tren Urbano Systems Criteria.”

construction of the stations. The goals of the signage plan are to convey enough information to let the public know where they are and what choices they need to make to get where they want to go, while minimizing the number of signs for the sake of simplicity.²⁴²

The signs will be mostly text, with some directional arrows, and a few symbols (such as the wheelchair symbol for accessibility). Signs will be non-illuminated, illuminated, and backlit, and will serve three purposes: direction, information, and warning/restriction. Directional signs will provide a wayfinding function from outside in the neighborhood to the station, into the headhouse, onto the platform, and finally, onto the train. As such, the stations are divided into five “areas” – each area governs the number and type of signs to be used:

- **Site** – signs are geared toward orientation, consisting of station location and identification, parking, drop-off/pick-up, and connecting transit (bus, público) information
- **Headhouse free area** – signs provide orientation information for entering and exiting the station (including directional signs to parking and connecting transit), as well as maps of the transit system and station neighborhood, other rider information, and directional signs to ticketing and other passenger service facilities
- **Headhouse paid area** – directional signs guide the customer to the platform, identifying the locations of elevators and escalators, and indicating which platform serves which end destination (in the case of dual side-platform stations)
- **Platform** – signs guide the customer toward exits to the headhouse(s), identify which side of the platform serves each train destination (in the case of single center-platform stations), and notify riders onboard arriving trains of the station name
- **Rooms** – signs provide door identification for restrooms, restricted areas, and other such rooms²⁴³

Variable message signs (VMS)

Variable message signs will be located both on the plaza level in the headhouse and above the platforms. As currently planned, VMS will serve three purposes:

- **Transit system status** – located both outside the headhouse and within, facing customers entering the paid area, indicating whether the system is operational (the outside signs will be active at all times) and possibly when next trains will arrive
- **Escalator operation mode** – as many stations will have only one escalator per headhouse, VMS will be used both below and above the escalator indicating which direction (up or down) it is operating

²⁴² Wallace, Floyd, Associates, Inc., *Tren Urbano Sign Program Manual.*, p. 3.

²⁴³ Wallace, Floyd, Associates, Inc., *Tren Urbano Sign Program Manual.*, pp. 3-4.

- **Train arrival status** – signs above the platforms will indicate how many minutes until the next train to each end destination will arrive, and as trains approach and stop at the platform, the destination of the train²⁴⁴

Audio messages

Audio messages will be broadcast within the stations. These will consist of both prerecorded messages about train destinations and other public service information as well as live information about the system status (delays, disruptions, etc.).²⁴⁵

Station agents

There will be a station agent booth within each headhouse. In the case of most stations, which have two fare gate areas, at least one booth will be manned (the one at the main station entrance as designated), although the second may also be, based on demand. Agents will answer travel questions as well as assisting customers with other concerns. At stations with only one agent despite two headhouses, only a portion of customers will pass the agent. Therefore, complete signage and other information must provide an adequate substitute.²⁴⁶

6.4.3.3. *In-vehicle information*

In-vehicle information will be consistent with most new rail transit cars. Static signage within each car will consist of strip maps of the route above or beside each door. Variable message signs (VMS) will indicate the train's next stop, the destination of the train, and the name of the station as the train approaches the platform. Audio messages will indicate the train's next stop, the destination of the train, and the name of the station as the train approaches the platform.²⁴⁷

²⁴⁴ Wallace, Floyd, Associates, Inc., *Tren Urbano Sign Program Manual.*, p. 7.

²⁴⁵ Ferretti, Joseph, telephone conversation on July 9, 1998.

²⁴⁶ Ferretti, Joseph, telephone conversation on July 9, 1998.

²⁴⁷ Ferretti, Joseph, telephone conversation on July 9, 1998.

7. Developing a Plan for San Juan

The San Juan context, as it pertains to customer information, was described in the previous chapter. This included discussions about the people, transit services, and existing customer information in the region. Here, the San Juan Metropolitan Area is analyzed following the general structure of eight-step decision-making process developed in Chapter 4. The first section defines goals for improving customer information within the San Juan context. The second presents a series of recommendations for implementation in San Juan. The third section raises some questions that should be considered in more depth, especially for longer-term customer information decisions. Finally, the chapter concludes with a brief summary of the key points.

7.1. Goals for Improving Customer Information

Following are the first four steps of the decision-making framework in Chapter 4:

1. Define the local context
2. Define goals for customer information
3. Evaluate existing customer information
4. Define goals and objectives for improving information

These steps are followed in this section, with the result being several general goals for improving customer information in the short-term.

7.1.1. The Local Context

As defined in Chapter 4, the local context considers characteristics of local transit agencies, transit customer market segments, and customer needs. Each of these is addressed here in light of the background discussed in the previous chapter.

7.1.1.1. The Agency Context

There are several key characteristics regarding transit service in San Juan, as it relates to customer information:

Decreasing Mode Share

The San Juan Metropolitan Area has experienced increasing use of the automobile and decreasing use of public transportation over many years. The transit mode share has decreased from 37% of person trips within the SJMA in 1964 to only 9% in 1990. Primary

reasons include increased rates of auto ownership and declining transit service quality. The underlying objective for improving public transportation in San Juan is therefore to halt, if not reverse, this trend.

Major Changes to Public Transit Service

The mid-1990s have seen the beginning of a “new age” in public transportation in San Juan. The fixed-route bus network restructuring and introduction of two new Metrobús routes have become the centerpiece of a strategy to greatly improve bus service in the region. The introduction of Tren Urbano in 2001 will lead to an even more dramatic improvement in transit quality. These changes should be viewed as both a challenge to, and an opportunity for, providing customer information. The challenge is that suddenly routes that have existed for many years have been eliminated or radically altered, and transit customers need to be made aware of these changes. And in 2001, the people of San Juan will have an entirely new form of transit available which should be the basis for a radical reshaping of their views on public transportation.

These changes present new opportunities for transit customer information. First, the need to communicate these service changes provides a clear and strong motivation to improve customer information from its previously poor state. This motivation has translated into increased attention toward customer information in terms of political and financial support. Finally, the substantial improvement in transit service quality, especially with the introduction of Tren Urbano, presents an opportunity to redefine what the people of San Juan can and should expect from customer information, just as their expectations of transit service should increase.

Institutional Structure

As identified in Chapter 6, four modes of transit will be serving the SJMA by 2001, administered and operated by various agencies and companies. Figure 7-1 summarizes the organizational structure of public transportation providers. Transit services are listed as the last row of five boxes, with shading indicating the extent of the role of the private sector in providing these services.

