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# **Assessment of Service Integration Practices for Public Transportation: Review of the Literature**

**Mark A. Miller**

**California PATH Working Paper  
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# **Assessment of Service Integration Practices for Public Transportation: Review of the Literature**

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## **ABSTRACT**

This report documents a review of the literature of transit service integration policies. It is the initial task of a project whose objective is to understand service integration policies and practices that transit agencies have employed and the benefits such policies have brought. Studies have shown that ongoing coordination and integration of transit services can improve public transportation system connectivity and reliability, and help make transit a more attractive travel mode alternative to the car. Findings from the literature shed light on several topics, including how service integration policies are part of overall changes in transit properties' traditional way of conducting business; the types of categories of service integration policies including route, schedule, and fare payment integration; examples of criteria to use to select participants in a subsequent project survey; a description of locations around the U.S. where service integration policies have been implemented; a focus on the experience in the San Francisco Bay Area; use of advanced technologies in the implementation of service integration policies; topic areas for questions to include on the survey; and examples of measures of performance for evaluation of service integration policies' impacts. Results of the literature review in all these areas will provide valuable input to each of the remaining project tasks.

**Key Words: service integration practices, public transportation**

## **EXECUTIVE SUMMARY**

Historically, intra-regional transit agencies in the U.S. have operated fairly independently of one another with public operators being given exclusive rights to provide public transportation services within a given jurisdiction, whereby fare and service attribute policies are established, executed, and monitored by a managing or governing board overseeing the activities of the transit agency. The incentive is for each transit agency to naturally focus on its particular service area and its own ridership. This tradition is changing into a more holistic business model involving coordination and service integration practices. Numerous examples exist from many locations around the world, especially the San Francisco Bay Area in the U.S., but such examples of implemented policies are usually presented in descriptive terms of the policy and how it works with no discussion of its impacts, and rarely, if ever, in quantitative terms.

There are numerous service integration policies and practices either directly or indirectly impacting transit passengers. Among those having a direct or more immediate impact on passengers include infrastructure (route, transfer centers), fare payment (universal transit fare card or passes), schedule (coordination and synchronization of arrival and departure times), information (single one-stop delivery of information to transit customers such as trip itinerary planning and real time information about transit delays and incidents), and special event/emergency condition integration (coordinated multi-organizational policies of implementable action plans during or in response to events). Among those policies implemented by and among transit agencies having an indirect impact on passengers include data sharing, joint procurement of equipment, joint funding proposals, coordinated public information dissemination activities, coordinated improvement at intermodal transfer facilities, and planning and research

The first major milestone for the project is administering a survey of selected public transit agencies in the U.S. From the review of the literature we have identified criteria with which to select those transit-related organizations for participation in the survey. Such criteria include transit agency attributes (level of modal diversity, size of vehicle fleet), regional institutional setting (number of transit agencies and the markets they each serve, existence of single regional transportation authority, history and age of the transit system and its component parts), and

regional characteristics (population, geographical layout, and level of urbanization). We have also identified general topic areas for questions to include on the survey including, for example, type of service integration policies, agency motivation and objectives for implementing these policies, regional institutional setting among transportation organizations including governmental role, level of commitment toward improvement of integration, legal and regulatory issues, institutional approaches, financing, use of intelligent transportation system technologies for policy implementation, and types of data used to quantify service integration impacts. Finally we have identified measures of performance to consider in our evaluation of service integration policies' impacts including facilitating transfers, increased passenger flow, travel time savings, operating cost savings, and enhanced customer convenience/reduced anxiety.

In the literature, there are descriptions of several sites where service integration policies have been implemented with particular emphasis in the San Francisco Bay Area. The Bay Area has a single regional transportation organization that has been actively promoting service integration policies in the region including helping to finance the establishment of regional interchange facilities, coordination of schedules between operators, provision of a single source of public transportation information, and implementation of a regional fare instrument based on Smart Card technology. Another example of service integration policies are transit trip itinerary planning tools. In the U.S. these have been implemented in the San Francisco Bay Area, Los Angeles, metropolitan Seattle area, Minneapolis-St. Paul area, Chicago, San Diego, New Jersey, Oregon, and metropolitan Washington D.C. area. These are examples of how advanced technologies can help make transit service integration easier to accomplish as well as provide an incentive to engage in service integration policies and practices. Other technologies include advanced communication systems facilitating the sharing of schedule and passenger information so that transfers can be coordinated and more readily achieved, automated vehicle location and identification systems, automated passenger counter systems, and transit signal priority systems.

