Assessing Opportunities for Intelligent Transportation Systems in California’s Intermodal Operations and Services – Review of Literature

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Assessing Opportunities for Intelligent Transportation Systems in California’s Passenger Intermodal Operations and Services—
*Review of the Literature*

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Interim Report for MOU 375

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ABSTRACT

Ever since the implementation of the Intermodal Surface Transportation Efficiency Act and continuing with the Transportation Equity Act for the 21st Century, intermodalism has garnered much attention. A project to investigate passenger intermodalism in urban areas of California is in progress whose primary goals are to assess the current state of passenger intermodal operations and services and to identify opportunities to utilize intelligent transportation systems to make improvements. Initially, a literature review was performed to investigate the state of knowledge in this area to help develop a baseline knowledge of current passenger intermodal services and operations, to find methods for evaluating intermodal performance, and to assess how intelligent transportation systems have already been applied to intermodal systems in both the United States as well as internationally.

This research documents the literature review findings, including motivating factors for an intermodal system, barriers to its implementation, the support of intermodalism via policy measures, the development of intermodal terminals, intermodal performance evaluation, the linkage of transit with intermodalism, implementing an intelligent intermodal system and lessons learned.

Key Words: intermodalism, passenger intermodal operations and services, intelligent transportation systems
# TABLE OF CONTENTS

<table>
<thead>
<tr>
<th>SECTION</th>
<th>PAGE</th>
</tr>
</thead>
<tbody>
<tr>
<td>ABSTRACT</td>
<td>i</td>
</tr>
<tr>
<td>INTRODUCTION</td>
<td>1</td>
</tr>
<tr>
<td>THE NEED FOR A SEAMLESS INTERMODAL TRANSPORTATION SYSTEM</td>
<td>1</td>
</tr>
<tr>
<td>BARRIERS TO INTERMODALISM</td>
<td>2</td>
</tr>
<tr>
<td>Institutional Barriers</td>
<td>2</td>
</tr>
<tr>
<td>System Integration Barriers</td>
<td>2</td>
</tr>
<tr>
<td>Interoperability Requirements</td>
<td>3</td>
</tr>
<tr>
<td>Funding Constraints</td>
<td>3</td>
</tr>
<tr>
<td>Poor Condition of Physical Infrastructure</td>
<td>3</td>
</tr>
<tr>
<td>Low Market Demand for Intermodal Services</td>
<td>3</td>
</tr>
<tr>
<td>User Concerns</td>
<td>3</td>
</tr>
<tr>
<td>Lack of Data</td>
<td>4</td>
</tr>
<tr>
<td>Lack of Performance Criteria</td>
<td>4</td>
</tr>
<tr>
<td>Uncertainty of Actual Benefits</td>
<td>4</td>
</tr>
<tr>
<td>POLICY MEASURES</td>
<td>4</td>
</tr>
<tr>
<td>DEVELOPMENT OF INTERMODAL TERMINALS</td>
<td>5</td>
</tr>
<tr>
<td>EVALUATING INTERMODAL PERFORMANCE</td>
<td>6</td>
</tr>
<tr>
<td>IMPROVING TRANSIT AND INTERMODAL SERVICES</td>
<td>7</td>
</tr>
<tr>
<td>DEPLOYMENT OF INTELLIGENT TRANSPORTATION SYSTEMS IN PUBLIC TRANSIT</td>
<td>10</td>
</tr>
<tr>
<td>IMPLEMENTATION OF AN INTELLIGENT INTERMODAL SYSTEM</td>
<td>10</td>
</tr>
<tr>
<td>LESSONS LEARNED</td>
<td>11</td>
</tr>
<tr>
<td>EVALUATION FRAMEWORK</td>
<td>11</td>
</tr>
<tr>
<td>REFERENCES</td>
<td>12</td>
</tr>
</tbody>
</table>
INTRODUCTION

Ever since the Intermodal Surface Transportation Efficiency Act (ISTEA) was authorized in 1991, the subject of intermodal transportation has received a considerable amount of attention. The desire to develop a truly intermodal transportation system has created the need to further understand the current system, and the barriers and opportunities to intermodalism.