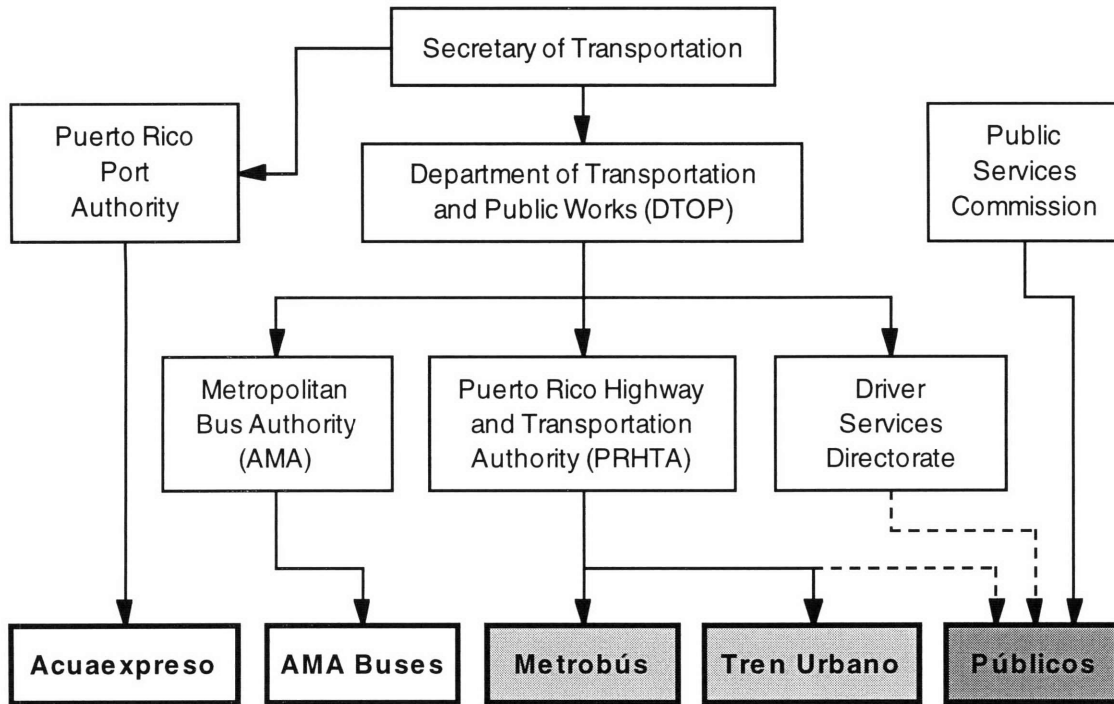


Figure 7-1: Organizational Structure of Public Transportation in San Juan

The DTOP has overall responsibility for both fixed-route bus services and Tren Urbano (note that Metrobús and Tren Urbano, shaded in light gray, are operated under contract by private companies). Acuaexpresso is provided by the independent Port Authority, for which the Secretary of Transportation serves as chairman. Público operators are independent, however they are regulated by the Public Service Commission. The PRHTA and the Driver Services Directorate also play a role in the administration of público service – the PRHTA one of service planning and the Driver Services Directorate handles vehicle licensing and terminal or stop planning. These roles are not strongly active however, hence the dashed lines in the figure above.

Because of their association as sister divisions of the DTOP, AMA and the PRHTA should be able to coordinate closely in providing customer information. This has been shown, with the joint efforts to promote the bus network restructuring changes. This working relationship can be continued and furthered to better integrate information about AMA, Metrobús and Tren Urbano services. There may be some limit to this in practice, however, especially with respect to operational data, such as real-time customer information. The PRHTA may be able to get and publish static information about AMA service, but it will be

difficult to get access to real-time information without a supporting policy decision issued by the DTOP.²⁴⁸

The other two modes, being provided by entities outside the authority of the DTOP, are a more difficult consideration. It has been suggested that the Acuaexpreso be reorganized as a department of the DTOP to promote integration between the transit modes – this is indeed a long-term recommendation in Randall’s thesis on the subject.²⁴⁹ Públicos, which are discussed in the next subsection, are a more complex issue due to the nature of the service and the respective roles of the public and private sectors in providing it. These issues of interagency cooperation and multimodal integration of customer information are discussed further in the remainder of this chapter.

The Role of Públicos

Providing roughly two-thirds of all transit trips, públicos play a crucial role in transportation in the SJMA. This role is made that much more important with the introduction of Tren Urbano, for which públicos will serve as an essential feeder system. To date, público information has been virtually nonexistent, which limits ridership and also intermodalism. Maintaining up-to-date information about público service, which is provided by as many as 2,200 private operators, is a significant challenge. With a five-year licensing cycle, the Public Service Commission (PSC) is unable to maintain accurate records about service provided. Furthermore, there is no public agency with the official responsibility to distribute customer information about these private services.

Only minimal cooperation from público operators can be expected – intermodalism is not a priority for them, and in some cases at least will be viewed as a threat. In addition, público operators currently have a relatively low, and decreasing, annual income – one cannot expect them to sacrifice some portion of this toward providing customer information without a guaranteed return. The approach to resolving these problems is just one aspect of a more complicated issue of público integration and cooperation with the public sector.

In his thesis Strategies for Improving Jitneys as a Public Transport Mode, Lau identified several strategies for improving público service.²⁵⁰ These strategies, involving varying levels of government intervention, fall into three categories: improvements within the current model which primarily consists of further public subsidy of público infrastructure

²⁴⁸ Ferretti, Joseph, telephone conversation on July 9, 1998.

²⁴⁹ Randall, *An Assessment of Acuaexpreso*, pp. 161-171.

²⁵⁰ Lau, *Strategies for Improving Jitneys*, p. 102.

and vehicles without direct government control, movement to a hybrid service model like the Hong Kong case where service standards for some routes are dictated by the government, or movement to fully contracted service. Any of these strategies would permit a greater government role in providing customer information. Lau considers each strategy for different types of público routes, and recommends that each be tried on a few potential Tren Urbano feeder routes to determine the most effective approach or approaches.²⁵¹

7.1.1.2. Market Segmentation

As was mentioned in Chapter 2, all market segments defined for use in developing a customer information plan must be actionable – that is, the agency must have sufficient resources to target information provision to each market segment. This resource constraint clearly affects the choice of a market segmentation. In the San Juan case, customer information to date has been of relatively poor quality, and there is much room for improvement. It is therefore sensible to initially target information to a few large segments of the public. As time passes and information quality improves, this market segmentation can be refined and narrower segments can be targeted for further improvements to customer information.

Familiarity with Transit Service	Frequency of Transit Use	Customer Type
Unfamiliar or Familiar / Infrequent		Commute Non-commute Senior / Disabled Non-user <i>Student</i> <i>Tourist</i>
Familiar	Frequent	Commute Non-commute Senior / Disabled <i>Student</i>

Table 7-1: Proposed First Phase San Juan Market Segmentation

First Phase Market Segmentation

A proposed market segmentation for use in such a first phase analysis is given in Table 7-1. This is based on the sample segmentation in Section 4.1.2.1, with some modifications

²⁵¹ Lau, *Strategies for Improving Jitneys*, p. 128.

specific to San Juan. The result is a relatively compact, actionable division into ten market segments.

Familiarity with transit services and frequency of transit use, as discussed in Section 4.1.2.1 are highly appropriate in the San Juan case. There are not many transit options and traditionally they have changed infrequently – furthermore, many services do not adhere very strictly to official schedules. However, many people simply do not know enough about transit services to use them effectively. Therefore needs of familiar users versus those of the unfamiliar are very different. To minimize the number of segments, however, frequency of use has been used as the primary division, with unfamiliar and familiar but infrequent customers being categorized together.

Students and tourists have been italicized in the above table to indicate that these segments perhaps need less attention at present than the others. The differences in transit needs between a student and commuter are relatively insignificant, and thus customer information targeted toward commuters should serve students quite well. However, there are two key differences which should be recognized. First, students are generally more concentrated in destination, with the University of Puerto Rico (UPR) in Río Piedras being a major trip attractor. The addition of a UPR station to the Tren Urbano alignment highlights the importance of this market segment. Second, students have ready access to some special media – in particular, student newspapers, campus resource offices, and the Internet.

There has been some consideration that tourists might eventually make up a significant portion of transit ridership in the San Juan Metropolitan Area. Long term plans for Tren Urbano include extensions to the hotel zones of Santurce, Condado, Old San Juan, and Isla Verde, as well as the Luis Muñoz Marín International Airport. Cooperation of area businesses is necessary to target these groups, and thus it may be desirable to begin forming these relationships as soon as possible. However, attracting tourists to transit should not be a major priority in the short term when there are many other customer information weaknesses to be improved upon.

7.1.1.3. Customer Needs

The primary customer information needs of San Juan residents have been mentioned several times in this and the previous chapter. These are briefly summarized here:

- **Information** – there is a need for information about transit services; people do want to know more (as is evidenced by requests for more detailed bus schedule

information), and they definitely need to know more about the services available to them, particularly those who currently are unfamiliar with transit service

- **Confidence and composure** – the need to show up at work on time and in a presentable condition is not always assured with transit, therefore a common belief is that to keep a decent job, one must drive to work
- **Improved image of transit** – the issue of image is very important, with higher social position defined by the automobile while AMA buses and públicos are considered lower-class
- **Security** – passengers, especially women, have concerns about personal safety on transit, especially waiting at bus stops and on públicos, for which real-time customer information can be of help

This list is by no means complete, or very detailed for that matter. Further research is definitely needed here – through basic surveys, more in-depth focus groups, or other forms of market research. Specific knowledge of what customers need is essential to meeting these needs.