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## **1. INTRODUCTION**

The overall objective of this project is to understand service integration policies and practices that transit agencies have employed and the changes such policies have brought, quantitatively, in terms of the benefits and costs from them. Studies have shown that ongoing coordination of transit services can improve public transportation system connectivity and reliability, and help make transit a more attractive travel mode alternative to the car, especially single occupancy cars. Thus the implementation of service integration policies and practices are not an end in and of themselves. It has been argued that successful implementation of such policies can result in demonstrable benefits to 1. Transit properties, 2. Transit passengers, and 3. Society as a whole. This project's deliverables will include development of estimates of the benefits of service integration policies and practices that have been implemented by transit properties and a set of guiding principles to understand what policies and practices have worked best under what conditions (and have not worked so well). The results of this project will provide transit properties with a model to follow to improve service integration and with it improve transportation services to the public. In this project we will also investigate the relationship between service integration policies and intelligent transportation systems/advanced technologies. This relationship may indeed be two-way, that is, intelligent transportation system (ITS) technologies can play an important role in service integration policies and practices as such systems provide an incentive to and a methodological tool for transit agencies to implement such policies, e.g., with the use of automated vehicle location and electronic fare payment systems, and so studying the benefits from these policies is linked to understanding ITS benefits. Then again, transit agencies could become more interested in coordination and service integration because they want to implement advanced technologies and perhaps one agency is taking the lead role.

## **2. LITERATURE REVIEW OBJECTIVES**

Our first project task has been to conduct a review of the literature in this field. Our primary objective has been to begin the process of answering some very basic questions about the implementation of service integration policies and practices in the U.S. Namely,

- Who has implemented service integration policies and practices in the United States?

- What policies and practices have been implemented?
- What has motivated transit properties to implement such policies and practices?
- What have been the impacts, in terms of both benefits and costs, of implementing these policies and practices, in other words, how effective have such policies and practices been in achieving their objectives?

### **3. RELEVANT TOPICS FROM THE LITERATURE**

A review of the literature has also provided us with information that will serve as input for subsequent project tasks. We highlight below those major topics from the literature that are of direct relevance to and highly valuable for the research team in order for us to achieve the project objectives. These topics consist of the following:

- Changes in transit properties' traditional business model
- Identification of major categories of service integration policies
- Identification of criteria to use to select participants in project survey
- Description of site-specific implementation of service integration policies
  - Focus on the experience in the San Francisco Bay Area
- Use of advanced technologies in the implementation of service integration policies
- General topic areas for questions to include on the survey
- Measures of performance for evaluation of service integration policies' impacts

#### **3.1 Changes in Transit Properties' Traditional Business Model**

Historically, intra-regional transit agencies in the U.S. have operated fairly independently of one another. In technical terms, transit agencies have acted as “regulated spatial monopolies”, that is, public operators that are given exclusive rights to provide public transportation services within a given jurisdiction, whereby fare and service attribute policies are established, executed, and monitored by a managing or governing board overseeing the activities of the transit agency (1, 2, 3, and 4). The incentive is for each transit agency to naturally focus on its particular service area and its own ridership and to protect against potentially rival transit services from “stealing” away its passengers where service areas overlap. Under this paradigm we see that while transit agencies appear to take an “our passengers come first” attitude, it is a very limited and only a

partial interest in their passengers in that they care only about that portion of their passengers' trips that call for use of their transit system. Thus, it is less a focus on their passengers; rather, it is more a focus on the supply of transport services that they offer their passengers and the resulting benefits only when their travel requirements overlap with this supply of services. Fortunately, this tradition is changing into a more holistic business model paradigm involving coordination and service integration practices. Such changes are often referred to in the literature as "new paradigms for local public transportation organizations" (5, 6, 7, and 8). Numerous examples exist from many locations around the world, including the San Francisco Bay Area, London, Vancouver, and Hamburg, but such examples of implemented policies are frequently presented only in narrative terms with a description of the policy and how it works but with no discussion of its impacts, and rarely, if ever, in quantitative terms. There is, thus, a need to understand these policies and the changes they have brought, especially quantitatively in terms of benefits resulting from them and costs assumed to secure them.

