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TCRP Synthesis 19

Passenger Transfer System Review

A Synthesis of Transit Practice

Transportation Research Board
National Research Council

TRANSIT COOPERATIVE RESEARCH PROGRAM

Synthesis of Transit Practice 19

Passenger Transfer System Review

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TRANSIT COOPERATIVE RESEARCH PROGRAM

The nation's growth and the need to meet mobility, environmental, and energy objectives place demands on public transit systems. Current systems, some of which are old and in need of upgrading, must expand service area, increase service frequency, and improve efficiency to serve these demands. Research is necessary to solve operating problems, to adapt appropriate new technologies from other industries, and to introduce innovations into the transit industry. The Transit Cooperative Research Program (TCRP) serves as one of the principal means by which the transit industry can develop innovative near-term solutions to meet demands placed on it.

The need for TCRP was originally identified in *TRB Special Report 213--Research for Public Transit: New Directions*, published in 1987 and based on a study sponsored by the Federal Transit Administration (FTA). A report by the American Public Transit Association (APTA), *Transportation 2000*, also recognized the need for local, problem-solving research. TCRP, modeled after the longstanding and successful National Cooperative Highway Research Program, undertakes research and other technical activities in response to the needs of transit service providers. The scope of vice configuration, equipment, facilities, operations, human resources, maintenance, policy, and administrative practices.

TCRP was established under FTA sponsorship in July 1992. Proposed by the U.S. Department of Transportation, TCRP was authorized as part of the Intermodal Surface Transportation Efficiency Act of 1991 (ISTEA). On May 13, 1992, a memorandum agreement outlining TCRP operating procedures was executed by the three cooperating organizations: FTA, the National Academy of Sciences, acting through the Transportation Research Board (TRB), and the Transit Development Corporation, Inc. (TDC), a nonprofit educational and research organization established by APTA. TDC is responsible for forming the independent governing board, designated as the TCRP Oversight and Project Selection (TOPS) Committee.

Research problem statements for TCRP are solicited periodically but may be submitted to TRB by anyone at anytime. It is the responsibility of the TOPS Committee to formulate the research program by identifying the highest priority projects. As part of the evaluation, the TOPS Committee defines funding levels and expected products.

Once selected, each project is assigned to an expert panel, appointed by the Transportation Research Board. The panels prepare project statements (requests for proposals), select contractors, and provide technical guidance and counsel throughout the life of the project. The process for developing research problem statements and selecting research agencies has been used by TRB in managing cooperative research programs since 1962. As in other TRB activities, TCRP project panels serve voluntarily without compensation.

Because research cannot have the desired impact if products fail to reach the intended audience, special emphasis is placed on disseminating TCRP results to the intended end-users of the research: transit agencies, service providers, and suppliers. TRB provides a series of research reports, syntheses of transit practice, and other supporting material developed by TCRP research. APTA will arrange for workshops, training aids, field visits, and other activities to ensure that results are implemented by urban and rural transit industry practitioners.

The TCRP provides a forum where transit agencies can cooperatively address common operational problems. TCRP results support and complement other ongoing transit research and training programs.

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The members of the technical advisory panel selected to monitor this project and to review this report were chosen for recognized scholarly competence and with due consideration for the balance of disciplines appropriate to the project. The opinions and conclusions expressed or implied are those of the research agency that performed the research, and while they have been accepted as appropriate by the technical panel, they are not necessarily those of the Transportation Research Board, the Transit Development Corporation, the National Research Council, or the Federal Transit Administration of the U.S Department of Transportation.

Each report is reviewed and accepted for publication by the technical panel according to procedures established and monitored by the Transportation Research Board Executive Committee and the Governing Board of the National Research Council.

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PREFACE

A vast storehouse of information exists on many subjects of concern to the transit industry. This information has resulted from research and from the successful application of solutions to problems by individuals or organizations. There is a continuing need to provide a systematic means for compiling this information and making it available to the entire transit community in a usable format. The Transit Cooperative Research Program includes a synthesis series designed to search for and synthesize useful knowledge from all available sources and to prepare documented reports on current practices in subject areas of concern to the transit industry.

This synthesis series reports on various practices, making specific recommendations where appropriate but without the detailed directions usually found in handbooks or design manuals. Nonetheless, these documents can serve similar purposes, for each is a compendium of the best knowledge available on those measures found to be successful in resolving specific problems. The extent to which these reports are useful will be tempered by the user's knowledge and experience in the particular problem area.

FOREWORD

By Staff
Transportation
Research Board

This synthesis will be of interest to transit agency general managers, and agency staff in customer service, operations, budget, marketing, and financial divisions. It offers user information on a variety of transit agencies' approaches to transfer programs. Policy and operational issues, service design, and transfer automation are discussed, based on the experience of transit agencies in the United States and in Europe.

Administrators, practitioners, and researchers are continually faced with issues or problems on which there is much information, either in the form of reports or in terms of undocumented experience and practice. Unfortunately, this information often is scattered or not readily available in the literature, and, as a consequence, in seeking solutions, full information on what has been learned about an issue or problem is not assembled. Costly research findings may go unused, valuable experience may be overlooked, and full consideration may not be given to the available methods of solving or alleviating the issue or problem. In an effort to correct this situation, the Transit Cooperative Research Program (TCRP) Synthesis Project, carried out by the Transportation Research Board as the research agency, has the objective of reporting on common transit issues and problems and synthesizing available information. The synthesis reports from this endeavor constitute a TCRP publication series in which various forms of relevant information are assembled into single, concise documents pertaining to a specific problem or closely related issues.

This report of the Transportation Research Board documents a wide diversity in implicit transfer policies and many different approaches used at selected transit agencies. It covers practices dealing with restricting or allowing back riding or stopovers, fare levels, and alternatives to transferring.

To develop this synthesis in a comprehensive manner and to ensure inclusion of significant knowledge, available information was assembled from numerous sources,

including a number of public transportation agencies. A topic panel of experts in the subject area was established to guide the researchers in organizing and evaluating the collected data, and to review the final synthesis report.

This synthesis is an immediately useful document that records practices that were acceptable within the limitations of the knowledge available at the time of its preparation. As the processes of advancement continue, new knowledge can be expected to be added to that now at hand.

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Valuable assistance in the preparation of this synthesis was provided by the Topic Panel, consisting of Carm Basile, Director of Information, Capital District Transportation Authority, Albany, New York; Fred M. Gilliam, Deputy General Manager, Transit Services, Metropolitan Transit Authority of Harris County, Houston, Texas; Randall H. Kresley, Manager, Route Development and Contract Service, Lehigh and Northampton Transportation Authority, Allentown, Pennsylvania; Stephen Oller, Superintendent of Transportation, Riverside Transit Agency, Riverside, California; Richard Pain, Transportation Safety Coordinator, Transportation Research Board; Sean Ricketson, Transportation Program Specialist, Federal Transit Administration; and Richard L. Ruddell, General Manager, Toledo Area Regional Transit Authority, Toledo, Ohio.

The Principal Investigators responsible for the conduct of the synthesis were Sally D. Liff, Manager, Synthesis Studies, and Donna L. Vlasak, Senior Program Officer. This synthesis was edited by Linda S. Mason.

Valuable assistance to the Topic Panel and the synthesis staff was provided by the TCRP Committee for Project J-7 and by Gwen Chisholm Smith, Senior Program Officer, Transit Cooperative Research Program, Transportation Research Board.

Information on current practice was provided by many transit agencies. Their cooperation and assistance were most helpful.

PASSENGER TRANSFER SYSTEM REVIEW

SUMMARY

The various elements of a transfer system, for example, policy, operating characteristics, cost, and time are often subjects of concern for transit customers, bus operators, and managers. Issues such as transfer charges and rules, convenience, and transfer instruments need to be considered by agencies in developing policies appropriate to their goals and objectives.

In the ideal world, transfers would be a continuation of the journey, not an inconvenience. Transfer rules would be well understood and accepted. In the real world, however, transit agencies must compromise between passenger convenience, operating requirements, and cost.

This synthesis of practice regarding transfer programs provides information to the industry on a variety of approaches used by transit agencies. A survey of selected transit agencies in the United States and Canada provided information on the following issues:

- Agency policy with regard to use, implementation and control of transfers, including goals and objectives,
- How transfer policy is developed,
- Fare structures and cost of transfers,
- Fraud experience,
- Design and format of the transfer instrument,
- Elapsed time of transfer period,
- Stopover policy,
- Service design to minimize difficulty in transferring between vehicles,
- Convenience to customer, such as the distance customer has to walk, and
- Automation.

Considering that so many transit passengers must connect between vehicles to complete their journey, there is a surprising lack of information on transferring. No national-level data have been compiled on what percent of passengers must transfer, although most transit agencies collect information at a local level.

Most agencies have not considered transfer rules as part of their overall service delivery philosophy. Transfer rules typically are well defined for operating personnel, however, in most cases the rules have developed over a number of years in ad hoc response to operating problems. It is very rare to find that a transit agency has a formalized policy, as compared to rules for governance of bus drivers. Where policy is considered, it most often relates to whether and how much to charge for the transfer "privilege."

Survey respondents reported wide diversity in their implicit transfer policies. They have many different approaches to such issues as:

- Restricting or allowing back riding or stopovers; most restrict these to some extent.
- Fare levels; most don't charge for transfers.
- Alternatives to transferring; several respondents have all-day passes in place of, or in addition to traditional transfers.

Even so, the majority expressed satisfaction with the way their transfer system was functioning. This indicates that each transit agency has probably done a good job in designing its transfer systems to its perceived needs.

Transit agencies generally believe that passengers won't transfer more than once in a journey. Some make an active effort to schedule service to reduce waiting time, especially at night when passengers waiting on isolated street corners may be at risk. Interlining or "through routing" is used to reduce transferring, although operating considerations are also important.

All of the respondents provide some type of shelter for passengers at selected locations. These range from simple awnings to large buildings with off-street loading areas, heating and air conditioning and other amenities.
Applying technology to transfers seems to fall into two areas:

- Dynamic scheduling to reduce waiting time and "protect" (guarantee) connections.
- Automation of the transfer slip issuance and acceptance function.

Dynamic transfer protection was found only at two transit agencies, and then in relation to paratransit service. However, there have been several implementations of such systems in Europe. With the spread of automatic vehicle location technology through the transit industry, it appears that dynamic transfer protection would be an ideal application to consider, especially if it can reduce the amount of paratransit service required.

Several transfer issuing/accepting devices have been utilized. Most recently these have relied on magnetic stripe technology. Transfers are encoded with information about the originating bus and route. These data are displayed to the driver on the receiving bus, and some validity checks are made. These systems have achieved an acceptable level of reliability, however, establishing the software and operating "logic" can be an arduous process.