7.1.2. Identifying Goals for Customer Information

To identify goals for customer information, one must first identify goals for public transportation in general, for which customer information could have some impact, and are objectives generally recognized by decision-makers in the region. In the San Juan case, goals for each mode tend to be similar and therefore have been generalized for the public transportation system as a whole.

7.1.2.1. Goals for Public Transportation

General goals for public transit in San Juan include:

- increasing public knowledge of public transportation services,
- increasing ridership, especially on under-performing routes,
- attracting a broader segment of the public,
- improving service frequency, directness, and reliability,
- minimizing the impacts of service uncertainty and disruptions, and
- improving the image of transit service.

These goals are reflected in the driving goals of the Tren Urbano project – to develop an intermodal transportation system that is convenient, of high quality, and user-friendly. Making the system a pleasant place to be by maintaining a positive image.²⁵² Key components in doing so include improving:

²⁵² Barber, John, “Tren Urbano Systems Criteria.”

- the level of customer satisfaction with the service,
- the ease of using the service,
- Tren Urbano's interface with other transportation modes and the convenience of these transfer facilities, and
- compliance with the Americans with Disabilities Act of 1990 (ADA).

To be user-friendly, the Tren Urbano system and supporting feeder services, must be convenient, easy to use, aesthetically pleasing, bilingual, and easily identifiable.²⁵³ Again, because of this dependence on other modes of transit for half of its ridership, intermodalism is a key concern for Tren Urbano and the San Juan region. It is important to begin to develop these existing modes with this idea in mind. Thus, three sequential intermodal objectives are:

- to encourage use of multiple modes for trip-making, as a substitute for the automobile,
- to improve and develop the three existing modes in the short term for introduction as Tren Urbano feeder services in 2001, and
- to encourage and support the use of the three existing modes as Tren Urbano feeder services.

7.1.2.2. Goals for Customer Information

One can then target customer information goals to assist with meeting these general goals:

- provide comprehensive information to improve public knowledge of transit services,
- provide clear information about transit services to make them easier to use,
- target information to segments of the population currently underserved by transit, such as the elderly and disabled,
- use customer information to minimize the impacts of problems with reliability and uncertainty,
- integrate information about all transit modes to encourage multimodal transit trips,
- develop transit centers and terminals as places for multimodal information to be distributed, both in printed and oral form, and
- provide high-quality, accurate information to help improve the image of transit service.

²⁵³ Spooner, Herb, "Tren Urbano Design Criteria."

7.1.3. Evaluation of Existing Customer Information

In this section, the current customer information activities and plans are evaluated with the above goals in mind. This analysis is performed by mode, and includes the current plans for providing information about Tren Urbano. There has been little successful experience to date, which has cultural and habitual implications. People are not used to receiving information about transit service, particularly in printed form, and thus are less likely to make use of such information unless it is well-designed. However there is plenty of demand for it, as evidenced by the use of oral modes of information during the AMA bus restructuring and the desire for more detailed printed schedules.

There is currently a lack of multimodal transit information in San Juan. Recent joint efforts of PRHTA and AMA to publicize the Metrobús and new AMA services as a single fixed-route bus network are a positive sign. However, little effort has been expended in integrating Acuaexpreso, and especially the públicos, with these bus services. Also, current planning for Tren Urbano customer information has not yet addressed this issue in much detail.

A second general shortcoming of information in San Juan is the accessibility to customers with disabilities, particularly those with visual and hearing impairments. Plans for Tren Urbano address this problem for that service – however, improvement is needed for the existing modes.

7.1.3.1. Fixed-route Bus

Pre-trip information

The customer information campaigns for the two phases of network restructuring have been well-received. 34% of passengers surveyed used the “Official Guide” for information immediately after the changes had taken place. PRHTA and AMA also got valuable feedback from passengers – that people want a single manageable system map rather than the larger guide, and individual route-specific timetables with a map and detailed schedule instead of the schedule summaries currently provided. This is indeed planned for late 1998. One shortcoming of these campaigns is that the printed information ran out soon after the campaigns ended, and no new stock was printed.

Telephone information has been ineffective. The AMA number is not publicized at all, which is probably just as well as it is not particularly well-staffed. The PRHTA number is apparently better staffed, but communication between the two agencies is not formal.

Therefore, while PRHTA can give static information about all bus services, they are not aware of the real-time status of AMA buses. The hours of service are also limited to regular business hours.

The DTOP World Wide Web site is not well-used, indicating that it is not being promoted and probably not accessible by many bus riders. It is also not very well maintained – the English version of the site is many months out of date.

Wayside information

Transit terminal staff were very helpful during the restructuring changes, and the permanent staff at AMA bus terminals are also well-used. However, there is a need to make the availability of these staff members more known. AMA has failed in labeling all bus stops with the routes that stop there – this had been done at major stops and transit centers, but extension to all stops has been delayed until the completion of major route changes. The variable message signs at transit terminals are virtually useless as currently provided, although they could be used for real-time information at some point in the future.

In-vehicle information

Bus drivers are an important resource for transit information. There is potentially concern about this added role interfering with their driving responsibilities. The use of agency staff could minimize this effect, at least at terminals and transit centers. There is currently very little printed information provided within vehicles. Route timetables, when published, must be available within the vehicles – this is a good distribution source and also a way for uncertain passengers to regain confidence in their trip.

7.1.3.2. Públicos

There is currently next to no information available about público services, other than what is painted on the vehicles themselves. PRHTA plans for improving this are still at a very early stage and thus needs a lot more effort and planning. Providing as much information as possible would be helpful, even if this is simply a guide to públicos with approximate routes, service frequencies, and fare information.

7.1.3.3. Acuaexpreso

The types of information currently provided are sufficient for the most part given the limited scope of Acuaexpreso services. However, more care must be given toward keeping it up-to-date and available, to remedy current problems. The availability of information is

currently limited to ferry terminals and on the vessels themselves, which should be expanded to other major locations, including AMA terminals and major public buildings. Service disruptions are poorly publicized, if at all, which is a strong concern given service reliability problems, especially on the Hato Rey – Old San Juan route. This should be addressed, and could benefit from the use of real-time information technology.

7.1.3.4. *Tren Urbano*

The current plans for Tren Urbano are excellent – all needed types of information will be provided. The telephone information center will be staffed during all system operating hours. A sufficient amount of printed pre-trip information will be available on racks at the stations, and a well-developed signage plan for stations and within vehicles are being implemented. Variable message signs will be used to provide next train arrival times as well as other relevant information. Stations agents will be available to answer questions which is critical given the stress on oral forms of communication. The system will also be in full compliance with the Americans with Disabilities Act, complete with public address announcements in stations, next-stop announcements within vehicles, and Braille versions of all critical signage.

7.1.4. Goals for Improving Information

The current state of customer information in San Juan is not very encouraging. Because of this, identifying specific goals for improvement to particular modes and methods of providing information is both difficult and unhelpful. Instead, several general goals for improving customer information as currently provided, which are applicable to all existing modes, are identified here. The goals are to:

- provide transit information that is accurate and timely,
- provide transit information consistently and reliably,
- increase the availability and accessibility of transit customer information,
- provide sufficiently comprehensive and detailed information, including route, schedule, and fare information, to meet customers' needs and answer their questions,
- target all potential transit users, especially non-users and the visually, hearing, and physically impaired, and
- coordinate between transit providers to develop and distribute comprehensive, intermodal customer information.

Of course, the goals must all be considered in light of budgetary constraints, which in the San Juan case, are very significant. Available resources need to be directed to all aspects of

transit service, including operations and maintenance – customer information is only one expense item. The issue of budgeting and customer information is raised in the third section of this chapter.