### **3.2 Identification of Major Categories of Service Integration Policies**

Service integration policies and practices may be grouped into two categories as to whether they have a direct or indirect impact on transit passengers. We have identified five major elements that have a direct impact on passengers (9 - 14):

#### Direct Impact

- Infrastructure
- Fare payment
- Schedule
- Information
- Special event/emergency conditions

### **3.2.1 Policies with a Direct Impact on Passengers**

By having a *direct* impact on passengers, we mean policies, when implemented, having an immediate affect on passengers' transit travel routines through route or schedule changes, new options in how to pay for transit services, and new choices in what and how they learn about transit-related information.

By *infrastructure* integration, we mean physical changes such as 1. Integration of routes, that is, changes to the route structure of at least two transit properties so as to be more in alignment with the travel pattern needs of their passengers and 2. Establishment of interchange or transfer centers to facilitate the movement of people between different transit modes as well as within different routes of the same mode.

Integration of *fare payment* systems consists of the establishment of a universal transit fare card (conventional paper card or computer-chip embedded Smart card) or passes that provides transit customers the ability to use a single media with which to pay and, pay only once, for transit services regardless of the transit service provider within the boundaries of the regional jurisdiction overseeing the implementation of such a regional card.

*Schedule* integration involves the coordination and synchronization of arrival and departure times to facilitate the movement of transit customers from their trip origins to their trip destinations between any of the following four different combinations of transit service providers and transit modes:

1. Multiple transit service providers for different modes, e.g., Bay Area Rapid Transit (BART) and Alameda-Contra Costa County (AC) Transit in the San Francisco Bay Area
2. Multiple transit service providers for the same mode, e.g., the Metropolitan Transportation Authority and the Santa Monica Big Blue Bus in Los Angeles County
3. Different modes for a single transit service provider, e.g., Massachusetts Bay Transportation Authority (MBTA) rail and bus services
4. Multiple lines of a single mode for a single transit service provider (MBTA Red and Orange Lines).

From an institutional perspective, it is clearly easier to establish and maintain, and reap the benefits from schedule integration within the jurisdiction of a single service provider, that is, from types 3 or 4 rather than from types 1 and 2.

*Information* integration includes a single one-stop-shopping way of delivering information to transit customers, both existing as well as potential. The types of information include

1. Transit trip itinerary planning about how to take transit from their trip origin to their trip destination
2. Real time information about transit delays and incidents, such as, current location and/or speed of “their” bus to be used for planning a just-in-time arrival at their usual transit station or stop and traffic conditions affecting the bus along the public transit route they usually take.

While such information could be delivered to transit customers over the phone, a faster and more efficient way of providing this is through the Internet from an at-home or at-work computer, cell phone, or personal digital assistant. While access to the Internet is becoming more ubiquitous, it must not be forgotten that the cohort of transit customers most dependent on the availability of such services, such as low-income people and the elderly, are still less likely to have Internet access relative to other segments of the population. Providing such information services, including its design, development, operation, and maintenance tasks are usually overseen by a regional transportation/planning authority. For example, the Washington Metropolitan Area Transit Authority (WMATA) has Ride Guide that includes WMATA bus and rail service as well as other bus services operated by neighboring jurisdictions. Another example is in the San Francisco Bay Area and the TakeTransit Internet trip planner sponsored by the Metropolitan Transportation Authority.

By *special event or emergency condition* integration, we mean coordinated multi-organizational policies consisting of an action plan to implement during and/or in response to particular events in order to minimize the negative impact that the occurrence of such events have on the regional

transportation system. Such events may be planned for or at least expected as well as unplanned for with no warning; they may be either natural/weather-related or man-made. Examples of these include 1. Major sporting events like the Olympics and political conventions (planned and man-made), 2. Terrorist attacks (unexpected and man-made), 3. Hurricanes (expected and natural), and 4. Earthquakes (unexpected/unplanned and natural).