CHAPTER ONE

INTRODUCTION

To travel from origin to destination, many transit passengers must transfer from one bus to another. This synthesis was undertaken to identify the types of transfer policies and systems in use at North American transit agencies.

ORGANIZATION

This introduction provides an overview of the methodology used to collect data, an overview of survey respondents with respect to the total transit market, and an overview of transfer use.

Chapter 2, Transfer Policy Issues, examines agency policies with regard to use, implementation, and control of transfers. Design and format of the transfer, fare structures and cost of transfer, dissemination of customer information, and policies related to vehicle holding time are discussed.

Chapter 3, Service Design, focuses on implementation of the policies in revenue service. Location and design of transfer points, fraud experience, and passenger wait times and walking distance between transfer stops are discussed in detail.

Chapter 4, Transfer Automation, shows that automation technology is in the early phases of implementation at a few agencies. Automation strategies include service design (coordinating transfers through scheduling and "dynamic" control of service) as well as machine issuance and processing of the transfer document.

Chapter 5 presents conclusions drawn from the study and includes areas of potential improvement in transfer system design.

BACKGROUND

A peer survey was the primary means of collecting data used to develop this synthesis. The survey questionnaire is included in Appendix A (a somewhat simplified survey was used for those agencies that do not have interagency or intermodal services). The selection of agencies to survey reflects the diversity of the transit industry in range of size and operating styles.

Where appropriate, follow-up phone calls were made to clarify information from some agencies. In several cases, site visits were made to investigate new systems.

A profile of the type of agencies surveyed is shown in Table 1. Appendix B provides a list and profile of the individual survey respondents.

Fifty-eight percent of the surveyed agencies responded--this group represents roughly one-fifth of the U.S. fixed-route motor bus industry. Table 2 provides a profile of the survey respondents, as compared to the total U.S. bus industry (1993 statistics).

TABLE 1
TYPES OF AGENCIES SURVEYED

Agency Category	Surveys Distributed	Survey Respondents
Bus Operator Only	41	23
Multi-modal Operator	12	8
Total	53	31

TABLE 2
SURVEY RESPONDENTS PROFILE

	Survey Group	Percent of U.S. Total
Bus Revenue	$529 million	17
Passenger Boardings	1.1 billion	20
Buses operated	14,000	22

CHAPTER TWO

TRANSFER POLICY ISSUES

NEED FOR TRANSFERS

There will always be a need for transfers in public transit as long as one or both of the following conditions prevail:

- Single point-to-point transit service is not available to all locations required by ridership;
- Different modes of transit are required to go from the point of origin to the destination.

With many transit agencies down-sizing and cutting service, there may be a greater need for transfers and formalized policies in the future.

Respondents' passengers transfer primarily from bus to bus (208 million) and bus to rail (111 million). There are virtually no transfers between paratransit or van pool and other modes. This is not surprising, as paratransit and van pools should be "point-to-point" services in most cases. However, as ADA requirements take hold and operating budgets are squeezed, it seems likely that more transferring could take place with paratransit.

There may also be "hidden" transfers between van pools and transit, as some van pools are oriented to rapid transit or busway stations rather than employment locations. Because van pool passengers must pay a fare when riding transit, information on van pool use to feed the transit system is lost.

Figure 1 shows the percentage of respondents' passengers that transfer. The chart indicates a relatively wide dispersion in the percentage of riders transferring.

It is not possible to compare these transfer volumes to national trends to determine if the sample is representative. The National Transit Database (formerly Section 15) data collected and reported by the Federal Transit Administration (FTA) does not include such data, and no other national-level data were found.

TRANSFER POLICY

Transfer policy reflects an agency's goals and objectives, and provides the guidepost for the transfer rules and the actual transfer process. One of the survey objectives was to determine the types of policies that transit agencies use to guide them in setting transfer rules. As shown by Figure 2, most transit agencies claim to have a formal policy on transfers.

However, review of the sample transfer policies provided by respondents indicates that most transit agencies confuse transfer *policy* with transfer *rules.* In fact, only three of the respondents provided documents that seemed to specify goals and objectives of the transfer system in relation to passenger or operating convenience, revenue generation, or other factors.

Transit agencies' comments in the survey indicate they don't consider transfer *policy* an issue, particularly compared with the problems of providing service each day. Nor do they consider that a policy on transferring could allow them to enhance their service by considering the effect on transferring passengers when service changes are made. Yet, there is a pitfall in this approach; there is an evident dichotomy between generating revenue from transfers versus improved mobility for the public and increasing total ridership. As one or the other larger objective takes hold, the transfer system will change, often with unanticipated consequences.

However, transfer policy is implicit in any set of transfer rules. Yet the possibility exists that in the absence of a stated policy, transfer rules may contradict other agency goals and objectives.

The most common transfer policy objectives were identified through an informal interview process and compiled on the survey questionnaire. The survey asked respondents to rank each objective's importance. Figure 3 summarizes the responses. The respondents' philosophy on transfers seems to be heavily oriented to passenger' convenience (Table 3), although driver imput weighs heavily in developing transfer policy. Sometimes passenger and driver inputs are combined. Drivers deal directly with the shortcomings of transfer rules, since they have to deal with passengers who abuse the system. Transit agency "culture" can produce an overly protective driver attitude toward the system, which can result in conflicts and assaults. At the other exteme, some drivers (and unions) make it clear they want nothing to do with enforcement.

Transit transfers are sometimes compared to the "hub and spokes" system adopted by airlines in the 1980s. As new hubs were opened, airlines often advertised the convenience of connecting through them. Many transit agencies have suburban transit centers where numerous routes converge. However, it seems that few of these have adopted "airline style" advertising to promote the transit center.

Few (24 percent) of the respondents have marketing programs for transfers. Respondents described their marketing as including:

- No charge for transfers,
- Longer usage periods,
- Guaranteed transfer opportunities and connections,
- Transfer privileges through passes, and
- Reboarding permitted on the same route.

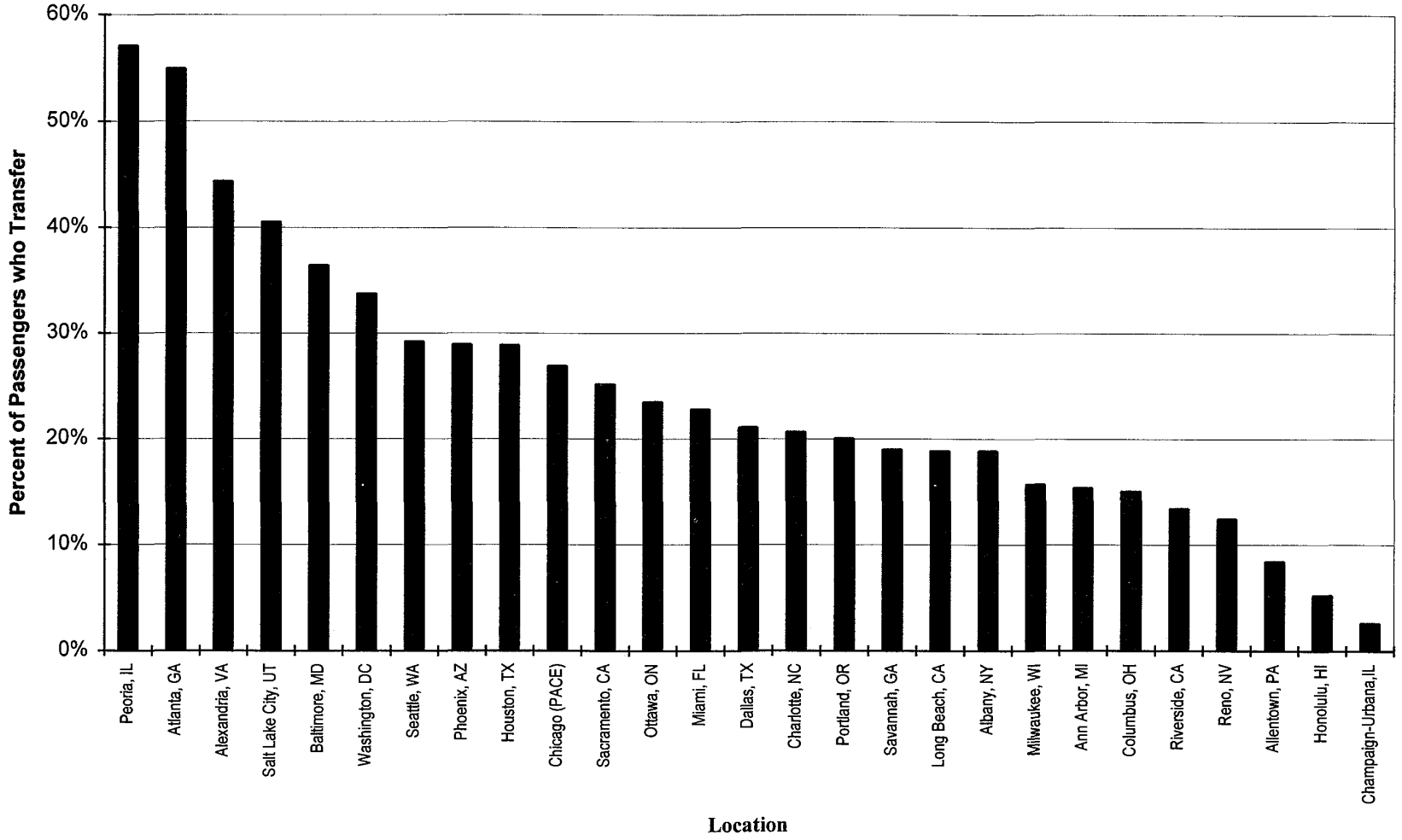


FIGURE 1 Percent of passengers transferring.

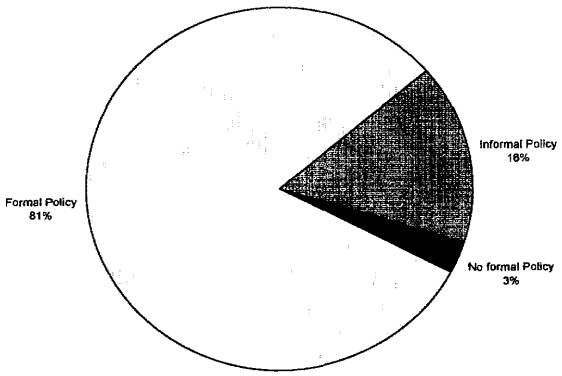


FIGURE 2 Responses: Do you have a transfer policy?

These are more service design than promotion, indicating that promotion of transfer locations is not considered viable in transit. Marketing is considered inherent in the design of the transfer program.