7.2. Recommendations for San Juan

The goals for improving customer information identified above are both comprehensive and broad, for which there are many appropriate customer information methods. Given the current, information-poor transit environment in San Juan, most reasonable suggestions for customer information are worthwhile. Prioritization is then the driving purpose for evaluation – which alternatives should be implemented first in light of limited resources. A thorough evaluation of alternatives requires significantly more resources than are available with this thesis effort. There is a need for market research, through surveys or focus groups, to identify the factors influencing the success of different passenger information methods recommended above. The issue of prioritization is raised again in the third section of this chapter.

In this section, a series of recommendations are presented for customer information in San Juan. First, four primary recommendations are given that should be considered immediately. Then, specific recommendations for implementation are given for each mode. These are presented for consideration in two phases – the first includes short-term improvements that should all be implemented, while the second longer-term methods should be reexamined after the first phase is complete.

7.2.1. Primary Recommendations

Four primary recommendations for general improvements to customer information are discussed here. These should be considered in making any decision about customer information in San Juan.

Provide information about públicos

A well-recognized shortcoming of current público service is that virtually no information about it is available to the customer. Knowledge of público service is generally spread by word-of-mouth – it is therefore difficult to attract new riders to specific routes, especially for occasional trips. As mentioned earlier, there is little motivation or ability for individual público operators to take on this responsibility. Thus, some level of government participation is needed.

To accomplish this, however, a process for collecting information from the público operators, compiling it, and disseminating it to the public must be developed. This process will require substantial cooperation between the private operators and government agencies involved. At the very least, the Public Service Commission (PSC), responsible for issuing licenses to público operators, must be kept informed of what services público operators are providing. Such an exchange of information could perhaps be required as a condition for licensing, however with the current five-year licensing period and the understaffed PSC, this would likely be unsuccessful. This also implies a good line of communication between the PSC and PRHTA, the most obvious candidate for assembling and distributing such information to the public.

An alternative to the público – PSC – PRHTA relationship, where the inability of the PSC to perform its necessary duties would eventually break the process, is to use público route associations as the direct source of information. In this scenario, the route associations, which are comprised of those drivers operating from the same terminal and serving a similar geographic area, would regularly provide information about service to the PRHTA (or other agency adopting the dissemination function). In many cases, these associations determine how many and which operators will operate along specific routes (circumventing the PSC's role), and thus are already privy to the needed information. Developing a working relationship in the highly politicized environment between government and the associations is the challenge.

As was discussed in Chapter 5, Hong Kong has had good success with public sector provision of information, via printed publications and signs at stops, about the government-specified *green* public light buses. Consideration of these and other improvement strategies, as discussed by Lau, is a significant undertaking, however it is also a necessary step in improving the effectiveness of público service. Indeed, by following the Hong Kong experience in installing signs at público stops, the government will improve the quality of service to the customer. At the same time, this can demonstrate to público operators that a cooperative relationship with the public sector can be beneficial, and that the government is interested in promoting the público as a transportation alternative. Of course, providing anything beyond basic, traditional static information about público services as currently operated, such as requiring service to be provided on a fixed schedule or installation of AVL in vehicles to provide real-time information, is a much larger issue.

Provide complete, accurate information with consistency

A key consideration is the poor experience with providing customer information in San Juan. As described in Chapter 6, several previous AMA attempts at providing relatively unsophisticated information failed, either due to unforeseen problems with the implementation or an inability to provide the information consistently. Cost-reduction measures, such as manufacturing bus stop signs and printing bus stop maps in-house, rendered some attempts unsuccessful. Even the “successful” publicity campaigns for the two fixed-route bus restructuring phases were short-lived – the printed information was no longer available soon after the campaigns were finished.

There is little sense spending resources on designing and developing an information program if it will not be sustained. This can also have a negative impact on passengers as old information can result in their distrust of other sources and also carries a poor image of neglect. Inaccurate and incorrect information also impacts passengers. It only takes one or two experiences with missing a bus due to incorrect information before a passenger will lose confidence in the source, and possibly transit in general.

There is therefore a need for evidence that information can be provided reliably in San Juan, with simple, traditional forms of transit information before it is worth considering more complex methods. Sophisticated methods of providing customer information require significant resources, both for development and ongoing support. Reliability problems with the STOPWATCH real-time information system discussed in Chapter 5 were partly attributed to insufficient technical support for the new technology. Such skills are definitely not available for AMA and público services in San Juan today.

It is suggested that all improvements and additions to customer information be made incrementally. Each new project should be implemented successfully and a commitment made to sustaining it before the next project be started. Doing so will prevent the transit providers from overextending themselves and ending up with several incomplete projects rather than one or two successful ones. Thus, the agencies should begin with something simple, and show that (a) it can be done, (b) it can be maintained indefinitely, and (c) it is useful to the customers it is intended to target before starting the next project.

Provide integrated multimodal information

The importance of multimodal public transportation has been mentioned several times in this and the previous chapter. Three goals for multimodal transit were stated earlier: to encourage multimodal transit trips, to improve the three existing modes in the short-term,

and to support the use of the three as feeder services for Tren Urbano. The role of customer information in this is clear – integrated information needs to be provided that treats all modes as a single public transportation system. Information about any and all modes should be available from one place, and should be presented in a consistent style and at a similarly high quality.

This can be done within the current institutional structure of public transportation. Each agency, AMA and PRHTA for fixed-route bus service, the Puerto Rico Port Authority for Acuaexpreso, PRHTA for Tren Urbano, and the PSC (or perhaps PRHTA) for públicos, should routinely exchange information about the services provided. Each should then integrate sufficient information about the other modes with their own in developing customer information materials, to encourage the use of multiple modes for travel. However, this process can be quite time-intensive and result in duplicated effort, with each agency communicating much of the same information to each of the other agencies. Also, without a formal agreement, such an arrangement can disintegrate as agency priorities and policies change or staff positions turn over. Some possibilities for more formal institutional integration are discussed in the third section in this chapter – it is strongly suggested that these options be considered and action be taken on one of them.

The San Francisco Bay Area case study described an integrated set of technologies that are being used to resolve the communication problems between many different agencies. The core to this strategy is the Regional Transit Database, a clearinghouse for transit information that will fuel various dissemination sources. This may be overkill for the four transit modes in San Juan. However, the underlying idea of combining information from multiple agencies to be provided, via the Internet or telephone, to the public, and development of support tools such as a multi-agency trip-planning system, can be applied to San Juan.

Develop a regional strategy for improvement

The “new age” in public transportation was mentioned as a key issue regarding transit service in San Juan, and one that presents new opportunities for customer information. As is currently planned, customer information provision for Tren Urbano is on par with most modern rail systems in the world, and a tremendous improvement over any existing transit information in San Juan. Information for all modes should be improved over time, such that by the introduction of Tren Urbano, they are at a point where customers expects high quality, reliable information about all local transit services. This is important to maximizing use of the multimodal transportation network – that all services are publicized equally in

terms of quantity and quality of information. In addition, it will allow the new image of Tren Urbano to be carried over to the other modes which are currently regarded very poorly.

The timeline in the following figure illustrates this point, as well as the suggestion of incremental improvement discussed earlier. For each mode, the quality and sophistication of information is improved in small, feasible steps. By late 2001, when Tren Urbano is operational, all modes are at a similar level in terms of quality of customer information.