This project focuses on passenger intermodalism. The project’s goals are to 1) assess the current state of passenger intermodal services and operations in California and 2) identify opportunities to utilize Intelligent Transportation Systems (ITS) to improve passenger intermodalism. The project’s initial task has been to perform a literature review to investigate the state of knowledge in this area; more specifically, the literature review has enabled the development of a baseline knowledge of current passenger intermodal services and operations, to find methods for evaluating intermodal performance, and to assess how ITS has been applied to intermodal systems in both the United States (US) as well as internationally. In addition, the evaluation framework developed for the remainder of the project is described.

This report constitutes the project’s Interim Report. The remainder of the report begins with a discussion of motivating factors for an intermodal system followed by the barriers to its implementation. The support of intermodalism via policy measures is then discussed followed by the development of intermodal terminals and intermodal performance evaluation. Focus on transit and its linkages with intermodalism and Intelligent Transportation Systems are subsequently discussed. Next, implementing an intelligent intermodal system and the lessons learned from this literature review are presented. Finally, the evaluation framework developed to serve as a guide for the remainder of this project is described.

THE NEED FOR A SEAMLESS INTERMODAL TRANSPORTATION SYSTEM

A good example, which illustrates the need for a new approach to intermodal passenger transportation in the US, is that which compares the long-distance travels of a package to that of a person. A freight delivery service plans every aspect of the trip that the package will make, which will usually involve several modes. The whole operation from the perspective of the sender of the package is virtually seamless. On the other hand, a person traveling a similar distance cannot go through one service and plan an intermodal trip. She must coordinate her own schedule, deal with each mode individually, and pay for each separately. This is contingent upon her having access to the proper information. With the current resources available to the typical traveler, it is difficult to visualize all the links of a trip and plan accordingly. This fundamental difference between freight and passenger transportation represents the deficiency of intermodal passenger travel in this country (1). The importance of an intermodal passenger transportation system is twofold. First, the
concept of intermodalism utilizes the existing transportation infrastructure, instead of constantly expanding infrastructure to keep up with demand (2). Expanding roads and highways to meet capacity has been the common approach to congestion mitigation in the past, and has proven to be a very costly and politically contentious solution. The application of ITS to the existing transportation system could increase efficiency and productivity of the intermodal system, so that it would operate as one seamless entity. A second reason for improving passenger intermodalism is to increase the number of transportation alternatives available to the traveling public. Public transportation, in particular, would likely become a more attractive mode due to streamlining the transfer process and other improvements in quality of service. Transit-dependent and formerly auto-dependent populations would benefit from improved accessibility and mobility. Programs, such as Welfare-to-Work, could be more effective with a transportation system that supports program objectives by providing better access to employment and services. In general, an intermodal system that supports commerce, commuting, and other personal travel, would increase productivity and accessibility. This could yield significant gains in economic opportunity, creating a major incentive to improve intermodal efficiency (2). Increasing the number of viable transportation alternatives can also help to reduce energy consumption, traffic congestion, and automobile emissions. This is critical, especially in light of legislation, such as ISTEA in 1991 and the Clean Air Act Amendments of 1990, which have prioritized the reduction of transportation-related impacts on the environment and on public health (1).

**BARRIERS TO INTERMODALISM**

There are a number of barriers which have prevented the significant advancement of intermodal passenger transportation. Later discussion addresses the manner in which policy, terminal development and ITS have and can help overcome these obstacles. The primary source for the description of barriers is (3).

**Institutional Barriers**

The lack of incentives among transportation agencies to cooperate poses implementation challenges for intermodalism. These may include differences in objectives, organizational biases toward certain modes, concerns about potential liabilities, and local development restrictions (3). Sometimes, regulations established by a transit property can discourage intermodal travel as well. For instance, restrictions that do not allow bicycles on board transit vehicles during peak hours may deter potential passengers, who might otherwise use a combination of bicycle and transit to commute to work. Restrictions on bicycles lead to trade-offs among potential riders (bicyclists, non-bicyclists) and the transit operator itself.
System Integration Barriers

These are barriers created by inter-jurisdictional resistance to a centralized system. System integration would require changes in local agency operations to make them compatible with system-wide procedures and forfeiture of control to inter-jurisdictional management. The tendency for transit agencies to focus solely on their service areas, rather than consider their operations in the context of the regional transportation system, is also an integration barrier.