The survey group was also asked if their transfer policy was successful. (The success rating was based on the agencies' own definition of success.) A majority of respondents (78 percent) rated their transfer policy a success when measured against their objectives. There did not appear to be any correlation between objectives of the transfer system, design of the system, and the respondents' evaluation of its success.

TABLE 3
TECHNIQUES USED TO DEVELOP TRANSFER POLICY

Technique	Number of Respondents	Percent of Respondents
Driver input	16	32
Public hearings	11	22
Market surveys	9	18
Passenger focus groups	5	10
Historical practice	3	6
Employee input	2	4
Research other properties	2	4
Informal passenger input	1	2

Table 4 lists respondents' reasons for believing their transfer system to be successful or unsuccessful. Most respondents have not changed their transfer policy in the last 3 years. As with the rating of the transfer policy success, the reasons respondents provided for policy changes coincided with the objectives listed in Figure 3. Table 5 ranks reasons for changing the transfer policy and the expected results. Transfer rules may change without affecting the policy, but when the transfer policy changes, transfer rules must change with it.

Respondents were also asked if they provide written guidelines to drivers. Sixty-two percent provide written rules. Several respondents provided sample guidelines. These ranged from simple memos to very detailed books of operating instructions of up to several hundred pages. The longer

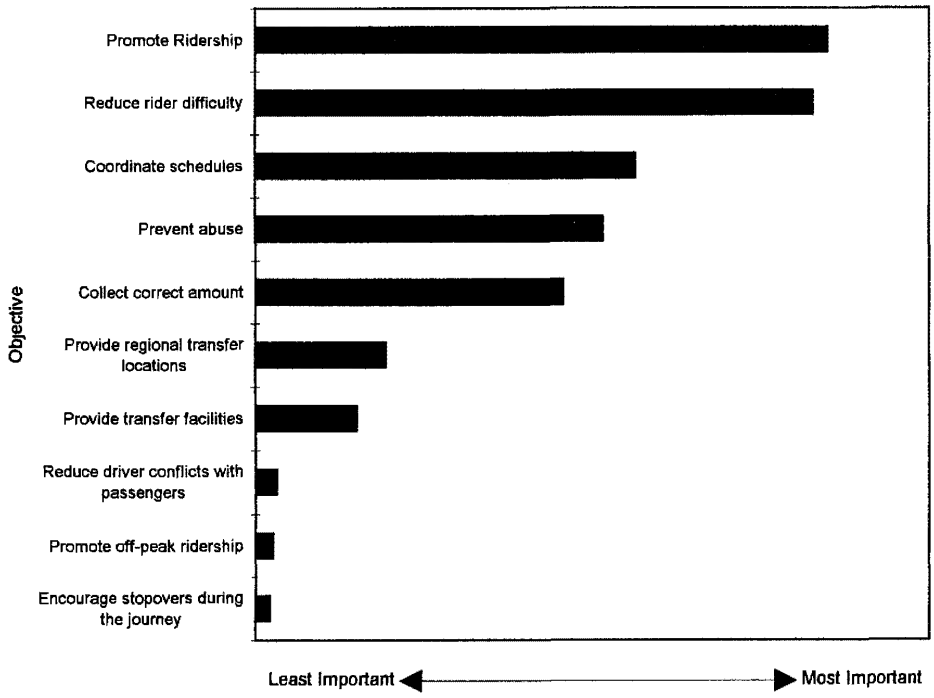


FIGURE 3 Transfer systems objectives, ranked by importance.

TABLE 4
RATING OF TRANSFER POLICY SUCCESS

Reason-Successful or Unsuccessful	Number of Respondents	Percent of Respondents
Successful		
Simplified transfer process	6	19
Better coordination of connections	1	3
Written policy provides clear guidelines	1	3
Encourage round tripping	1	3
Charging for transfers	1	3
Unsuccessful		
System encourages abuse	3	10
Too many driver confrontations with riders	1	3
No response	15	48

TABLE 5
TRANSFER POLICY CHANGES

Change Made	Reason for Change or Expected Result	Number of Respondents	Percent of Respondents
Change in time period	Increase convenience to encourage ridership	3	30
Added new transfer media/category	Accommodate other modes of transport and other agencies	2	20
Eliminated directional restrictions	Simplify use	2	20
Printed date on transfers	Reduce abuse	1	10
Charge for transfers	Minimize abuse	1	10
Created formal policy	Did not have one	1	10

documents provide route-by-route guidance to operators, and transfer rules are only a small portion.

Simpler transfer systems often consist of guidelines printed on the back of the transfer itself. The agencies using day passes (discussed below) do not need to provide detailed instructions to bus operators; this is one of the advantages of the day pass. However, experience in a number of agencies with traditional transfer systems shows that detailed guidelines are often required to formalize the transfer policy. This becomes even more important in large transit agencies with different fares, complex route structures, or interchanges with rail or other bus operators. If a bus is crossing many other routes with different fare zones or express charges, the potential for making round trips without paying a second fare exists. A driver must be given detailed instructions on how to enforce the rules at each location.

One transit agency pointed out a conflict of interest in enforcing transfer rules. The transit agency is interested in maximizing ridership. Yet, enforcing the transfer rules is equivalent to charging some passengers a higher fare, and this can reduce ridership.

FARES AND TRANSFER PRICING

Fare Levels

Eight (26 percent) of the respondents charge for a transfer. On average, the transfer charge is about eleven percent of the basic fare.

Figure 4 shows the relation between the basic fare and the fare charged for the elderly and disabled. Respondents have adopted three policy variations:

- Free transfers for elderly and disabled passengers,
- Elderly and disabled passengers discount equivalent to half the base fare, rounded to the closest five cents, and
- No discount.

For comparison, federal law mandates that fares for the elderly and disabled be one-half of adult base fare. Nationally, this has been implemented with an average elderly and disabled fare of 48 percent of basic adult fares.

Figure 5 shows the relationship between basic fare and transfer charge. While it appears that transfer charges tend to be applied more often as fares increase, the relationship is not a strong one. Relatively few of the respondents charge for transfers.

Most of the respondents have some type of prepayment program such as passes or multi-ride tickets. Fifty-nine percent of the respondents report that they include the transfer privilege in the prepaid fare; 23 percent require an additional prepaid fare. Eighteen percent use both policies. In most cases, the transfer privilege is included in passes, whereas passengers with tickets are assessed an additional transfer charge. Eighteen percent have a combination of policies, depending on what type of fare instrument the passenger has purchased.

The reasons for assessing an additional transfer charge for prepaid passengers are summarized in Table 6. Most often,

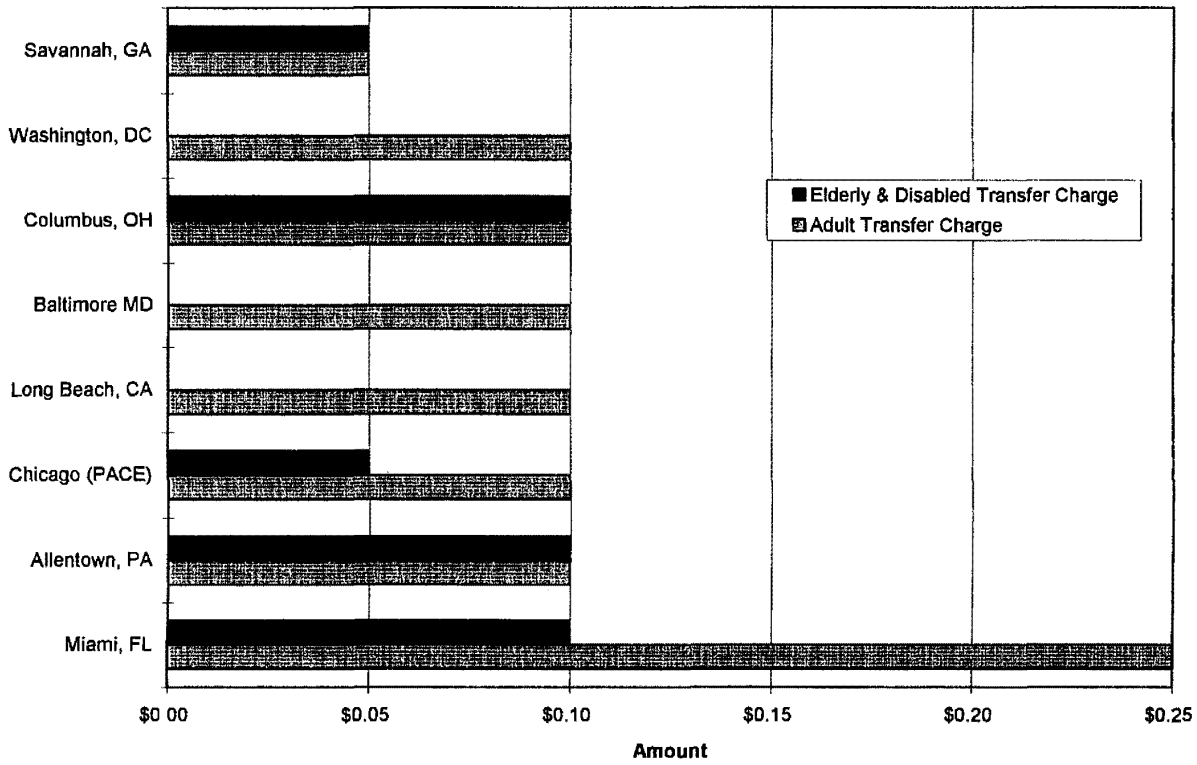


FIGURE 4 Transfer charges for elderly and disabled.