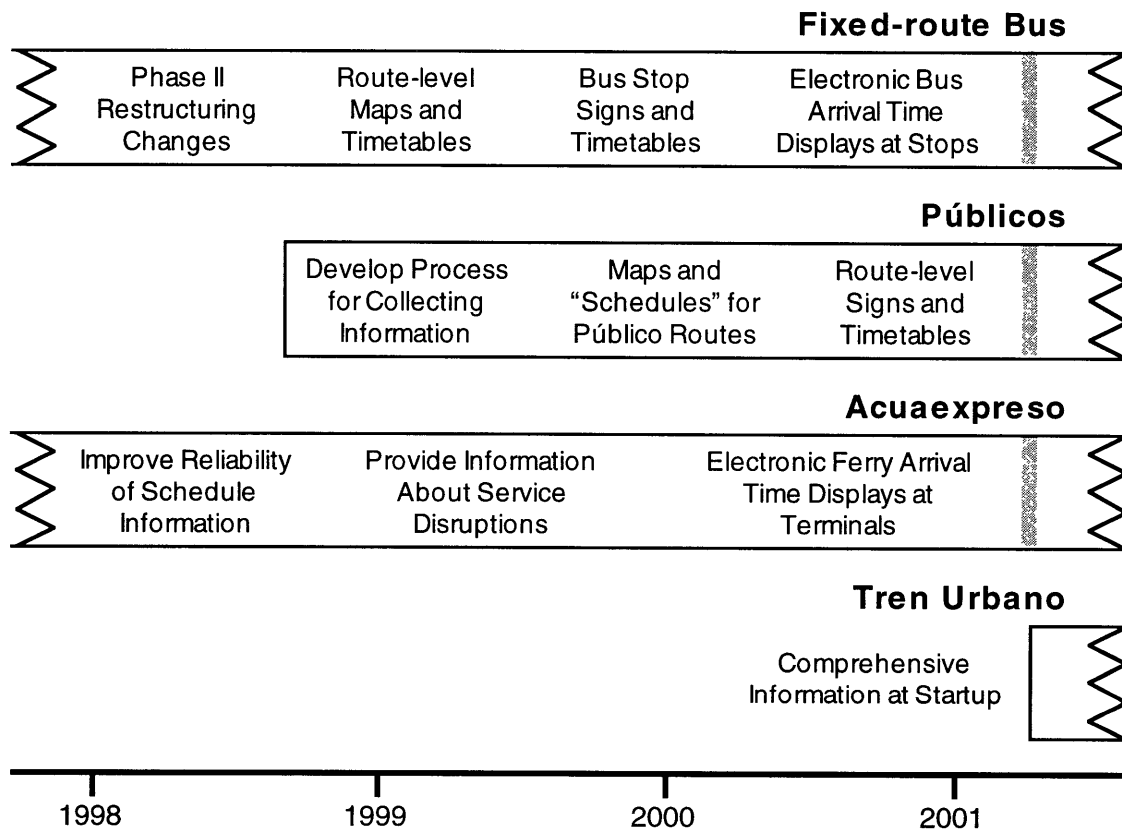


Figure 7-2: Illustrative Implementation Timeline

7.2.2. Specific Recommendations

With these general guidelines in mind, several recommendations for specific improvements to customer information are presented in this subsection. These are organized into two phases, although the time frame involved is uncertain. Instead, the first phase corresponds to basic improvements that should be implemented before any of the alternatives listed as Phase II are considered. This first phase should be complete before Tren Urbano begins

operation in late 2001. Second phase recommendations are generally more complex, and should thus be evaluated in more detail closer to possible implementation time.

7.2.2.1. Phase I Plan

The key goal of the Phase I recommendations is to provide a basic level of customer information about all transit modes reliably and consistently. From a multimodal perspective, the region should establish an integrated telephone information center (TIC), providing route and schedule information, trip-planning assistance, and notification of current service conditions for all modes of transit. This center should be accessed by a single telephone number that is promoted by all transit services. In addition, adequate signage guiding passengers between key modal facilities, such as from ferry terminal to bus terminal to público terminal, should be installed.

Fixed-route Bus

The issue of sustainability is very important here, as AMA has in the past experimented with various different customer information methods, most of which have been abandoned. A basic, sustainable plan for providing traditional customer information should be developed and followed, consisting of at least the following six items:

- Provide an efficient telephone information center (TIC), including trip-planning assistance and notification of current service conditions – this should be combined within a single TIC for all modes
- Develop route-level maps and timetables, and distribute them on vehicles, at transit centers and in major public buildings (currently in progress)
- Place agency staff at major transit terminals during peak and midday operating hours, with an official responsibility of answering customer questions, and consider creating dedicated information agent positions for all transit centers
- Install bus stop signs with route identification at all stops, and with timetables (route maps and schedules) at all major stops
- Display system maps at all transit centers and stops with bus shelters
- Announce major stops, landmarks, and cross streets on board vehicles
- Provide notice of service changes and disruptions via telephone, signs at transit centers, and flyers in vehicles

While the existing bus information on the DTOP World Wide Web site is not accessed very frequently, this is a project that should be continued. All information on the site should be kept current, with service modifications reflected on the effective day, if not earlier. The site should also be promoted – on printed materials, in signs in vehicles, and on the UPR campus.

A second phase recommendation for fixed-route bus is to install real-time bus arrival time displays, similar to the Countdown and STOPWATCH systems, at all transit centers and major stops. It is suggested, though, that this be implemented in Phase I as a trial on the Metrobús I / Metrobús Express corridor. These routes operate at relatively high frequency but with some degree of unreliability. The local and express route options along the same corridor, like the successful Uxbridge Road Countdown trial, gives the customer a route choice decision for which arrival time prediction can be a helpful aid. Furthermore, a GPS-based AVL system could be operational on these routes by the end of 1998, pending the purchase of the final component, a new radio system for the buses.²⁵⁴ The additional cost of implementation should be relatively minor, and would produce valuable information about the value and promise of such a system in San Juan.

Públicos

First phase recommendations for públicos are primarily aimed towards beginning a formal process for gathering and providing information. Specifically, the following items are suggested:

- Identify the government entity responsible for providing público information to customers, and determine the respective roles of this and other relevant agencies, such as the PSC, in the information process
- Develop and execute a process for collecting service operations information about público routes, through a working relationship between público operators, route associations, the PSC, and PRHTA
- Post maps and signs in público terminals and staging areas identifying where públicos to specific destinations pick up passengers (where not currently done)
- Develop route maps and summary schedules for público routes to post at both público terminals and bus transit centers
- Encourage municipalities to erect stop signs with route identification and summary schedules (using FTA and local funding)²⁵⁵
- Establish a telephone information center (TIC) to answer customer queries about público service – this should be combined within a single TIC for all modes
- Develop, publish, and distribute regional guides to público services, including general route, service frequency, and fare information

Printed guides should be distributed at público terminals, transit centers, and in major public facilities such as libraries and government offices.

²⁵⁴ Wensley, Jim, telephone conversation on August 19, 1998.

²⁵⁵ Barton-Aschman Associates, Inc., et. al., *Integration of San Juan Metropolitan Region*, p. 138.

Acuaexpreso

The amount of information needed to be provided about Acuaexpreso is much less than the other modes, due to the relatively simple route structure and schedules. However, this information is not currently being provided effectively, and thus it is recommended to:

- Improve the reliability of providing current schedule information
- Provide information about service disruptions
- Provide Acuaexpreso information outside the system – at transit centers, in public facilities, and by telephone

Tren Urbano

Current Tren Urbano customer information plans are quite comprehensive. Thus, the primary task is to follow through with these plans, with some enhancements:

- Provide comprehensive customer information at service startup (following through with current plans)
- Continue current customer information planning and design, including coordination with and formal cooperation from AMA and the Port Authority
- Provide ridematching services to Tren Urbano stations
- Provide train arrival time information outside on variable message signs outside urban stations to draw passengers to the service and allow them to make trip choices before entering the station
- Install courtesy phones in key station locations to allow patrons to communicate with station agents

7.2.2.2. Phase II Alternatives

After the basic Phase I recommendations have been successfully implemented, one can then look at more sophisticated alternatives. The general goal of these methods is to further improve the quality of information provided to customers

Multimodal

The only multimodal recommendation in this phase is to develop an automated trip-planning support tool for use by telephone operators (and possibly also Internet users). A multi-agency system, such as the ROUTES system in London or the TranStar system being developed in the San Francisco Bay Area, is necessary to provide unbiased trip-planning assistance across modes.