Interoperability Requirements

To establish an intermodal communications network, there must be a continuous synchronization of intermodal operations and the exchange of reliable and timely information. The hardware and software must be reliable, expandable, and upgradable.

Funding Constraints

Operating agencies, taxpayers, and system users may not be willing to fund capital investments. Experts believe there will be a need for government subsidies to implement and sustain an intermodal system. With little private sector interest in intermodalism thus far, it is uncertain whether privatization of services is feasible. It is also questionable whether an intermodal system, which requires heavy investment in capital improvements and operations, will be cost-effective.

Poor Condition of Physical Infrastructure

Many intermodal facilities are inadequate for accommodating intermodal transportation due to poor design or location. Costly renovations or constraints on available land can inhibit the redevelopment of these facilities.

Low Market Demand for Intermodal Services

The dominance of the automobile as a primary transportation mode is perceived as a major obstacle to encouraging intermodal travel. It is a concern that only a slight modal shift toward transit would occur with an improved intermodal system, resulting in negligible impacts on congestion mitigation. In addition, transit has a reputation for being unreliable, inconvenient, and unsafe. The negative perception of transit service may discourage investment in public transportation, and in passenger intermodalism.

User Concerns

Travelers and operators both have concerns about intermodal integration. The traveler may have privacy concerns, especially in some cases of using “smart” fare media where records
of personal travel and information on financial accounts are kept. Operators may have difficulty with new hardware or software, or feel reluctant to use them. They may be unwilling to share information with other competing transportation agencies. There are also issues involving division of labor amongst the different departments, as a result of restructuring the transportation system.

**Lack Of Data**

Without adequate information, agencies and local governments are unable to make informed policy and planning decisions. This includes the lack of accurate data on travel patterns, and trips by non-motorized modes, such as bicycling and walking. There is also little data available on the combinations of modes used in intermodal trips. Absence of data may be due to the fact that it is too difficult or time-consuming to collect.

**Lack of Performance Criteria**

Without standard performance criteria, it is difficult to assess the effectiveness of intermodal systems and how they should be improved. Transfer time tends to be the common measure of intermodal performance, but rarely are other quantitative or qualitative factors considered.

**Uncertainty of Actual Benefits**

There has been no extensive research or empirical evidence to determine the actual benefits, which could be gained from intermodalism. Since congestion is such a widespread concern, the ability of intermodalism to achieve congestion reduction goals is of interest to skeptics and supporters alike. Without estimates of potential benefits, it is difficult to convince stakeholders, operators, and travelers to invest in or support an intermodal system.

**POLICY MEASURES**

The passage of legislation at the federal level has provided the policy support for a national intermodal system. In particular, ISTEA and its recent reauthorization, the Transportation Equity Act for the 21st Century (TEA-21), have provisions for encouraging further development of an intermodal system. The first paragraph of ISTEA policy calls for the development of a “National Intermodal Transportation System that is economically efficient and environmentally sound, provides the foundation for the Nation to compete in the global economy, and will move people and goods in an energy efficient manner” (4). The National Intermodal Transportation System (NITS) integrates all modes of transportation and calls for major improvements to public transit. This would contribute to goals of air quality, energy conservation, international competitiveness, and mobility.
ISTEA also promotes the application of advanced technologies to the transportation system. The portion of the Intelligent Transportation Systems program that applies to public transportation, is referred to as Advanced Public Transportation Systems (APTS). As part of an effort to encourage the development of Intelligent Transportation Systems, the U.S. Department of Transportation established a program to develop a national ITS architecture. A unifying architecture would provide a framework for compatible systems across modes and between regions. These national standards could eventually enable seamless movement of passengers and goods across all jurisdictions (5).

Some of the historical barriers to intermodalism are addressed through ISTEA legislation. For example, there are six management systems authorized by ISTEA to improve the management and maintenance of the transportation system. One of the objectives of establishing these management systems is to emphasize the importance of performance measures (6).