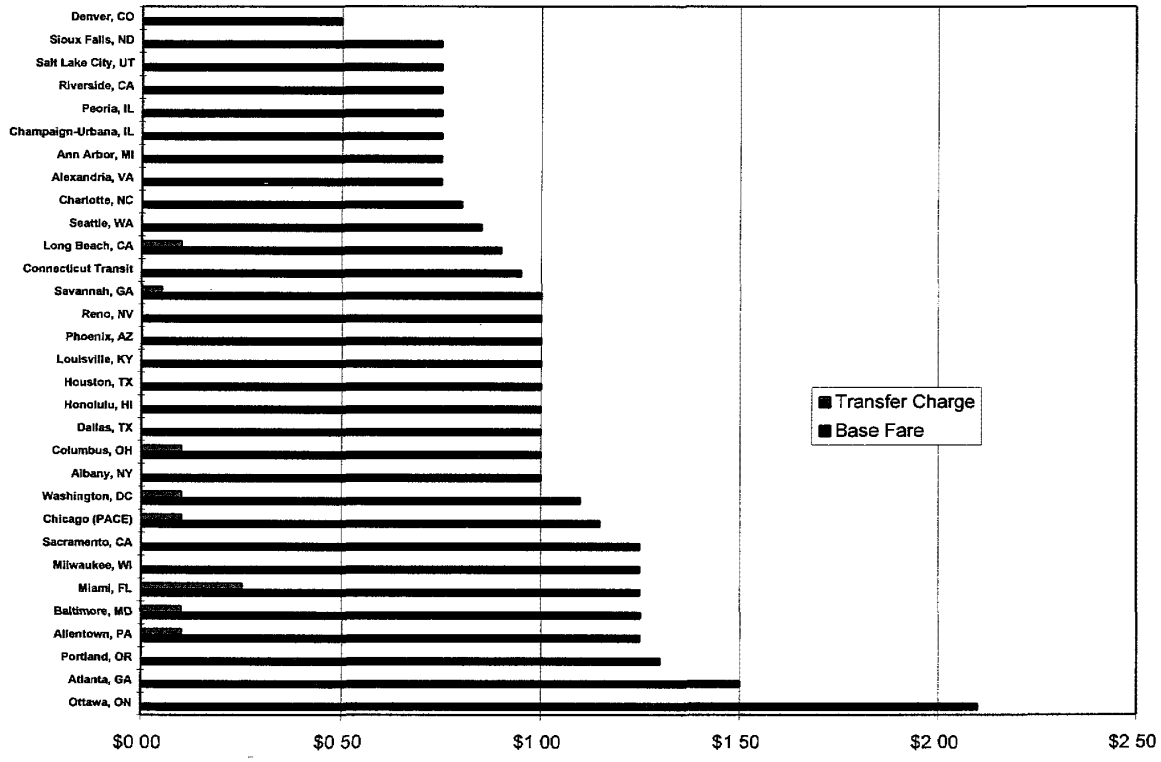


FIGURE 5 Base fare and transfer charges.

TABLE 6
REASONS FOR ADDED TRANSFER CHARGE

Reason	Number of Respondents	Percent of Respondents
Transfer to other agency or mode requires an additional charge	2	25
Multi-ride tickets require a transfer charge	2	25
Difference in fare must be paid in second or third zone	1	13
Transfer from local to premium zone	1	13
Transfer free for school tickets	1	13
Fee required for crossing service boundary or zone	1	13

additional charges are imposed to upgrade to premium services (for example, a passenger may board a downtown circulator with a low fare to get to the boarding point for an express bus). In other cases, the additional charge substitutes for a zone charge on a distance-based tariff.

Only 25 percent of the respondents charge different transfer fees for different services (Table 7). In most cases this is an add-on for transferring to express service.

Nineteen percent of the respondents have changed their transfer fees in the last 3 years. Respondents indicated these changes had been made to accommodate interagency transfer and to increase revenue.

TABLE 7
TRANSFER PREMIUM CHARGES

Reason for Premium Charge	Number of Respondents	Percent of Respondents
Transfer from local to express service	5	50
No transfers from downtown circulator	1	10
Interagency transfer	1	10
No response	3	30

Round-Tripping And Stopovers

Some passengers can be very creative in finding ways to "cheat the system" One of the easiest ways is to board a bus inbound and request a transfer, then use the transfer to board an outbound bus and return to the point of origin without paying a second fare. This is called round-tripping.

Transit agencies with many parallel routes (or rail lines where direction of travel often can't be controlled) are especially vulnerable to this type of abuse. Traditionally, transit agencies (and their private-sector predecessors) have taken strict precautions to prevent round-tripping, especially where the same route is used inbound and outbound. Most of the survey respondents do not allow any form of round-tripping (Figure 6). Several agencies allow round-tripping, primarily

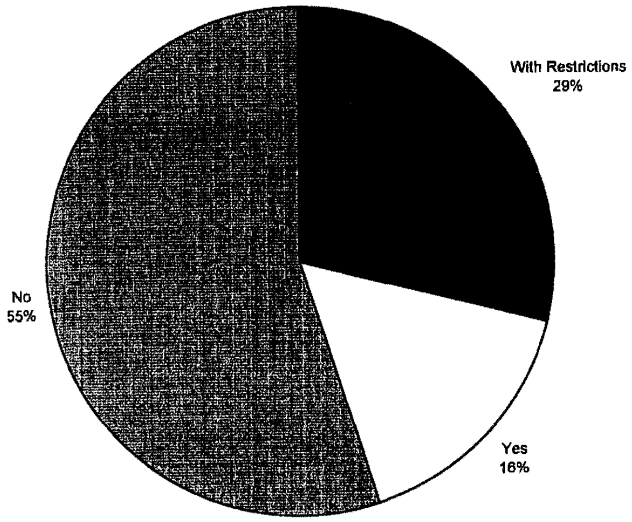


FIGURE 6 Round tripping allowed?

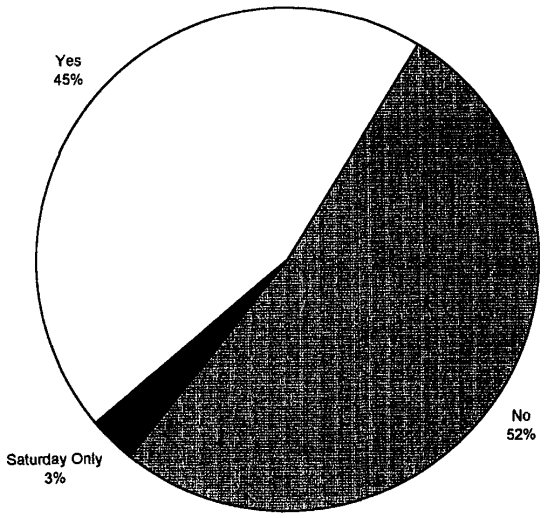


FIGURE 7 Agencies allowing stopovers.

during weekends and off-peak periods when the objective is to generate ridership rather than generate revenue.

Another form of abuse is the stopover. In this case, the passenger gets off the bus enroute and later reboards a bus on the same route going in the same direction. Half of the respondents do not allow this. Those that do commented that the passenger must reboard a bus to continue the journey within the time allowance of the transfer (Figure 7).

Transfer Time Limits

Almost all of the agencies set a time limit on the use of the transfer. In most cases, expanding or contracting the time limit

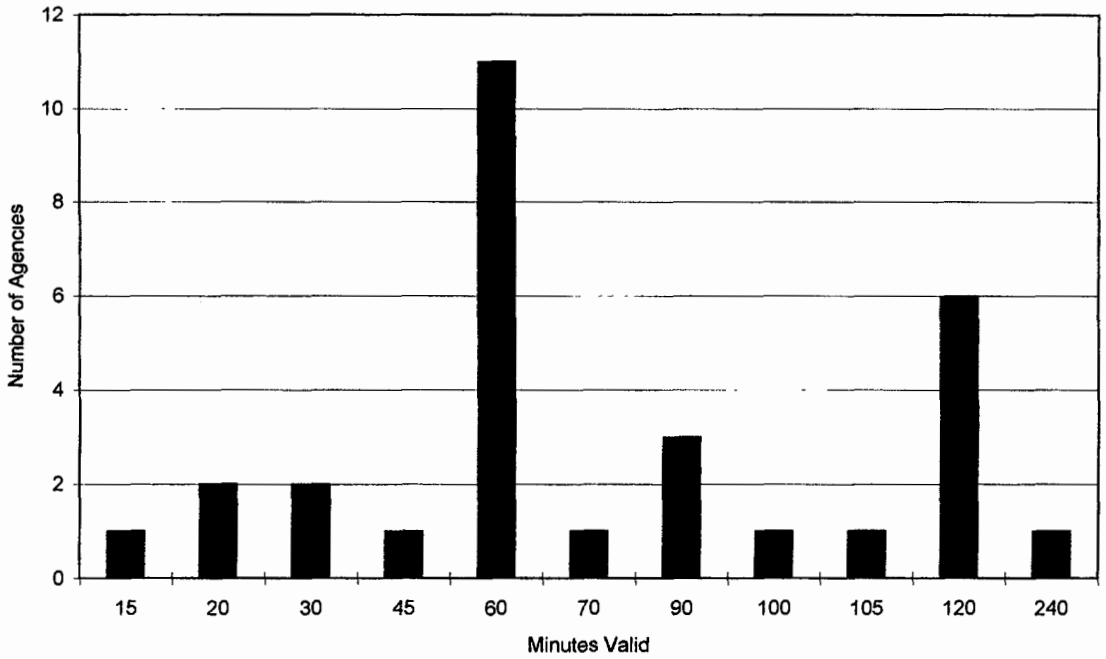


FIGURE 8 Transfer time limits.

has a major impact on the transfer system and customers' ability to make connections. The service schedule also impacts the time limit. A short time limit might be set in an agency that has frequent service, and a longer time limit to routes that operate infrequently. Some agencies overcome this by having drivers cut or punch the transfer for the arrival time downtown. Then the next outbound bus will accept the transfer, regardless of the time limit.

Most of the respondents allowed 60 minutes for passengers to complete their transfer, though there is a great deal of variation, as shown in Figure 8.

FRAUD EXPERIENCE

Transit drivers often complain about passengers abusing transfers. An informal survey was conducted to determine transit authorities' most common types of transfer fraud exposure. Some examples include:

- Passengers who don't need a transfer will get one anyway, then give it to a boarding passenger or a friend after leaving the bus. (Some agencies have reported telephone poles papered with transfers at major stops.)
- Passengers will try to use an expired transfer. Passengers can be very creative about this, punching additional holes, marking up an old transfer to look like it was issued on the current day, etc.
- Passengers will sometimes "pass back" a transfer, passing it out the window of the stopped bus to another boarding passenger.
- Passengers stealing transfer pads from the bus, in some cases with the driver's connivance.
- Transfer counterfeiting rings, encouraged by the fact that transfers are typically printed on cheap, low security newsprint paper. They are easy to duplicate, using a photocopy machine or simple printing equipment.

Some of these problems aren't unique to transfers; any fare medium can be abused, counterfeited, or sold.

The results of the informal survey were compiled into a list, and the respondents were asked to rate them on a 1 to 5 scale. Table 8 summarizes the responses. According to the survey results, the two most serious fraud problems are passing on unused transfers to other passengers and the use of expired transfers. Most other types of fraud are negligible, or reflect the agency's particular operating environment. None of the fraud problems was rated "5", indicating that transfer fraud is not considered a serious problem by the respondents.

Only eight of the respondents had estimated revenue losses due to transfer fraud. Their estimates average less than one percent of passenger revenue. None of the respondents had done any formal study of transfer revenue losses, so their data are based on opinion, drivers' reports of problems, or similar sources.