Fixed-route Bus

There are also more sophisticated customer information methods that could be worthwhile. These should not be considered until the above basic plan is in place and carried out with some evidence of long-term reliability. They include:

- Installing real-time bus arrival time displays at all transit centers and major stops, using a more-reliable AVL system than the odometer-based system that is currently in place on AMA buses
- Installing in-vehicle next stop displays and annunciators

Públicos

There are no second phase recommendations for públicos.

Acuaexpreso

A key complaint with Acuaexpreso service is poor schedule adherence. Thus, real-time ferry arrival time displays should be installed at terminals, and perhaps integrated with Tren Urbano train arrival information at the Nuevo Centro station allowing Acuaexpreso to serve as a connector from Tren Urbano to Old San Juan. Because there are relatively few vessels and only three docks, this system can be relatively unsophisticated. While a global positioning satellite (GPS) based AVL system would work best, it may not be necessary. As travel time is relatively constant while the vessels are in transit, one could simply register when vessels arrive and leave the docks, and from this information, the route itinerary, and the expected speed of travel, the system could calculate the expected arrival time.

Tren Urbano

Tren Urbano should become the basis for a multimodal information program. As the Tren Urbano telephone information center will be operating for much of the day, this would be an ideal center to respond to customer inquiries about all transit services. Also, the private contractor responsible for operating the Tren Urbano system could provide needed skills and technology to customer information. These ideas are considered in more detail in the next section.

7.3. Questions for Further Study

There are four critical questions that need to be addressed through further discussions by the concerned parties. First is the issue of budgeting – how much should be spent on customer information. Second, the issue of how to better identify what the customers’

needs are and how to satisfy them is discussed, raising the questions of which groups should be targeted, and what types of information should be provided. Then, the related issue of prioritization of alternatives – given a limited budget, which specific methods should be implemented before others. Finally, some ideas are presented for reshaping the institutional structure to provide better multimodal customer information.

7.3.1. Budgeting

The extent to which an agency (or group of agencies) can provide customer information is limited by their budget. There are two budget horizons – the short- and long-term. In the short-term, the agency departments associated with customer information must allocate their budgets among different activities, ideally with the goal of maximizing customer welfare. This requires the department(s) to address questions of prioritization and evaluation of customer information methods, which is discussed in more detail later in this section.

A long-term, agency decision is what portion of the total agency budget should be spent on customer information activities. Here, the relative prioritization of customer information versus all other operational and managerial activities is relevant. This idea can be taken to a higher level, considering not only how much of the agency’s total budget should be allocated, but how large should the agency’s budget be in the first place. In the San Juan case, this would require a decision at the DTOP or even Commonwealth level – how much to spend on public transportation, and of this, how much to spend on customer information.

Making this decision is difficult, and inherently political. As a starting point, it is helpful to look at what other, similar transit agencies spend on these activities. By selecting a group of peers, in terms of size, total budget, and type of service, and determining what percentage of their budgets are allocated to these purposes, one can get an idea of how agencies in San Juan compare in terms of customer information effort. In addition, looking at agencies that are particularly successful at providing information to passengers, even if they are not members of the same peer group, can determine if San Juan agencies are underspending on these tasks, and what level of resources are necessary to do a good job. Finally, one should consider not only the percentage of the total budget spent on customer information, but also how these resources are allocated among different activities.

7.3.2. Customer Needs

Determining the needs of the customers is of considerable importance throughout the evaluation process followed in the analysis of the San Juan case. While some attempt at doing so was made in this research effort, there is plenty of need for further study by those in San Juan. The AMA survey of passengers during the Phase II restructuring is a good beginning, but only briefly touched on customer information needs. More detailed surveys or focus groups should be conducted to learn more about how useful current customer information provided in the region is, and what needs are not being met.

From such research one would hope to answer three questions:

- which customer groups need to be targeted by customer information methods,
- and what types of information will satisfy these customers' needs, and
- how this information should be provided.

From these answers, one could more narrowly define goals for each implementation project. This, however, relates back to the issue of budget constraints, in terms of how much an agency should spend on market research versus on the actual provision of information. Again, looking at what other agencies do in these regards is a helpful start for making this decision.

7.3.3. Prioritization of Alternatives

Given a limited budget for customer information, an agency must determine not only which specific methods to implement, but also the order in which to implement them. This can be done through a more thorough application of the analytical framework developed in Chapter 4, which should be possible if more information about customer needs and existing customer information can be gathered, and more successful experience with customer information obtained. To perform this analysis, one should follow the remaining four steps of the decision-making framework more strictly:

5. Identify key evaluation criteria
6. Select implementation alternatives
7. Evaluate the alternatives
8. Implement the preferred alternative(s)

Again, gathering more information to perform a more detailed evaluation in Step 7 requires further market research through surveys, focus groups, and other techniques. In performing this evaluation of alternatives, it is important to identify critical needs for improving customer information, from which specific goals of implementation can be

determined. From these goals, one can identify the characteristics of implementation alternatives that are most critical to the analysis to keep the scope of the evaluation reasonable. From the general goals outlined earlier in this chapter, the following criteria are most important:

- Accessibility (particularly location and availability)
- Information quality (both accuracy and relevance)
- Reliability
- Credibility (both perceived accuracy and cultural issues)
- Ridership
- System perception
- Agency/Regional Costs

Of course, with narrower goals defined for each particular project, identifying fewer, more specific criteria should be possible.

7.3.4. Institutional Reshaping

One of the primary recommendations given in Section 7.2.1 is to provide integrated multimodal information for the San Juan Metropolitan Area. This recommendation was made within the current transit institutional structure, however there is concern as to how successful one can be within this environment. Thus the idea of more formal coordination or consolidation is introduced here. First, three potential models are given for restructuring where the responsibility and authority for customer information lies. Of course, the private sector can bring skills and a dedicated focus to the role that may not always be possible with the government. Thus a discussion of the possible roles for the private sector in this institutional reshaping follows. Finally, the section concludes with a specific recommendation to be considered as a starting point.

7.3.4.1. Institutional Models

The four models listed below are possible institutional arrangements for providing customer information. Of course, changes to the structure would have ramifications for all aspects of transit operations – while these would be similar to the effect in terms of information provision, they should be examined in detail when considering any such change. The four models, which can be divided into two groups, are:

- Authority remains with each transit provider:
 - No formal coordination (the current state)
 - Regional coordinating council

- Authority assigned to a single entity:
 - Existing transportation agency
 - New public transportation authority

The three modified institutional models are discussed in further detail in the remainder of this subsection.

Create a Regional Coordinating Council

In the San Francisco Bay Area, one of the roles of the Metropolitan Transportation Commission is to facilitate a Regional Transit Coordinating Council, on which the general managers of many of the region's transit agencies sit. The Bay Area RTCC also has several committees, such as marketing, which agency staff participate in for the purpose of coordinating activities with one another. Such a council could be formed for customer information in San Juan, with the DTOP assuming the coordinating role between the five service-providing agencies (AMA, PRHTA, the Tren Urbano Office, the Port Authority, and PSC).

In this scenario, the individual authority and responsibility for providing customer information remains with each provider. Thus, concerns with accountability for maintaining accurate information is clearly retained by each agency. Each would identify a representative to sit on the council. The idea can be extended, as in the Bay Area example, from only customer information and marketing to fare integration, service planning, and other such transit functions.

While a coordinating council takes little institutional change to organize, there are issues regarding how effective such a body can be. It is difficult for any such body to wield and true power – programs and actions developed by the council are not enforceable and require the full, voluntary cooperation of all participants to be successful. The question of stability is also an issue – as agency representatives change due to attrition, the accomplishments of the coordinating council may be compromised.