ISTEA legislation addresses inter-jurisdictional issues by decentralizing transportation planning decisions, and empowering state, regional, and local governments to respond to community transportation needs (6). In particular, Metropolitan Planning Organizations (MPOs) are authorized to disperse funds among transportation agencies, and can play a crucial role in encouraging cooperation between them. While there are still issues to be resolved among various institutions, the mandate provides a foundation for beginning the process of cooperation. ISTEA has also helped to alleviate funding constraints by apportioning financial resources for intermodal projects.

DEVELOPMENT OF INTERMODAL TERMINALS

Efforts to improve the physical infrastructure of the intermodal transportation system are evident by the substantial investment in intermodal facilities in many major metropolitan areas. These facilities range in scale from simple projects to major developments that promote the ease of movement between modes. Throughout the United States, intermodal facilities are being designed and constructed in response to the promotion of intermodalism by ISTEA legislation (7). Examples of intermodal facilities which have been developed in California in recent years include the restoration of the Old Southern Pacific Railroad Depot in Sacramento, the redevelopment of the downtown San Francisco Ferry Terminal, the redevelopment of the Union Station in downtown Los Angeles, and renovation of the Santa Fe Depot in downtown San Diego. Each of these projects attempts to improve intermodal transfers by bringing several modes together at one facility. They also involve restoration of historic structures which are local landmarks in each region.

Because airports are large facilities that serve many passengers and whole regions, landside airport accessibility is somewhat indicative of a region’s intermodal connectivity. The robust economy has placed increased demands on airports to accommodate freight and passenger travel, resulting in a number of high-profile intermodal projects at airports all
over the world. In Europe, Asia, and the United States, the issue of improving the quality of airport access has inspired major construction and redevelopment projects at several airports. Heathrow Airport in London, Charles DeGaulle in Paris, Chek Lap Kok in Hong Kong, San Francisco International, and the Saint Louis Airport in Missouri are just a few of the airports introducing rail rapid transit connections to their terminals.

Overall, European and Asian cities tend to have superior airport access compared to most major American airports (8). While the demands for air and ground transportation are comparable in Europe and the United States, the geographical context for ground transportation systems with which the airport must integrate are wholly dissimilar. European airports tend to be connected inter-regionally, often by high-speed rail, while American airports tend to focus on access within the immediate metropolitan region (9). American airports also face various legislative and bureaucratic complexities. Because airports are public facilities (city/county/state-owned), they inherently have different perspectives than the privately run airlines, and the federally subsidized highway or transit agencies that provide the infrastructure and service for airport access (8).

A study by Lehrer and Freeman evaluates intermodal transportation links to the central business district at the twenty largest American airports. Among these airports, two are in California: Los Angeles International (LAX) and San Francisco International (SFO). The study finds that few systems in the U.S., namely Atlanta, Chicago, and Washington DC, allow ease of travel between the city center and airport, while most of the time getting to the airport is difficult, frustrating, and expensive. One of the conclusions is that the preference for the automobile in the U.S. has weakened the connection between airports and public transportation. The airports and local planning agencies surveyed for the study have made it a high priority to improve intermodal links to their airports. Funding is more probable since the passage of ISTEA, making such undertakings more feasible than in the past. The authors state that the key to achieving better airport access is to invest in intermodal connections which will not only benefit the airport, but the other transportation agencies as well (8).

In 1996, the Federal Highway Administration (FHWA) and Federal Aviation Administration (FAA) published a guide for airport operators and MPOs, *Intermodal Ground Access to Airports: A Planning Guide*, designed to provide policy guidance and analytical techniques for airport access planning. Shapiro and Katzman suggest that aside from this guide there is additional work that needs to be done in order to improve ground access to airports. Data is needed on airport access travel patterns as well as characteristics on the passenger occupancy of vehicles entering an airport. In addition, there is a need to publish more information on airport peaking characteristics for airports with different passenger levels and mixes, as well as a need for development of better tools and models for access planning (10). ITS technologies can assist in the collection of data, which was not previously obtainable by conventional means. However, without interagency cooperation and willingness to share information, it will be difficult to form an effective intermodal system.
EVALUATING INTERMODAL PERFORMANCE

To date, the most commonly used performance measure of passenger intermodalism is transfer time. As long as intermodal connections are weak (i.e. unpredictable, unreliable), transfer waiting time continues to be a significant burden to travelers. In a study by Liu, et al, revealed and stated preference data were used to assess the penalty associated with an intermodal transfer (11). The authors determined that the value of the transfer penalty is not equal to the service headway, or twice the average waiting time, but approximately three times the actual waiting time. It was also concluded that intermodal transfers have a significantly higher penalty than intramodal transfers do.