For any fraud problems rated "3" or "4," the respondents provided insight into the countermeasures that are being taken. Table 9 summarizes countermeasures that respondents have taken to decrease the effects of transfer fraud. Some agencies provided more information on their countermeasures as follows:

- Implement new transfer policy.
- Provide operator bulletins and training.
- Operator observations with undercover spotters and supervisors, in some cases coupled with stronger discipline.

TABLE 8
HOW TRANSIT AGENCIES RATE TRANSFER FRAUD PROBLEMS

Types of Transfer Fraud	Number of Transit Agencies Rating Fraud on a Scale of Negligible 1	2	3	4	Serious 5
Passing on unused transfer to boarding passenger	7	7	12	4	
Using of expired transfers	9	5	10	6	
"Pass-back"	11	10	8	1	
Stealing transfers	15	9	3	2	
Round tripping	6	6	3	2	
Employee selling transfers	20	8		1	
Counterfeit transfers	23	5		1	
Stop-overs	8	7	4		
Drivers not collecting transfer charges	15	3			
Drivers not collecting transfers			1		

TABLE 9
TRANSFER FRAUD COUNTERMEASURES

Countermeasures	Number of Respondents	Percent of Respondents
Increased fare inspection	3	14
Increased driver observation	3	14
No successful solution to round tripping	3	14
Retraining of operators on policy	2	9
Increased supervision and coordination with police	2	9
Addition of bus spotters and adoption of magnetic media	1	5
Evaluating use of additional technology	1	5
Collect transfers	1	5
Different graphics on transfer to simplify inspection	1	5
Limiting transfer use to specific direction-route	1	5
Passenger education campaigns	1	5
Implemented transfer charge	1	5

- Improve the design of the transfer to make it easier for the operator to see and determine validity. One agency developed a specialized transfer aimed at specific points and directions.
- Change transfer policy: reduce the time for which transfers are valid; require passengers to relinquish any used transfer to the operator and require the operator to visibly destroy and discard the transfer; and implement a transfer charge (if transfers previously were free).
- Stepped up observation at major transfer points. One agency used a boarding team of officers to spot check affected routes and runs.
- Coordinate with the police, including investigation and recording street sales with videotape and "stings."
- Improve passenger education and information.
- Convert to 'TRiM" or similar automated equipment that can issue and read magnetically encoded transfers.

Despite the variety of countermeasures employed by the respondents, success is not automatic. Several of the agencies were clearly frustrated with the persistence of transfer fraud, despite countermeasures.

While most of the respondents (87 percent) experience driver-passenger disputes involving transfers, 64 percent of the responses classified such disputes as "not serious," that is not resulting in injury or major altercation. Some agencies report that drivers perceive a direct relationship between their own job security and pay and being able to collect all transfer charges. If this is the case, the drivers become too aggressive about collecting transfer charges or enforcing rules that passengers may or may not understand.

Many respondents had taken similar steps to reduce the potential for confrontation between drivers and passengers. Better driver training is the most common approach. Several agencies have established human relations courses for drivers. These can include small group sessions with a psychologist/instructor, role playing, and interaction with passengers, as well as written materials. Some of these courses have been implemented with union cooperation in response to assaults on drivers. Course substance goes beyond the problem of invalid transfers, but disputes over transfers can lead to confrontations between drivers and passengers and prevention of such incidents is always preferred.

Table 10 shows some of the things transit agencies have done to deal with driver/passenger disputes over transfers.

In addition to improved training, transit agencies have taken other actions, including:

- Improving passenger information on transfer and other transit policies, using brochures, signs, etc.
- Increased use of transit supervisors and police to intervene in conflict situations.
- Aggressive prosecution of transfer abusers.
- Instructing operators not to argue over the validity of a transfer. Instead they are to accept the transfer and warn the passenger in a courteous manner.
- Upgrading radio system, or establishing new procedures to give priority to calls over transfer disputes.
- Installing randomly assigned TV cameras on buses.
- Extending a "grace period" after the transfer expires for 15 minutes or so.

TABLE 10
ACTIONS TO REDUCE CONFRONTATIONS OVER TRANSFERS

Action	Number of Respondents	Percent of Respondents
Driver training	6	15
Simplified/clarified transfer policy	5	13
Educated riders	2	5
Upgraded technology	2	5
Encourage riders to call complaint line	1	3
Operators instructed to call Communications Center	1	3

- Telling passengers to pay the fare and call on the complaint line.
- Providing operators with a supply of tokens. Operators may use a token and pay customer's fare if necessary.

In discussions with transit managers over the years, there has been disagreement whether to print and track serial numbers on transfers. Proponents argue that drivers should be assigned transfers by serial number to prevent theft or counterfeiting of transfers. However, this creates a significant amount of record keeping and it is rare for transit agencies to actually follow up on the information. Figure 9 summarizes respondents' policies on serializing and tracking transfers.

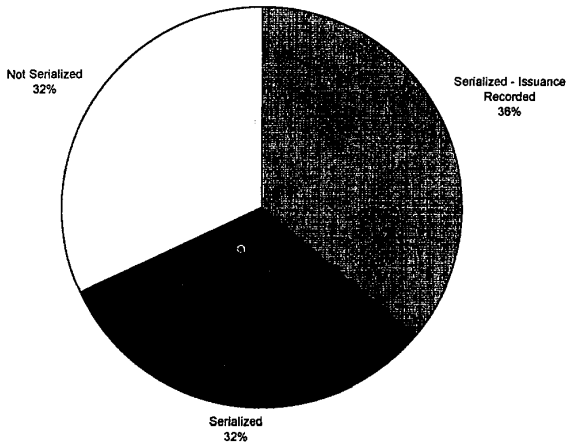


FIGURE 9 Transfer serial numbers.

Most agencies use historical data to determine how many transfers of each type to assign to drivers. Other methods used are: surveys and boarding counts, refill requirements for automated ticket machines, farebox data, and estimation when reordering stock.

Transit agencies sometimes recycle transfers, either by letting drivers keep them to issue on a subsequent day, or by turning them in to the garage and reissuing on another day. Dated transfers make this impossible, but undated and "letter coded" transfers can be recycled. While recycling transfers minimizes wastage, there is a considerable cost in clerical time to gather the transfers, sort them by route (if preprinted), and store them for subsequent issuance. This also requires a great deal of space. Only 35 percent of the respondents in the survey recycle transfers.

Respondents were also asked whether they store transfers in secured areas. While one would expect the response to be affirmative (and it was in 90 percent of the cases) the author's observations indicate that many transit agencies simply leave transfers in the drivers' club room to be taken as needed. This is especially common among smaller transit agencies that do not preprint the date or letter code on their transfers.

While the respondents to this survey generally did not consider transfer theft a serious problem, there is anecdotal evidence to the contrary from some large transit agencies. An article in the *Los Angeles Times* (October 19, 1995) reported that Los Angeles MTA officials estimated that transfer theft and resale by one driver resulted in $1.2-million in lost fares over one year. Several large transit agencies have adopted or are procuring automated transfer issuing equipment on the theory that printing transfers individually on the bus (in some cases with magnetic encoding) is more secure than using the traditional loose pads of transfers. Experience over 20 years of auditing transit revenue indicates that many transit agencies considered transfer chits to be valueless, because they charge the passenger little or nothing for the chit. However, the value of a stolen transfer is the fare a passenger would have paid; each pad of 50 transfers thus represents a considerable amount in lost revenue.

ALTERNATIVES TO TRANSFERS

Some transit agencies have approached the problem of passengers connecting between buses in very different ways, eliminating or modifying the traditional transfer concept. Three alternatives to transfers were identified by the respondents: multi-hour passes (passes good for several hours, but less than a day), day passes, and prepayments such as multi-ride or weekly/monthly passes. These fare media eliminate the need for a transfer because unlimited transfer privileges are included.

Day passes and multi-hour passes are particularly interesting forms of fare payment. They can be used in place of or in addition to transfers, and have several advantages over traditional "trip-oriented" transfers:

- They eliminate many abuses of the traditional transfer system like back-riding and stopovers.
- They can be smaller, thus saving paper.
- They reduce the potential for confrontation between passengers and drivers by eliminating disputes over transfer abuse.
- The transit agency is selling "x" hours of transportation that may be used in any way the passenger wishes. Policy makers see this as a logical approach that doesn't penalize any group.
- By taking advantage of the free service privilege during lunch and other midday periods, transit riders receive service

not available to them before. This increases the value of the transit agency to the passenger and the community, and increases ridership during the off peak when there is normally excess capacity.

- Day passes are easier for drivers to handle, since they don't requiring punching or tearing for the time of day or route. No interpretation beyond date of issue is required.

Negative factors that have been cited include the following:

- Drivers are carrying high-value fare instruments. The temptation to steal such documents is high. There is also a greater exposure to counterfeiting.
- The number of dollar bills handled in fareboxes may increase, and there may be a problem with high value currency such as $5 and $10 notes (fareboxes cannot differentiate currency values).
- Revenue is lost from passengers who use day passes at a higher rate than pricing would indicate.

Review of the American Public Transit Association's (APTA) *1995 Transit Fare Summaries* indicates that there are 31 bus transit operators in the United States offering day passes, and 10 rail agencies. Of the survey respondents, 14 (45 percent) offer some type of long period or day pass.

Such documents can be priced at the cost of two fares, or at various discounts. The survey respondents with long period passes did not charge any premium for them. Those with day passes charged an average of $2.18, which is roughly 2.13 times the base fare for this group. A passenger with a day pass must ride between two and three times per day to obtain a saving. This is in line with the group of day-pass-selling properties reported in the 1995 APTA Transit Fare Summaries. The average day pass among that group sells for $2.87, and typically requires two to three rides to produce a saving.

Some day passes are only available on weekends and holidays, thus being used as a promotion to increase ridership during these periods.

In most cases the day pass itself looks very much like a transfer. It is printed on newsprint and shows the current date. However, one large transit agency that recently implemented day passes felt a more secure approach was warranted for the relatively high value document. After discussions with drivers and public hearings on its new fare structure, the Maryland Mass Transit Administration procured thermal printing equipment to issue transfers on the bus. In addition to the security of the new system, this also provides information on ridership through a removable data cassette. (MTA implemented the day pass as part of an overall fare restructuring, shortly before this synthesis went to press. Early indications are that the day pass has been welcomed by the riding public.)