Assign Role to a Single Existing Agency

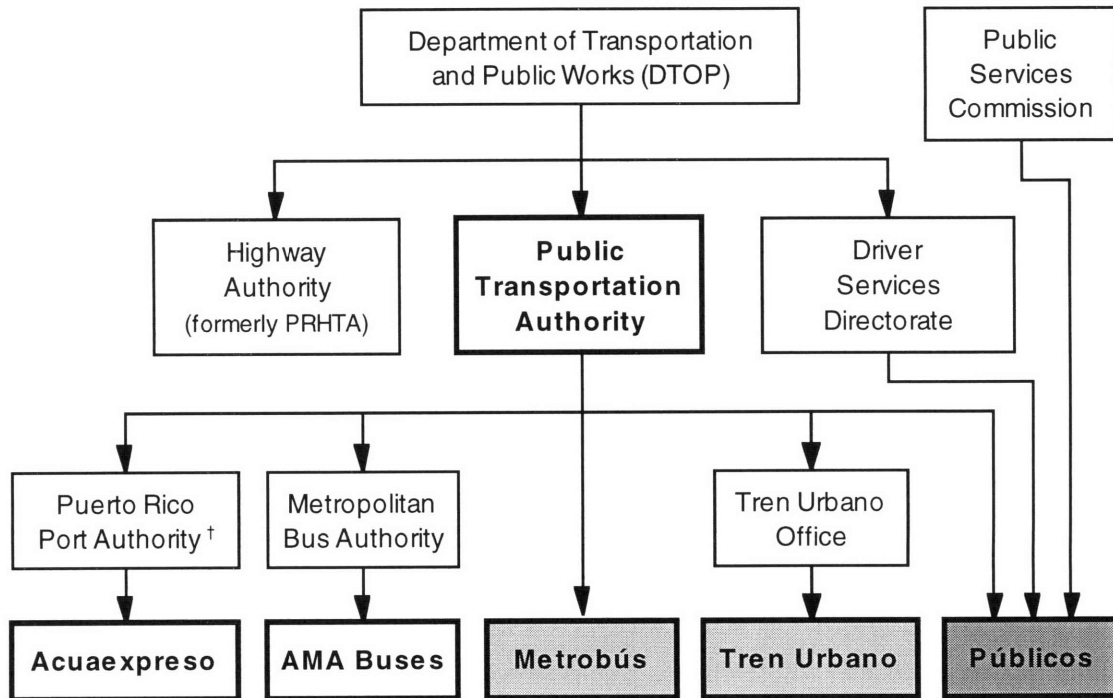
A second alternative is to assign the role of regional customer information provider to a single, existing entity. There are two variations to this idea. The role of the regional information provider can be to provide only multimodal information, with each operator continuing to provide information specific to its own services. Alternatively, it can be the primary provider of customer information for all services. In either case, the transit operators must consistently update the information provider with accurate information.

While the latter option would clearly result in a greater degree of integration between different services, it raises some potentially serious concerns. First is the issue of accountability – if incorrect information is provided to customers, it could be difficult to trace responsibility to either the operator or the information provider. Second is bias – with the information provider also being an existing transit service provider, there is concern that the agency will favor its own services. The third is dedication – an agency with existing duties, especially as a service provider, may not have the resources or the policy direction to concentrate enough attention to the customer information role.

In the San Juan case, the PRHTA is the most logical choice as information provider. The agency is already responsible for Tren Urbano and Metrobús, and holds the role of transportation planning agency for Puerto Rico. Ideally, one should create a group within the Authority whose sole purpose is customer information, either strictly for public transit or for transportation in general. Alternatively, this task can be added as a responsibility of the Ombudsman's Office, whose current role is to collect and respond to public complaints and comments about all aspects of transportation. Regardless, this new function should not simply be added to existing employees' job responsibilities – doing so will ensure that it receives little attention and effort. Sufficient new resources must be allocated to assign these duties to dedicated staff.

Create a New Public Transportation Authority

The idea of forming a new authority within DTOP with responsibility for public transportation has been recently suggested. Placing the role of regional customer information with such a new entity would achieve the same benefits of the previous strategy, but would also address the issues of bias and dedication. In the San Juan context, this would concentrate the existing PRHTA entirely on highway matters for the Island as a whole, and the new transit authority (with its own director and management) would oversee the various transit providers, possibly only for the San Juan Metropolitan Area. Figure 7-3 below illustrates this possible new institutional structure for public transportation.



† The Port Authority would be responsible to the Public Transportation Authority solely for the operation of Acuaexpreso, and would continue to perform other functions with sovereignty

Figure 7-3: Establishment of a New Public Transportation Department within DTOP

There are of course many complex, political issues with any such change which removes authority from one body and gives it to another. PRHTA's Metrobús service would likely be transferred to this department. Also one could conceivably have the Tren Urbano office, AMA, the contracted Metrobús operators, and the Port Authority (or a private Acuaexpreso operator) as service providers reporting to this central Public Transportation department. A new work group could be created to oversee público issues beyond the basic licensing issues that the PSC handles.

Such a new authority would control funding and service planning for these transit services. A group within the agency could have sole responsibility for customer information (and also marketing) for all services. These customer information responsibilities could include:

- collection of service information for all modes of transit,
- design and publication of customer information materials (for distribution by the service providers),
- oversight of the telephone information center that is being established (and operated privately) for Tren Urbano,
- evaluation, through market research and other survey means, of the effectiveness of customer information, and

- planning and development of new customer information methods.

The primary obstacle to such a plan is its political feasibility. AMA, in particular, will lose a great deal of authority and sovereignty with this change. However, the potential benefits are numerous, and thus this alternative is definitely worth further development and consideration.

7.3.4.2. *Private Sector Involvement*

The private sector can participate in customer information provision to varying degrees. For example, as consultants for individual projects, such as the design firm developing publications for the AMA and Metrobús services, or as exclusive providers of some or all aspects of a transit agency's customer information strategy. In theory, the private sector could participate in any of the four institutional models mentioned in the previous subsection. In all cases, the government agencies involved could contract out some or all of the required work to one or more private firms.

The level of responsibility placed with the private sector could also vary. Private firms could be asked to perform only specific tasks, such as designing a publication or performing a market research study. All planning and decision-making would then be retained by the public sector. This, for example, is the case with the San Francisco Bay Area's TravInfo project, where a private contractor operates the traveler information center to the Metropolitan Transportation Commission's specifications. Alternatively, the private firm could take on a broader responsibility for designing and implementing customer information methods to meet specifications laid out in their contract.

This latter role is basically what the Siemens Transit Team, as operator of Tren Urbano for the first five, possibly the first ten, years of operation will fulfill. The Operations and Maintenance Contract specifies minimum criteria for providing information which must be met, and leaves it up to the contractor to determine the exact plan. And as the Siemens team has a ridership-based financial incentive, they have motivation to provide sufficient customer information to maximize their profit.

7.3.4.3. *Recommendations*

It is clear that some institutional restructuring would be helpful to improving the integration of customer information between transit modes in San Juan. Due to the potential ineffectiveness of a regional coordinating council, and the small number of agencies that would be represented, that is not the preferred alternative. It is therefore recommended that

authority for providing customer information be given to a single entity, either an existing one or a newly created public transportation authority. The issues of bias and dedication associated with assigning the customer information role to an existing agency are significant. However, the creation of a new public transportation authority is a large step within a highly political environment, and will have impacts well beyond the scope of customer information. The decision between these two options, therefore, must be made by local policy-makers after consideration of all relevant issues.

It is also recommended that the private sector be given a significant role in this process. Indeed, the role of the public sector in providing customer information should only be one of coordination and administration. The public entity responsible for customer information should only specify what types of information should be provided and set minimum performance standards such as market penetration, availability, reliability, and accuracy. Decisions about the details of customer information provision should be left up to the contractor.

One choice for this contractor would be the current Tren Urbano operator – the Siemens Transit Team. This team has substantial management and operations experience in Alternate Concepts, Inc. (ACI), combined with the technological background of Siemens. They are already responsible for providing quality customer information for the Tren Urbano system. It should therefore be quite straightforward to extend their role through a contract amendment, adding the task of providing information about other transit services as well. However, one could question the ability of Siemens to provide unbiased service. With a ridership-based financial incentive in the operation of the Tren Urbano system, it is not unreasonable to expect Siemens to favor providing information about it over the other modes. Público operators would be most threatened by this, and thus would likely be even more reluctant to participate. For this reason, it may be necessary to exclude private operators of any local transit service from bidding for the contract.