One approach to minimizing transfer times that is practiced in Europe is the concept of integrated timed transfer (ITT). Clever suggests this technique be employed to better connect transit service between the Sacramento, San Francisco, and San Jose areas. The idea behind ITT is to have transit vehicles (buses) converge at common transfer points in a service area at scheduled intervals throughout the day. The advantages of a coordinated system, such as ITT, are that travelers are able to make their connections within a short period of time from when they arrive at transfer points. They can also plan trips with more confidence because arrival and departure times are fixed. One disadvantage of ITT is that it necessitates transfers, and may require some passengers to transfer more than they do without ITT. Additional disadvantages are that a region must be “blanketed” with transfer points and service must be consistent throughout the day in order for an ITT system to be effective. These criteria can be costly from the perspective of the transit property (12).

Little evaluation has been done to measure the quality of connections at intermodal facilities. A feasibility study for the Wisconsin Department of Transportation is one of the few studies, which attempts to evaluate the quality of intermodal connections. It suggests some standard weights, penalties, and time values of transfers depending on particular conditions. Most of the report mainly focuses on establishing criteria for the development of new intermodal facilities (13).

AlKadri and Benouar suggest two system concepts by which intermodal systems and services could be evaluated. These are interconnectivity, which is a quantitative measure dealing with physical connections, and interconnectedness, which a qualitative measure of the connections. The three criteria, which can be used to assess a system’s interconnectivity and interconnectedness include (a) the quality of infrastructure interconnectivity, (b) the quality of system management, and (c) the performance of the communications link. The quality of infrastructure connectivity is determined by how well the transportation system or facility is designed. It includes the characteristics of the intermodal terminals, the convenience and ease of transfers, the safety of the transfer, and the degree of coverage of the intermodal network. The quality of system management covers issues, such as availability of transfers, level-of-service, reliability, cost
distributions, and the efficiency of between agencies in meeting operational objectives. The performance of the communications link deals with the accuracy and availability of data, value of information, and user-friendliness of interfaces (3).

**IMPROVING TRANSIT AND INTERMODAL SERVICES**

Since intermodal trips often involve the use of at least one form of transit, addressing transit performance is necessary to improve passenger intermodalism. The inability of transit to adequately serve transportation needs is a major deterrent to intermodalism, but one which ITS can effectively address. ITS technologies can improve transit by addressing major problems, such as inconvenient bus routes, anxiety caused by waiting for the bus, long transfer times, safety concerns, and cost to the customer. With the accurate information that ITS can provide, agencies can plan routes that better suit public needs. Automatic passenger counters and Geographic Information Systems can assist in the collection and analysis of this data. With automatic vehicle location capabilities, real-time information on bus location and arrival times can reduce the anxiety that often accompanies the wait for a bus or other transit vehicle. Automatic vehicle location also helps dispatchers keep vehicles on schedule and coordinate connections with other vehicles, so that transfer times are shorter. Automatic vehicle location also enables the police to respond to emergency situations quickly, making the public transportation environment safer. The perception of transit costs can be reduced with the convenience of electronic fare payment. Moreover, the improvement in service due to all of these technologies would result in timesaving for passengers (14).

The three categories in which ITS can improve transit are fleet operation and management, fare collection, and customer information. Fleet operation and management uses specific technologies, such as automatic vehicle location (AVL), advanced transportation management systems integration (ATMS), signal priority, automatic passenger counters (APC), and geographic information systems (GIS). AVL is made possible with satellite technology known as global positioning system (GPS), which identifies the exact location of transit vehicles. Knowing the exact location of vehicles is useful in keeping them on schedule, in responding to emergencies and traffic incidents, and in providing dynamic information to customers.