The opposite approach is to offer no transfer privilege at all, requiring payment of a second full fare whenever boarding another vehicle. None of the survey respondents took this approach. Review of the *APTA Transit Fare Summaries* indicates that there are 22 bus agencies that offer no transfers at all. However, not all of these charge a fare each time a passenger boards a new vehicle. Five provide a day pass in place of a transfer. Several very small transit agencies are listed in the *Summaries;* one may speculate that these may not have connecting lines. Some small transit agencies simply allow passengers to make connections based on drivers' seeing them leave one bus before boarding another.

Services such as commuter rail, ferry boat, and heavy rail systems rarely issue transfers. Commuter rail tickets include the entire cost of a trip from one point to another, regardless of whether it will require two trains to get there--thus no transfer scrip is needed. Several heavy rail operators provide for transferring between lines without leaving the "paid area," using a system of connecting walkways and tunnels. Boston, New York and several others allow such transfers between rail lines, but don't provide for transfers between modes.

Interagency Transfers

National policy appears to be moving in the direction of "seamless" integration of transit services between modes and connecting operators. Part of this involves scheduling to reduce the wait time and other burdens associated with transferring. Pricing of interagency transfers is another related issue.

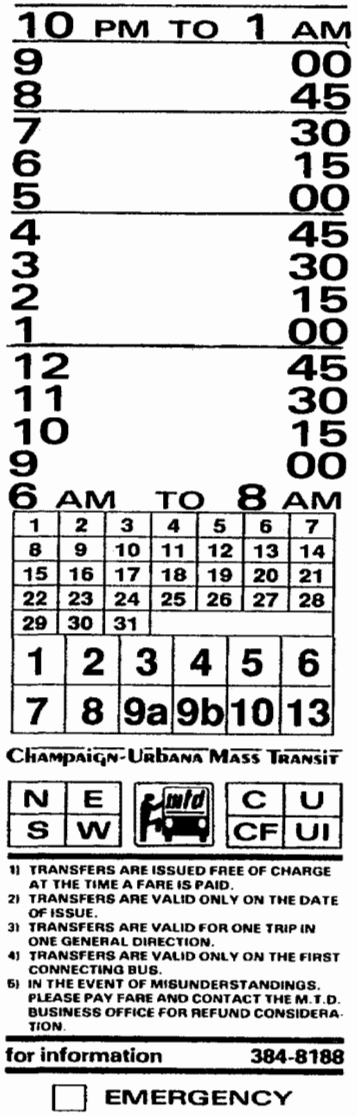
Forty-eight percent of the survey respondents participate in an interagency agreement as depicted in Table 11. Of the fifteen agencies participating in interagency transfer agreements, twelve have some type of formal agreement between the agencies. (Note that in the "No Response" category in Table 11, there are several agencies that do not interchange passengers with other transit agencies, thus interagency transfers would be inappropriate.)

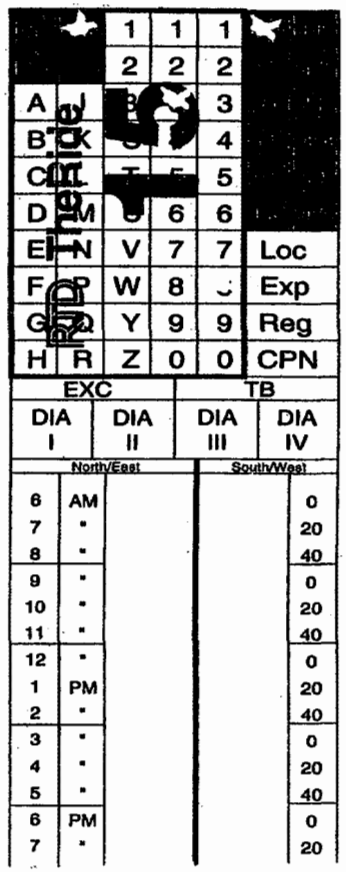
TABLE 11
INTERAGENCY PARTICIPATION SUMMARY

Number of Connecting Transit Authorities	Number of Respondents
6-10	3
5	0
4	1
3	1
2	4
1	6
No Response	16

Eighty percent of the respondents who participate in an interagency program have a formal interagency arrangement. The survey results indicate that these agreements are established in accordance with the prevailing circumstances. Examples of such agreements that were provided by the respondents are as follows:

- Both agencies agreeing to accept transfers as a base fare;
- Letter agreement permitting free transfers between agencies;
- Fare coordination and rules for acceptance and revenue allocation;
- Both agencies agreeing to accept specific transfers only;
- Service coordination, fares, and reconciliation;





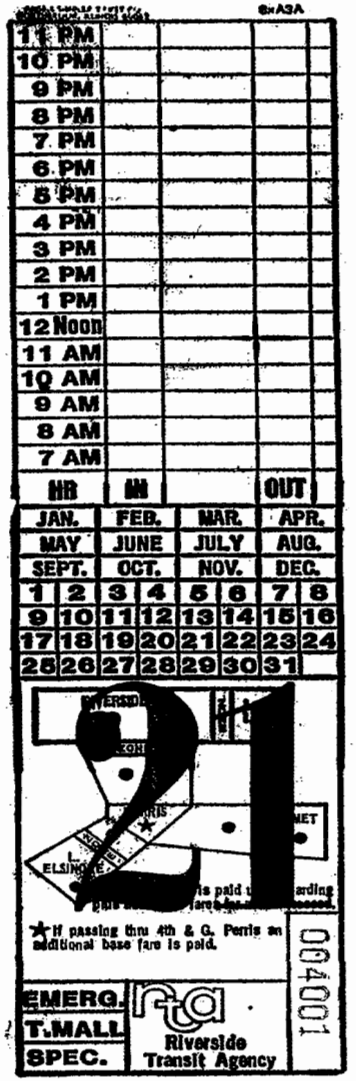


Figure 10 Sample transfers.

TABLE 12
TRANSFER DOCUMENT ELEMENTS

	Usability					Number of Respondents Using
	Poor				Good	
	-2	-1	0	1	2	
Daily Date Code						
Current day's date printed on transfers			1	1	20	22
Punched to show date issued		1	1	5	7	14
Letter or number code changed daily	1	2	1	6	8	18
Day of week printed on transfer	1		2	4	5	11
Transfer printer dates not accurate	1					1
Time Code						
Magnetic encoding					2	2
Printed when issued					2	2
Punched to show time			1	2	2	5
Torn to show time	2		2	9	11	22
Route Code						
Magnetic encoding					1	1
Printed when issued					1	1
Preprinted route		1		3	6	9
Punched route			2	5	9	16
Punched only for late night service				1		1
Direction Code						
Magnetic encoding					1	1
Printed when issued					5	5
Cut arrows					2	2
Unique punch				1		1
Punched travel direction	1	3	2	3	3	12
Other Common Elements						
Indication of distance traveled					4	4
Advertising agency				3	4	7
Graphic				2	2	4
Advertising			1	1	1	3
Up-grade fare paid				1		1
Class of service				1		1
Transfer rules	1	3	5	6	6	21
Major boarding locations			1			1

- Both agencies agreeing to accept transfers; however, transfers from one agency to another require an additional fee;
- All transfers accepted are single-zone peak fares and the issuing agency is billed accordingly; and
- Public agency supplying transfers to private carriers for issue (private carriers will not accept agency transfers).

In interagency agreements, the fares vary for all participants. Sixty-four percent of the transfer agreements require the payment of an additional fare when transferring to a premium service.

Only thirty-three percent of the respondents have a formal revenue exchange agreement with the other participants in an interagency transfer agreement. This circumstance is attributable to the fact that revenue for another agency is collected only as an exception during the transfer process. The additional fees paid when transferring between agencies are paid when transferring from the lower value to the higher value service. The common provisions of interagency revenue exchange agreements include one of the following:

- Revenue distributed according to negotiated percent,
- No revenue exchanged, or
- Revenue allocated according to annual ridership survey.

Of the survey respondents, all expressed satisfaction with their interagency agreements. However, some issues were identified as being important to address before entering into a formal agreement:

- Different fare structures, policies, time limitations
- Seamless transfers for riders
- Revenue allocation methodology
- Shared goals
- No inflation of management fee as a result of the agreement
- Simple format to the agreement
- Regular meetings to coordinate service and fare changes
- Consistency of transfer use
- User simplicity and revenue accountability.

TRANSFER DOCUMENTS

Drivers issue a small newsprint document to passengers to authorize the transfer to another bus. Over the years these have become fairly standardized--Figure 10 provides a number of sample transfers. These demonstrate the various elements that are commonly used on transfers.

Despite their similar appearance, the transfer documents are designed to comply with the specific regulations of the transit agency. In most cases, this means that the document must indicate to the receiving driver the date and time it was issued to the passenger. Dates are often preprinted, though "letter codes" or graphics or words selected at random from the dictionary have been used. The letter code allows drivers to turn in unused transfers for use on a later date. Time is shown by tearing the document in a special cutter, though some authorities have drivers punch the time on a grid or clock.

Route can be punched by the driver or may be preprinted. Direction is usually punched by the driver. Other common elements indicate the distance traveled (number of zones).

Respondents were asked to rate the usability of various elements of their transfer design (Table 12). Over the years, transit agencies have oscillated between transfer designs intended to minimize the potential for back riding and other abuse and simplifying the transfer document (and thus the driver's job). At the most restrictive extreme, transfers have included maps showing where the passenger boarded and the receiving driver is to calculate the number of zone lines crossed, the time allowed per zone, and compare this to the time the transfer was issued to determine validity (as well as check the direction and fare type). At the other extreme are the various day passes and machine-issued transfers. The transfers collected in the course of this study show a surprising degree of uniformity in their design.

Many transit agencies print transfer rules and regulations on the back of the transfer; several samples are shown in Figure 10. The intention is to help the bus operator by making sure all passengers have a copy of the rules. However, the rules often are printed with very small type on newsprint paper and, as several transit managers noted, make for difficult reading, raising issues of ADA compliance.

CHAPTER THREE

SERVICE DESIGN

RIDERS' WILLINGNESS TO TRANSFER

The willingness of riders to transfer seems to be a particularly important consideration in designing service, especially as new rail systems are started. Most rail systems involve redesign of local bus service to feed passengers into the rail system, thus increasing transfer frequency. Fifty-eight percent of the respondents believe that transit riders are only willing to transfer once per trip (Figure 11). Informal analysis at one agency indicated that some passengers were now transferring two or three times. On the other hand, passengers may prefer to transfer to a rail line rather than take a "slower" bus, even though the total trip time is comparable and the additional transfer introduces some uncertainty. Transfers to short feeder routes, for example, a circulator operating within a major activity center, may be more attractive.

Despite the importance of this perception, only 39 percent of the respondents validated the willingness to transfer with an empirical market study. The remaining 61 percent of the respondents based their perception of rider willingness to transfer on opinion. Also, detailed market studies on riders' perception of transferring have only been conducted at 30 percent of the responding agencies.