Of particular relevance for this project because of its setting is an informal agreement between BART and AC Transit in the San Francisco Bay Area. These two operators are highly interdependent since they have a common clientele for some service areas. This is reasonable because rail is highly dependent on bus feeder services for passengers to reach the rail stations. A busbridge emergency agreement was formulated from an informal agreement, somewhat like a “mutual-assistance pact” between AC Transit and BART approximately 25 years ago. In case of a BART failure on any portion of its rail network that is within AC’s jurisdiction, AC would provide emergency bus service for BART’s customers. The two agencies have worked together on the basis of mutual trust and a strong informal relationship. As a result, greater flexibility and adaptability were achievable with this agreement. The benefits of this busbridge agreement were realized when the BART Transbay tube fire and closure occurred in January 1979. The original agreement provided a set of immediate procedures to deal with the emergency situation. AC Transit dispatched buses to carry BART passengers across the Bay Bridge from the original BART rail stations. Also, since the closure of the Transbay tube lasted much longer than originally predicted, AC Transit chartered private coaches on BART’s behalf and at much lower prices because of AC Transit’s expertise for bus procurement and operation. Transferring the responsibility of bus chartering to AC Transit resulted in large cost savings for BART (15).

Another example of an effective emergency system is the Regional Incident Communication and Coordination System (RICCS) in the metropolitan Washington area. RICCS is designed to allow participating organizations to communicate via conference calling, secure Websites, and wireless communication using Nextel CDPD technology.

### **3.2.2 Policies with an Indirect Impact on Passengers**

By having an *indirect* impact on passengers, we mean policies, when implemented, having a more immediate impact on the business relationships between and among those transit agencies engaging in such policies. Such policies could, over time, be exhibited in more tangible ways with an influence on the direct experience of transit passengers, that is, in terms of the services that these agencies provide to their passengers.

Intra-regional transit agencies, especially adjacent ones with or without overlapping service areas may find it advantageous to work together in ways that could benefit all parties and ultimately the passengers. These coordinated activities may include the following:

- Data sharing
- Joint procurement of equipment
- Joint funding proposals
- Coordinated public information dissemination activities
- Coordinated improvement at intermodal transfer facilities
- Planning and research

### **3.2.3 The Regional Institutional Setting**

These eight primary groupings of service integration are connected by and interact through the *institutional* setting in which they are implemented. Moreover, their success depends substantively on the types of institutional constraints and barriers present. A precursor to successful and effective service integration policies is inter-operator coordination that helps establish the conditions necessary for two or more transit properties to jointly develop a means to integrate some aspect(s) of their services. Initially, there must be a commitment to or interest in system integration by all parties whether it is route, schedule, or fare integration, the setting-up of a transfer facility, or the implementation of an Internet-based transit-trip planning tool. It cannot be overstated how crucially important it is to have the right institutional environment and to have it working in order to have successful, that is, cost-effective, service integration policies and practices. It is argued in (13 and 14) that a necessary condition for effective service integration is to have a regional transportation authority promote various means of integration as

part of its overall regional mobility plan. Such an authority serves the role of regional champion for the service integration cause without which there would be little incentive, other than for purely altruistic reasons, for individual transit properties to promote service integration beyond the boundaries, both physical and operational, of their transit services.

The regulatory environment can play a major role in determining the success of service integration policies. In a completely deregulated or privatized environment, regional transportation planning is often not regularly performed in which case individual transit service providers must shoulder the burden of costs associated with coordination. One can view this as a two-dimensional classification of the level of privatization by the level of system connectivity in which these two characteristics of the regional transit service environment are inversely related to one another (14). The U.S. regulatory environment for the delivery of urban transit services is neither fully regulated nor fully privatized, but rather containing elements of both, that is, regulated spatial monopolies.