ATMS integration involves the electronic connection between a transit agency’s operations center and an external transportation management system. Because the external agency has access to real-time traffic information, it can alert the dispatchers when there are traffic incidents. With signal priority, a central control system extends the green time of traffic signals for transit vehicles approaching an intersection. This is intended to help transit vehicles stay on schedule, or make up time if they are behind schedule. Automatic passenger counters are an aid in collecting ridership data. These technologies will allow the collection of information, which may currently not be available, such as the number of passengers who board and alight at each stop.
GIS stores and displays data in a geographic context, allowing it to be analyzed and computed. It can be helpful in making informed planning and policy decisions.

Electronic fare collection involves the use of uniform fare media (usually cards) for fare payment instead of currency. Customers benefit from needing only one fare medium to pay for different modes, thus minimizing the time required for passenger boarding. “Smart Card” technology allows these cards to be used for a variety of tasks in addition to paying transit fare, such as making payments in restaurants, for entertainment, and accessing automatic teller machines. It also reduces the need for transit properties to count, collect, or handle money, which can be time-consuming, costly, and unsafe (14). Operators can also benefit from using smart cards by having the flexibility to introduce more complex fare structures, the opportunity to reduce fare evasion, and the potential to create partnerships with third party institutions to finance smart card implementation (15). A more efficient boarding process also makes it easier for transit drivers to stay on schedule.

In the San Francisco Bay Area, an automated fare collection program called Translink® will be implemented in the year 2000. Six transit operators¹ will participate in this demonstration project, which will allow riders with Translink® cards to pay for intra- and inter-operator trips with one card. A central Clearinghouse will disburse the funds to the operators according to where the cards are used. If the demonstration is received well by the participating transit agencies and the public, Translink® will become the primary method for paying for transit service in the Bay Area (16).

Customer information technologies include automated trip itineraries, in-vehicle annunciators (audio announcements), variable message-signs (VMS) and monitors, and interactive kiosks (14). Users will have access to better information via human operators, telephone, personal computer, interactive television, handheld devices and wayside devices at transit stations (17).

A pilot project in Europe, named Infoten Italia, is an example of a dynamic trip-planning service that provides passenger information for intermodal travel between Germany, France, Austria, Switzerland, and Northeast Italy. This includes access to pre-trip information, information at intermodal exchange nodes, and en-route information, via a variety of interfaces. This project has demonstrated that intermodal travel is improved significantly when there is cooperation among several jurisdictions (18).

In Japan, dynamic and static information is provided to travelers in efforts to increase attractiveness of and improve connections within the transportation system. Some of the

¹Alameda-Contra Costa Transit (AC Transit), Bay Area Rapid Transit (BART), CalTrain, Golden Gate Transit, San Francisco Municipal Railway (Muni), Santa Clara Valley Transportation Authority (VTA).
real-time technologies currently available to the public are bus arrival countdown systems and park and bus ride information systems (19).

Increasingly, ground access planners at U.S. airports are directing their attention to delivering higher quality of information to travelers for trip planning purposes (9). An evaluation of computer-based ground transportation information systems was conducted at five California airports: Oakland, San Jose, Sacramento, Burbank and Los Angeles. The objective of the study was to determine the effects of kiosk location on usage, preference of travelers for information provided, and the extent to which kiosks were being used by travelers. It concluded that kiosks are a cost-effective way to provide ground transportation data because they can be located in a number of locations, do not require staffing, and can provide additional information that is not transportation-related. Travelers surveyed for the study found the kiosks easy to use and helpful in providing desired information. However, it was inconclusive whether the kiosks had an impact on increasing high-occupancy modes to and from the airport (20). All the airports in the study, with the exception of Los Angeles, have since discontinued use of the information kiosks. Without a formal budget, a sponsor at each airport, and a centralized database, the kiosk program did not have the financial and institutional support necessary to operate (21).

**DEPLOYMENT OF INTELLIGENT TRANSPORTATION SYSTEMS IN PUBLIC TRANSIT**

In 1994 and 1995, a survey of 36 U.S. bus transit agencies was conducted to determine the deployment status and the benefits realized or perceived from ITS technologies (22). Among these, San Francisco and Los Angeles were participants in the study. The agencies were asked about six technologies: AVL/CAD (computer-aided dispatch), Smart Cards, automatic passenger counters, automatic annunciation, advanced passenger information, and signal preemption. It was found that among these agencies, the technology most widely used or planned for deployment is AVL/CAD (80%), followed by advanced passenger information systems (64%).