INCREASING TRANSFER CONVENIENCE

The "classic" small city transit service is built around the hourly "roundup" during which buses from all routes converge in the downtown area to allow passengers to transfer from one route to another with a minimum of wait. Such practices still continue throughout the United States. In larger cities, it is difficult to schedule such transfers for all routes, but an attempt is often made at outlying transfer centers (especially in conjunction with rail operations), or in the evening when missing a connecting bus can have safety implications as well as be an inconvenience.

When the agencies schedule their service, they take into consideration the factors identified in Table 13. The most common factor mentioned by the respondents is that only some and not all routes have guaranteed meets. The results of the survey indicate that agencies provide guaranteed meets under the following circumstances:

- Routes to transit centers,
- All intermodal bus to LRT routes,
- Routes with security issues, and
- Routes with long headways.

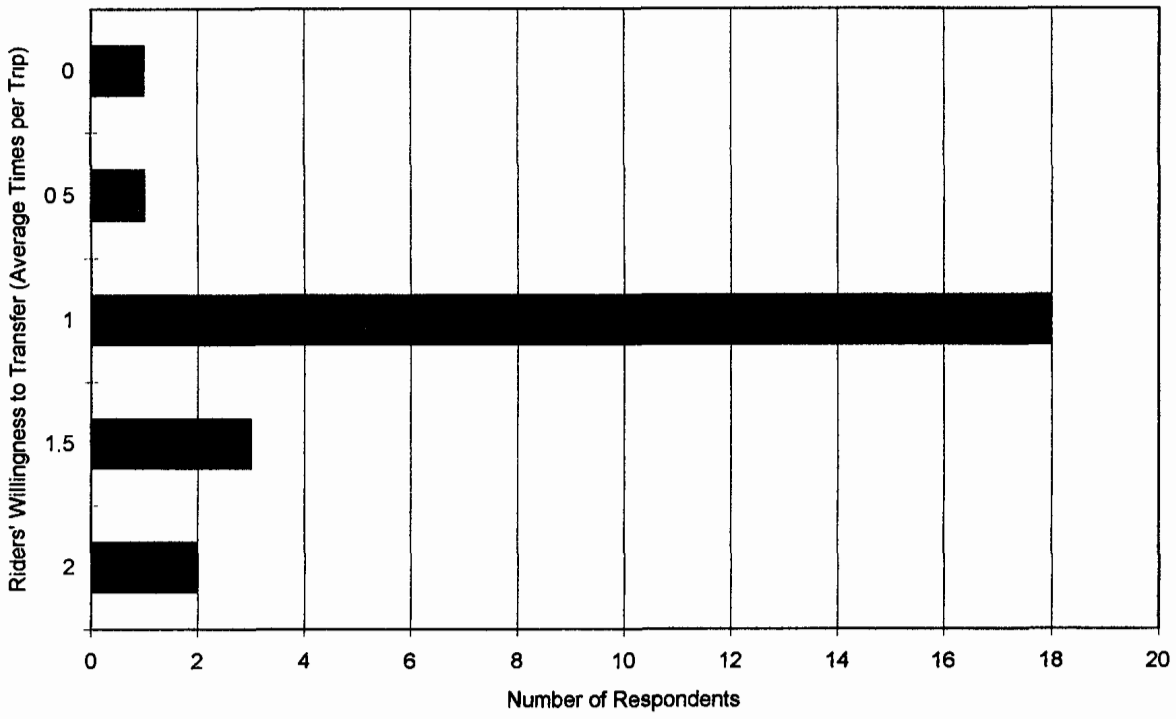


FIGURE 11 Riders' willingness to transfer.

TABLE 13
SUMMARY OF SERVICE DESIGN FACTORS

Factor	Number of Respondents
Guaranteed meets throughout the day	7
Guaranteed meets during off peak only	1
Guaranteed meets only at night or when rider security a concern	6
Only some routes have guaranteed meets	17
Driver or dispatch arranged meets	11
Hold vehicles for transferring passengers	12
Automated systems guarantee or arrange transfers (AVL based)	1
Hold buses for rail service	1
Determine tolerable wait time	1
During off-peak schedule additional recovery time	1
Layout bus stops to coincide with major transfer points	1
No response	1

TABLE 14
SERVICES WITH GUARANTEED TRANSFERS

From	To	Bus	Rail	Paratransit Van Pool
Bus		22	6	2
Rail			1	1
Paratransit/Van Pool				

Areas of frequent service, for example, park-and-ride and express bus routes, do not have scheduled meets.

Table 14 summarizes types of services with guaranteed meets.

Interlining

"Interlining" or "through routing" is the practice of having a bus enter the CBD from one route and leave on another. This is done to reduce the need for passengers to transfer, and increases operating efficiency by reducing the number of turning movements a bus must make in the crowded downtown area.

The factors used to determine routes to be interlined were identified in an informal preliminary survey. The survey candidates were asked to rate these factors in terms of importance. Table 15 shows that there are three key determinants for making interlining decisions.

- When large volumes of passengers need to transfer,
- When services need to have similar frequencies, and
- When services need to have complimentary running times.

Importance of the other factors is related to the individual respondent's operating environment and local geography. This is reflected in the number of responses in the other factors category.

Demand Responsive Transfers

Since the advent of voice radios on buses in the 1960s and 1970s, it became common in small transit agencies for drivers to contact the dispatcher (or another driver directly, if the agency allowed) when a passenger wished to transfer. The connecting bus would then hold at the transfer point. Such ad hoc scheduling aids passengers by assuring them their journey will continue smoothly. Many larger transit agencies use such arrangements at night and/or in high crime areas; 11 of the respondents to the survey indicate they do some of this. At least one large agency uses an amber light mounted on the roof of each bus at the front. The driver activates it when a passenger wants to transfer to a connecting bus.

Over the last 15 years, Automatic Vehicle Location and Control (AVL/C) systems have been installed at several U. S. transit agencies. While the early systems, based on radio "sign posts" have not fared well, newer systems based on the Global Positioning System (GPS) hold hope for effective operation. In Europe, several organizations are marketing software products which, coupled with AVL, automatically schedule connections in response to passenger demand. No similar applications were found in the United States, although at least one agency implementing a new radio communications system (Utah Transit Authority) has included a "transfer request" button on the driver's control interface for "future use."

Cleveland's Paratransit Program

The Greater Cleveland Regional Transit Authority (GCRTA) is implementing an automated transfer scheduling function to improve efficiency of service for the handicapped. Multisystem's MIDAS program is being implemented under the Americans with Disabilities Act (ADA). Transfer coordination is one module of the program.

MIDAS is a comprehensive service management system for paratransit, incorporating client registration, reservation taking, scheduling, dispatching, and trip data. It is intended to function on a real-time basis, though GCRTA currently schedules on a 24-hour advance notice. At this time, no AVL is used for the system.

The transfer scheduling module allows certain fixed routes to be designated as feeders to the paratransit service. When a passenger calls in, the system determines whether it is most efficient to use a fixed-route bus for part of the journey. Decision criteria include availability of a fixed-route schedule, trip length and service area, passenger's medical condition and other qualifications. The scheduler asks the computer for suggestions. These may include paratransit only or any combination of paratransit, accessible fixed-route, and rail. Most trips will be completed entirely with paratransit vehicles, but some can efficiently use fixed-route buses for part of the trip.

Once the scheduler has chosen an itinerary for the trip, the client is informed by fax (a map and schedule) or by telephone. Adjustments to the itinerary may be made.

TABLE 15
DECISION FACTORS FOR THROUGH ROUTING

	Not Important				Important
Routes With	1	2	3	4	5
Large volumes of transferring passengers	3	0	6	8	10
Complementary running times		3	3	14	5
Similar frequency	1	2	3	12	6
Minimize total running time	2	5	4	6	5
Cost saving vehicle needs reduction	1				1
Logical in grid network					1
Passengers with special needs					1
Related trip generators on the combined routes	1				

*Complementary running times allow two routes to be combined to achieve a desired interval between buses (headway). For example, if the desired headway is 60 minutes, one could combine two routes having 35 and 25 minute running times

All trips are scheduled for the next day by 4:00 p.m. Paratransit to fixed-route transfer requests are sent to the fixed-route garage. The fixed-route garage confirms by 5:00 whether a lift-equipped vehicle can be provided on all runs requested. If this isn't possible the trip will be rerouted using paratransit vehicles from door to door.

During the first month of the MIDAS system, requests for service increased from 250 per day to 500 per day. Early in the project, it was found that the fixed-route operation data base required considerable updating to be effective. In particular, more detail was required on bus stop location (near side vs. far side, availability of curb cuts, and traffic controls) and areas to avoid (dangerous, lack of sidewalks.). As a result, the transfer module was temporarily deactivated while the data base was improved.

European Systems

Two European manufacturers, Init GmBH and GSI Gesellschaft, sell transfer protection systems. These are sold as part of comprehensive AVL/C systems for fixed-route transit. The two systems are similar and can automatically define some trips or schedules as "connectors," thus programming in a wait for the delayed connections. (This can also be done manually by a dispatcher.) Automatic connections are secured by parameters that can be defined by the transit agency. The timetable data base provides the required information on connections, which are then shown on the printed timetable.

In cases when the system cannot automatically decide to schedule a connection, the dispatcher will be informed and requested to take action. The system informs the dispatcher whether:

- A delay of the connector would put further connections at risk;
- The follower vehicle of the connector is close behind;
- The waiting time of the connector exceeds a threshold;
- Due to the additional waiting time, the delay is greater than the layover time at the terminus of the trip; or
- The connecting vehicle or connector are nominally positioned vehicles not monitored by the AVL/C system.

At a specified time before the first bus involved in connections leaves its terminal, the system performs a check to determine if connections are at risk. Parameters include:

- Timetable adherence;
- Probable waiting time;
- Effect on following vehicles, and
- Later waiting time of passengers if the connection is missed.

The system instructs vehicles in a connection to wait for a delayed vehicle. These messages are transmitted to display screens facing the driver on the "control head." If a connection has been missed, a new connection is automatically generated and information transmitted to the driver.

Init GmBH transfer protection systems have been implemented in Osnabruck, Trier, Bremerhaven, and Wuppertal (Germany), and Madrid (Spain). GSI implemented a demonstration system in Australia, and currently has functional systems in Heinsberg County (Switzerland) and Saarbruken (Germany).

Walking Transfers

Ninety-three percent of the respondents allow "walking transfers," where a passenger may (or must) walk from one location to another to transfer between buses. Except for one agency that allows passengers to walk up to 1.5 miles to transfer, there is only a slight variance in the maximum acceptable distance for walking transfers. The average acceptable walking distance for the survey respondents is approximately 2 blocks (0.22 miles). The one exception allows transfers anywhere within the downtown zone, a 1.5 x .75-mile area.