The existence of a regional entity, though it has been argued is a necessary condition for service integration, does not necessarily alone suffice to bring about transit service integration. The regional or metropolitan authority must be empowered with a “stick”, e.g., withholding of state funding from transit operators unwilling to cooperate in regional service integration efforts, as well as a “carrot” (helping to pay the costs of implementing coordination activities). In the San Francisco Bay Area, for example, the metropolitan planning organization — the Metropolitan Transportation Commission (MTC) — has been empowered by the state of California through Senate Bill (SB) 1474 in 1996 that supports service integration to promote customer satisfaction and achieve a network of cost-effective regional services. There are, indeed, teeth in this piece of legislation. MTC has been directed to consolidate functions that will improve productivity and enhance service integration in “corridors of regional significance”. Moreover, MTC has the authority to withhold funds from those transit operators unwilling to cooperate with MTC in these efforts.



### **3.3 Identification of Criteria to Use to Select Participants in Project Survey**

The first major milestone for the project is the design and administration of and analysis of findings from a survey of selected public transit agencies around the United States with an emphasis on the goings-on in California. Initially, we will identify a set of criteria to help us select a candidate list of transit-related organizations for follow-up contact and request for participation in the project's survey phase. While the choice of such organizations will focus on transit properties, they will also include other organizations with an interest in public transportation such as the regional MPO. Among candidate participants, criteria will be identified to obtain a cross-section of properties in terms of attributes about the agency, about the regional institutional setting in which the agency exists, and characteristics of the region as a whole. We see from the literature that specific criteria to be considered will include the following (9 - 13):

- Transit Agency Attributes
  - Level of modal diversity, e.g., bus and rail or bus only
  - Size of vehicle fleet for each mode
- Regional Institutional Setting
  - Number of transit agencies and the markets they each serve
  - Existence of single regional transportation authority together with its level of authority and activity toward service integration
  - Interstate vs. intrastate regional differences
  - History and age of the transit system and its component parts; some regional entities were established to build modes while in other cases, the modes were pre-existing independent entities and then a regional body was created to coordinate or oversee the component parts.
- Regional Characteristics
  - Population
  - Geographical layout
  - Level of urbanization

### **3.4 Description of Site-Specific Implementation of Service Integration Policies**

In the literature, there are descriptions of several sites where service integration policies have been put into practice, some of which, however, are located outside the United States, the focus of our work on this project. Within the U.S. a great deal of emphasis has been placed on service integration policies and practices in the San Francisco Bay Area.

The San Francisco Bay Area region appears to be a model laboratory setting for examination of transit service integration because of the existence of a single regional transportation organization that has been very active promoting service integration at least in part because of the statutory authority given it by the California Legislature. Geographically, the region is a nine county area with a population of approximately 6.8 million people spanning approximately 100 miles in length from the wine country of Napa and Sonoma Counties in the north to Silicon Valley area of Santa Clara County in the south, both internationally recognized parts of the region. Since the 1970s, the Metropolitan Transportation Commission (MTC) has been the region's metropolitan planning organization primarily for transportation and in this role has encouraged interoperator coordination and integration of services. In the past 10 to 15 years, MTC has taken deliberate actions in the areas of

- Helping to finance the establishment of regional interchange facilities
- Coordination of schedules between operators
- Provision of a single source of public transportation information
  - TravInfo via the telephone providing connections to over two dozen Bay Area transit agencies
  - Take Transit via the Internet providing trip itinerary planning
- Implementation of a regional fare instrument based on Smart Card technology
  - TransLink

Moreover, as previously stated, the California legislature has specifically empowered MTC with a mandate to promote transit service integration policies (9 - 13).

Another example of transit service integration, in southern California, is the Field Demonstration using Smart Card and other technologies to provide an integrated fare medium across seven transit operators in Ventura County (2 and 4). In fact, multi-agency fare programs using

universal fare media and Smart Card system technologies are among the most common form of service integration policies in use. From the literature we have learned of the following U.S. metropolitan regions that have deployed Smart Card systems. The name of each region's Smart Card program appears in parentheses (16, 17, and 18):

- Ventura County (*GoVentura*)
- San Francisco Bay Area (*TransLink*)
- Washington, D.C. (*SmarTrip*)
- Chicago (*ChicagoCard*)

Another common example of service integration policies are transit trip itinerary planning tools. The name of each region's Trip Planning Tool appears in parentheses (19 and 20):

- San Francisco Bay Area (*Take Transit*)
- Los Angeles (*TranStar*)
- King County, Washington (*Metro Online Trip Planner*)
- Minneapolis-St. Paul (*Metro Transit Trip Planner*)
- Chicago (*Travel Information Center*)
- San Diego (*OTIS-Online Transit Information System*)
- New Jersey (*Trip Planner*)
- Oregon (*Transit Trip Planner*)
- Metropolitan Washington area (*Ride Guide*)

There are numerous other examples of transit trip itinerary planning tools that can readily be identified through a search on the Internet with key search words of "transit trip planners", for example.