7.4. Summary

From the background information presented in Chapter 6, several goals for improving customer information within the San Juan context were defined at the beginning of this chapter. From these goals, four primary recommendations for improving customer information were given: to provide information about públicos, to provide complete, accurate information consistently, to provide integrated multimodal information, and to develop a regional strategy for improvement. In addition, many specific recommendations

for particular information methods were made. These were organized into two phases – the first phase consists of basic, traditional methods for providing customer information that must be implemented successfully and consistently, while the second phase recommendations are more sophisticated methods that should be evaluated in more detail at a later date.

Finally, four critical issues that need further consideration were identified: budgeting, customer needs, prioritization of alternatives, and institutional reshaping. The last of these was particularly emphasized – in doing so, it was suggested that the customer information role for the region be assigned to a single entity, be it an existing agency or a new public transportation authority under the DTOP. Such an agency would have sole responsibility for providing customer information about transit service, and could contract to the private sector to fulfill these responsibilities.

8. In Conclusion

Public transportation is like any consumer product – the public needs to be exposed to it and taught how to use it properly. Customer information performs both these functions, as a means for promoting transit and instructing customers on how to use it most effectively and efficiently. It is therefore unfortunate that functions so fundamental to transit use are often overlooked by transit managers. This research and the resulting thesis has attempted to assist the transit agency in identifying what the information needs of its potential ridership are, and developing an information strategy to meet these needs.

This final chapter summarizes the results of this research effort, and identifies the areas where further research is most needed. This is done in regard to both the general application of the concepts and analysis presented in the earlier chapters as well as the specific application to the San Juan Metropolitan Area.

8.1. Regarding Customer Information

The goal of the general analytical framework developed in this thesis was to formulate a decision-making process for use in identifying weaknesses in existing customer information provision and in defining a customer information strategy to address these weaknesses. To begin developing this framework, key concepts in public transportation information and its provision were identified from existing literature on the topic. It is immediately obvious that many of these ideas are in their infancy in terms of application to public transportation customer information. Some questions in need of further study include:

- **Market research and segmentation** – What are the best market research methods for identifying who the audience for transit customer information is and what their needs are? Are there general lessons from market research that can be applied in a variety of transit contexts?
- **User acceptance and adoption** – There is a great deal of work being done in this area for ATIS for highway travelers, including sophisticated modeling of user response to the developed technologies. How can the results of this work be applied to transit customer information technologies? How well can the results be applied to non-technological methods? And what more can be learned about user adoption of customer information in general?
- **Influence of information** – To be useful, transit information must change travel behavior or attitude – nine types of influence were identified. How can one quantify this influence? What types of information, and methods for providing it, are particularly effective in having such influence?

- **Goals for customer information** – This thesis identified several goals for transit customer information, but was by no means exhaustive. What goals do transit agencies worldwide have for customer information? What have they done to address these goals? Have these efforts been successful?
- **Methods of information provision** – There are an overwhelming number of alternatives for providing customer information. The typology of customer information methods presented in this thesis again was not exhaustive. The series of *Advanced Public Transportation Systems: The State of the Art* reports published by the FTA summarizes new technology initiatives for transit customer information, but do not follow up on performance and do not include non-technological initiatives.²⁵⁶ What methods of customer information provision have been tried by transit agencies worldwide, and to what level of success? What are some new methods of providing information that can be developed and tested?

The decision-making process developed is based upon these concepts. As its foundation is a framework for evaluating customer information methods, both pre- and post-implementation. This framework combines the ideas of market segmentation, user adoption, and influence of information as a means for quantifying the benefit of these methods. While the evaluation framework was used as a template for reviewing two of the case studies, and the decision-making process as a guide for making recommendations for San Juan, neither constitutes a truly practical application. Thus two questions arise:

- Does the evaluation framework capture the true benefit and costs of a customer information method across all segments of the population?
- Can the decision-making process be applied in practice for making customer information implementation decisions?

It is undeniable that regardless of the success of this framework in practical application, its components can be further developed.

Five cases of customer information methods and strategies were studied over the course of this research, again both as a demonstration of the ideas developed and to summarize particularly interesting customer information initiatives. The cases studied are the London Transport Countdown and Hampshire County STOPWATCH real-time bus arrival time display systems, both in the UK; the GoTIC integrated information system architecture in Gothenburg, Sweden; four regional information systems in the San Francisco Bay Area; and a general review of transit customer information in Hong Kong.

Several key lessons arise from the case analyses. There are significant challenges to providing customer information when transit service is privately operated with little or no

²⁵⁶ See the bibliography heading *Advanced Public Transportation Systems: The State of the Art* for a listing of the reports in this series.

regulation, however the government can play a significant role in this. Regional government is particularly appropriate for integrating information about multiple regional transit services. Indeed, integrated advanced technologies can simplify the process of collecting information from multiple transit providers, and allow efficient use of collected information by disseminating it to different segments of the public via a variety of methods. All five cases use the World Wide Web, although each for slightly different purposes, and it is seen as a valuable, cost-effective media for promoting transit service. Real-time customer information at bus stops is successful in terms of benefit to passengers, although technical issues make reliability and accuracy a concern and require considerable technical support resources. The details of the project environment have an impact on the success of such initiatives, particularly the distinction between publicly operated, tendered, and deregulated transit service.

There are, of course, many other interesting customer information initiatives worldwide that should be studied. Lessons learned from such further study would contribute to and further the knowledge gained from this research.

8.2. Regarding the San Juan Metropolitan Area

The second focus of this thesis is the application of knowledge gained to the San Juan Metropolitan Area. Public transportation in San Juan is simply not what it could be. With Tren Urbano, a new heavy rail system, set to open in 2001, a “new age” in transit will begin. But even though customer information plans for the new system are comprehensive, the dependence of Tren Urbano on existing transit modes as feeder services requires improvement to customer information for all modes, and the development of an integrated regional strategy.

In addition to numerous specific recommendations for improving customer information in San Juan, several general but critical recommendations are given. It is suggested that a strong focus be placed on the largely ignored público service. Públicos carry two-thirds of San Juan transit riders, and will likely carry a similar proportion of the 66,000 daily Tren Urbano passengers transferring from other modes – the importance of their role in San Juan is unquestionable. However, because of the nature of público service, providing customer information for it is a challenge. The specific suggestions for doing so are certainly feasible, however, this issue of customer information should be incorporated into the larger question of integrating públicos into the total transit network. Lau provided a starting point with his thesis, but many issues, including information, remain unresolved.

Basic, traditional forms of information must be provided accurately and consistently. Because of a failure to do this in the past, transit passengers in San Juan do not expect, and may not trust, printed information about services. Transit managers in San Juan need to prove, to the government and to the people, that they can successfully provide even the most simple of customer information, before they should begin to consider anything further.

Transit customer information must be integrated across all transit modes. Publicly operated transit services are very few – 29 AMA bus routes, three Metrobús routes, two Acuaexpreso routes, and in 2001, one rail line. Multimodalism is the key to maximizing the efficiency and effectiveness of these services, yet without integrated customer information, this is not possible. Again, the públicos are the biggest challenge, but options are available. Means for better integration of information include both technological solutions and institutional change.

Finally, a regional strategy should be developed to leverage this “new age” in public transportation. If implemented successfully, Tren Urbano will give transit a new image in the eyes of the Puerto Ricans. Again, integration is the key to extending this improved image to the other transit modes, and customer information is the most visible.

But with the recommendations given, the work is not finished. Four issues relating to customer information in San Juan need further consideration by decision-makers in the region: budgeting, customer needs, prioritization of alternatives, and institutional reshaping. The last of these is particularly emphasized. It is suggested that the customer information role for the region be assigned to a single entity, be it an existing agency or a new public transportation authority under the DTOP. Such an agency would have sole responsibility for providing customer information about transit service, and could contract to the private sector to fulfill these responsibilities. The details of such a change, however, including the impacts it would have on other aspects of transit service and management, need further study before a final recommendation can be given.

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