In general, there are few documented results on quantifiable benefits of the deployment of ITS for transit applications. The primary benefits of AVL/CAD include the optimization of routes, which reduces run times and requires fewer vehicles. In the opinion of the transit operators surveyed, the savings in capital and operating costs make AVL/CAD the only economically justifiable ITS technology given that the investment can be amortized in about two years. Agencies that have AVL/CAD experience improved safety because of shorter emergency response times. On-time performance has improved as well, by 23% in Baltimore and 28% in Milwaukee. None of the agencies in this study project an increase in ridership due to the provision of real-time information to passengers, but feel it is necessary in this technologically advanced age in order to remain competitive with other modes (22).
IMPLEMENTATION OF AN INTELLIGENT INTERMODAL SYSTEM

The realization of an intelligent intermodal system will require continued support from policy makers, changes in institutional attitudes, substantial investment in infrastructure, and technological expertise. While ITS cannot provide solutions for all the barriers to intermodalism, the evolution of Intelligent Transportation Systems has created new opportunities for improving intermodal operations and services. ITS can encourage intermodalism by maximizing resources, by improving the management and operations of transportation services, and by bridging the gap between the physical and informational infrastructure.

The institutional and inter-jurisdictional issues are some of the more complicated matters that need to be resolved. It is suggested by Hall, Parekh and Thakker that we not consolidate our transportation agencies into central command stations, but that the transportation management centers retain their current organization and serve as the nuclei for an intermodal system (23). It will require a “great reversal” in the manner in which we currently run our transportation system to change from the current practice of relying on the existing physical infrastructure to relying on a new information infrastructure in order to advance to become a fully integrated intermodal system (2).

LESSONS LEARNED

From the review of the literature, it is evident that little has been done in the area of evaluating passenger intermodalism. AlKadri (3) and Horowitz (13) propose frameworks for evaluating the intermodal transfer process, but there is little evidence of such evaluations being performed at any transfer facilities. A possible explanation for this is the lack of data and quantifiable measures of effectiveness. Absence of data on linked intermodal trips poses a barrier to identifying where transfers occur, where intermodal needs are unmet, and where they might be improved. Many measures of effectiveness are not quantifiable, making it more difficult to perform evaluations that can be compared across modes or facilities. These qualitative measures, such as passenger comfort and convenience, are just as important as quantitative measures nonetheless.

EVALUATION FRAMEWORK

For this study, we are considering case studies of intermodal transfer facilities in the four major urban metropolitan areas in California: Sacramento, San Francisco, Los Angeles, and San Diego. In selecting the case studies we are focusing on facilities which have some regional importance and that are located in urban settings. Trip purpose will not be a major factor in this selection. All modes will be considered, however, our studies have naturally gravitated toward transit because it is generally accessible by urban populations and because the transfer process significantly impacts its performance. Ground access to airports is a popular intermodal trip in urban areas. However, it tends to be dominated by
private door-to-door transportation services. It is considered in our analysis, but is not the main focus.

To aid in the selection of the case studies, we are interviewing staff at each of the four major California MPOs (SACOG, MTC, SCAG, and SANDAG) to assess the state of passenger intermodalism in each region and to discuss some of the issues regarding ITS deployment. Through these discussions we are acquiring information about and perspectives on the different modes in the region, their physical and qualitative connectivity, important intermodal transfer facilities, existence and availability of performance criteria, and opportunities and barriers to ITS implementation. This information will be used to select the final case studies for our evaluation.

We will then visit and research the selected case studies in order to find specific information about the facility, such as modes located there, number of passengers served daily, transfers between modes (if data is available), and to determine if there have been any evaluations performed in the past. The evaluation of the facility is based on criteria recommended by AlKadri (3), Horowitz (13), interviewees from the various MPOs and our own performance measures. Based on these evaluations, we will recommend how ITS could be incorporated to improve intermodal transfers at these facilities. Our recommendations will be based on findings from the case studies, the literature review, as well as estimated value-added to the quality of transfers through the addition of Intelligent Transportation Systems.

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