The San Gabriel Valley in Los Angeles County in southern California has been the site of a Field Operational Test (FOT) and an evaluation of a Smart Shuttle conducted over a three-year period (1997-2000). The FOT attempted to integrate services from three local municipal public transit operators and a regional fixed-route transit property through the use of intelligent transportation system technologies including networked computer-aided dispatching, automated vehicle

location and mobile data terminals. The integrated system never fully deployed due primarily to institutional constraints and barriers (1 and 3).

### **3.5 Use of Advanced Technologies in the Implementation of Service Integration Policies**

Lack of transit service integration can contribute to reductions in transit use, and consequently has been identified as an important area for advanced transportation technology applications. Advanced technologies can help make transit service integration easier to accomplish as well as provide an incentive to engage in service integration policies and practices. For example, advanced communication systems facilitate the sharing of schedule and passenger information so that transfers between services can be coordinated and more readily achieved. Additional examples of intelligent transportation systems include automated vehicle location and identification systems, automated passenger counter systems, Smart Card technology for fare payment, and bus transit signal priority systems (1, 2, 11, and 13).

### **3.6 General Topic Areas for Questions to Include on the Survey**

Tasks 2 through 4 of the project are all survey-related. They consist of identifying the appropriate transit agencies to participate in and provide responses to the survey, design and administration of the survey, and analyze survey findings. The project team is only interested in transit properties that have either already implemented or have plans to implement service integration policies. For either of these cases, we are mainly interested in the following overall topics from which the institutional survey will be designed and administered:

- Type of service integration policies
- Agency motivation and objectives for implementing or planning to implement these policies together
- Regional institutional setting among transportation organizations including governmental role, level of commitment toward improvement of integration, legal and regulatory issues, institutional approaches, financing, and overall management
- Extent of use of intelligent transportation system technologies for this policy implementation
- Means of measuring the performance of such policies

- Impact such policies have had on the delivery of public transportation services
- Types of data used to quantify impacts
- Lessons learned from such service integration policy deployment experiences

### **3.7 Measures of Performance for Evaluation of Service Integration Policies' Impacts**

After the survey is administered and its responses are analyzed, the project will enter its next phase of collecting data and assessing the impacts of service integration policies and practices. The literature has provided only few examples of cases in which the impacts of service integration policies and practices have been measured, even qualitatively, let alone quantitatively. Where those cases exist, certain performance measures have been used and these measures provide us with input for the impact assessment phase of the project (13 and 21).

Examples include the following:

- Facilitating transfers
  - Number of transfers between coordinated services
  - Time between transfers between coordinated services
  - On-time transfer performance
- Increased passenger flow
- Travel time savings
  - Reduced dwell time
  - Reduced running time
- Operating cost savings
- Enhanced customer convenience/reduced anxiety

The project team will consider these measures of performance as well as others that are deemed appropriate depending on site-specific factors for each case study we conduct.

## **4. NEXT STEPS**

This section describes the activities for the next tasks of the project.

### **4.1 Qualitative Assessment of Transit Service Integration Policies**

The next three project tasks will involve qualitatively assessing what transit service integration policies have been implemented and the impact such policies have had using the survey methodological approach. We are now identifying candidate transit properties to participate in the survey based on criteria such transit property attributes, characteristics of the region as a whole, such as its population, and metropolitan areas with multiple transit properties within that area or in adjacent areas. Our objective is to focus on California and select up to three additional targeted regions outside the state to which the survey will be administered. We will then design and administer the survey instrument to representatives of the transit properties previously identified after which we will analyze the survey's responses. An important part of the survey will be questions related to whether properties have collected sufficient data in order to measure quantitatively the impact such policies and practices have had on transit services, as the project's next set of tasks after the survey will involve performing a quantitative assessment of service integration practices where such data exists.

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