TRANSFER FACILITIES

Nearly all of the respondents provide some type of dedicated facility for the transferring passenger. The type of dedicated

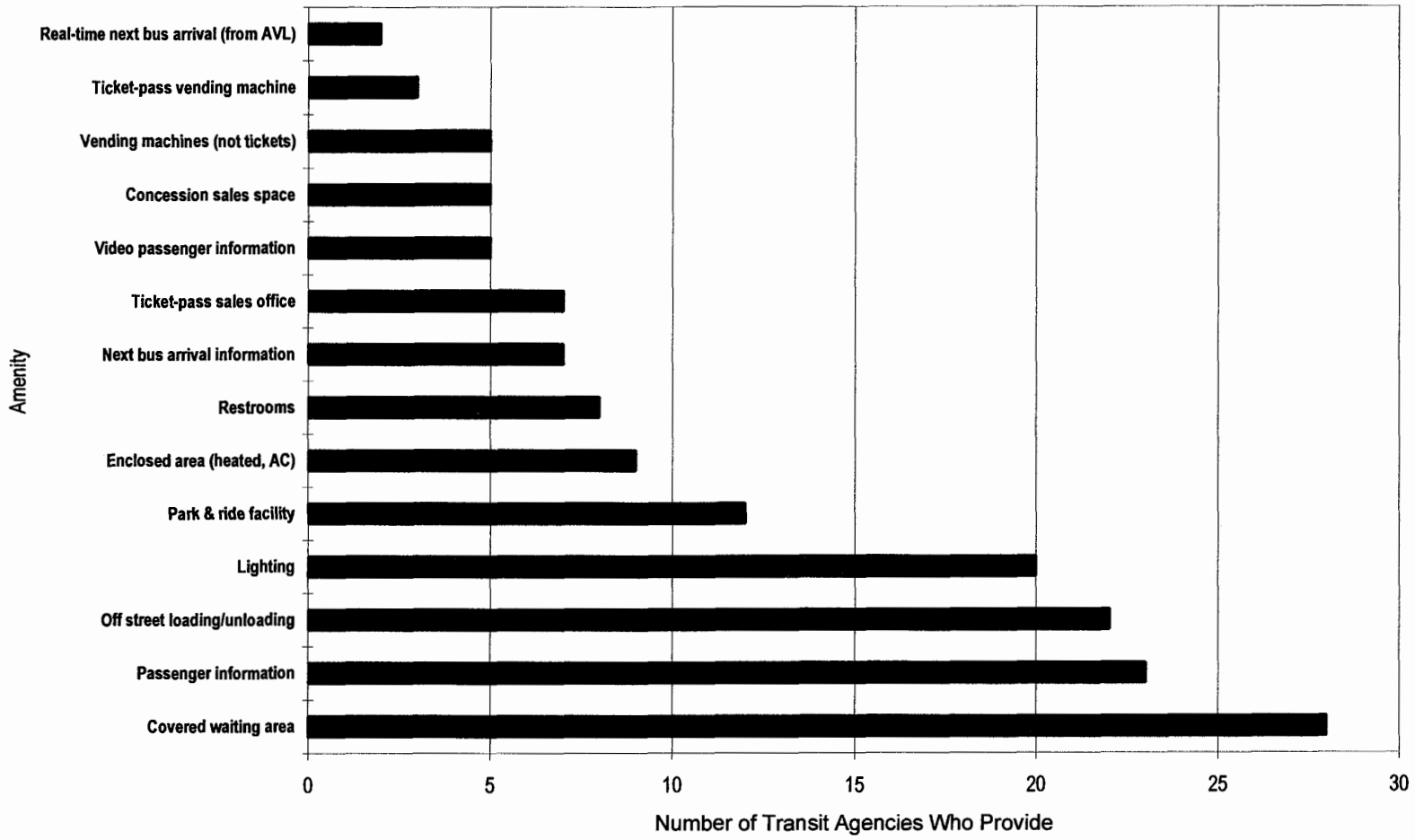


FIGURE 12 Transfer location amenities.

facility could range from simple weather protection to a comprehensive transfer station that includes amenities discussed below.

However, only one-third of the respondents indicate that they have formal service standards that are used for locating shelters or transfer facilities. Where such standards (explicit or implicit) exist, they are prompted by the number of passengers transferring at the location and the stop's proximity to activity centers (Table 16). Security is the second most important issue for the majority of the respondents.

Most (63 percent) of the respondents do not have a formalized policy to determine transfer facility amenities; decisive factors are routes serving the location, passenger volume of transfers, and frequency of service.

According to the results of the survey, the four most common amenities provided at transfer facilities are:

- Covered waiting area,
- Off street loading and unloading,
- Passenger information, and
- Lighting.

Figure 12 provides an overview of the amenities provided by the survey responses. The range of amenities provided at transfer locations reflects the operating environment of the individual agencies. Several agencies provide nothing more than a typical bus stop shelter, supplying minimum protection from the elements. Others supply off-street terminals with ticket sales, food, or other items for purchase. Some agencies vary the level of amenities depending on the location and usage of the transfer point.

About half of the respondents expressed concern about passenger security and criminal activity at transfer locations. Agencies operating in urban environments have a higher level of exposure to crime, but significant physical damage to transfer facilities is relatively rare--only one-quarter of the respondents had experienced incidents involving damage over $1,000 in value. Because many of these facilities have been designed to deter and withstand vandalism, damage has been minimized. Table 17 summarizes the actions taken by the respondents to increase security or prevent criminal activity at transfer locations.

It is common in rail transit agencies to use fences and gates, turnstiles, and similar devices to improve the flow of passengers through the facility, separate "paid" from "unpaid" areas for fare collection purposes and reduce congestion. Only three of the respondents (one of which is a multi-modal operator) indicate that they use such arrangements for their bus transfer facilities.

TABLE 16
STANDARDS FOR LOCATING TRANSFER FACILITIES

Basis for Standards	Number of Respondents
Passengers transferring at location	19
Intermodal transfers	2
Security	4
Adjacent activity centers	10
Locations are **at** rail stations or park-and-ride lots	1
Shelters provided by local businesses	1
Only in the CBD	1
Frequency of service	1
Ability to physically locate shelter	1
Three or more routes converge	1

TABLE 17
ACTIONS TO REDUCE CRIME AT TRANSFER FACILITIES

	Number of Respondents
Regular patrolling by non-transit police	13
Patrolling by transit police or security	12
Telephones, alarms, and other emergency communications	11
Closed circuit cameras	6
Limited hours of operation	4
Secured access to facility	1
Station agents	1
Solutions according to location	1
Plain clothes police	1
Locked rest rooms	1
Frequency of service	1

CHAPTER FOUR

TRANSFER AUTOMATION

TRANSFER PRINTERS

Over the years various devices have been used to automate transfers. These are receiving renewed attention as a means of solving some of the perceived problems of the traditional paper transfer.

During the 1980s Almex marketed, with limited success, an electro-mechanical device based on Proof of Payment ticket issuers commonly in use on European buses. It used ink printing on a cash-register type paper roll. Physically, the design was compact and highly reliable. While Almex's marketing was based on reducing paper use, transit agencies found it useful in

- Simplifying a complex transfer system,
- Making transfers easier for drivers to read, especially when passengers board in quick succession (though it should be noted that the ink printing was often hard to read),
- Eliminating the time needed to sort and shelve unused transfers for agencies that recycled them, and freeing their storage space for other uses, and
- Increasing flexibility (minor route changes can render preprinted transfers "void").

Two of the survey respondents had on-board electromechanical Almex transfer printers. Both planned to remove them from service because of age and unavailability of parts, one planned to convert back to paper transfers and the other to obtain comparable but updated equipment.

Recently, Almex has begun marketing an electronic transfer printer that uses thermal printing. As mentioned above, the Maryland MTA has purchased this system as part of their conversion to a day pass. Initial reports indicate the equipment is working in a satisfactory manner.

ADVANCED TRANSFER HANDLING SYSTEMS

Domestic and foreign manufacturers recently have marketed devices that use thermal printing to improve readability. Some of these include magnetic encoding, which offers some amount of automatic validity checking. The devices with magnetic encoding can also process passes, stored-ride tickets, stored-value tickets and other fare documents. A number of transit agencies, including two of the survey respondents, have implemented such systems. Another nine are considering such equipment, thus, some one-third of the total sample may have such equipment in the next few years. Clearly, transfer automation is making serious inroads into the transit industry.

Respondents with or considering transfer issuing systems were asked what benefits they expect to obtain. Answers included fewer conflicts with passengers and reduced potential for fraud and abuse.

Problems reported with the systems already installed included the following:

- During equipment failure, transfers can not be issued, and passenger may board without paying;
- Inadequate support from manufacturer and lack of spare parts;
- Running out of transfer stock in revenue service.

Smart Cards

Another approach to automation is the use of smart cards. Smart cards look like credit cards, but carry a memory and/or microprocessor chip that can interact with a reader. They provide much more memory and security than magnetic stripe cards, and have been promoted by several manufacturers for transit fare systems.

No U. S. transit agency has adopted smart cards agencywide. However, a number of agencies and regional groups are looking at smart cards as a means of improving service, especially for passengers transferring from one mode or agency service to another. Among the survey respondents, 42 percent are considering the use of smart cards, though most indicate reasons beyond simple transfer systems. These reasons included:

- A fare study in progress with smart cards as an option
- Improved data reporting
- Desirability of proximity card
- Possible Medicaid billing
- Planning stored-ride card
- Trial in progress.

Case Study: Connecticut Transit

Given the evident popularity of automated systems, it is worthwhile to focus on the process of implementing such advanced technology in a transit agency. Connecticut Transit (CT) recently equipped its buses with new fareboxes and Ticket Reader and Issuer Machines (TRiM), manufactured by GFI Genfare of Elk Grove Village, IL. The CT experience is instructive.

CT operates buses in three cities: Hartford, New Haven, and Stamford. CT had a traditional fare collection system based on nonregistering Keene fareboxes and paper transfers.

The transfer system was designed to allow passengers to continue their trip in the same direction and within a reasonable time after starting the journey. A sampling of the rules pertaining to transfers includes the following:

- Drivers punch transfer while inbound to indicate the route issued from.
- Drivers tear the transfer in a cutter to indicate the time of arrival in the downtown area.
- If the passenger pays for two zones, the drivers punches the transfer in the appropriate location.

When receiving a transfer, a driver was expected to:

- Check for the correct date (preprinted on the transfers),
- Check that the correct time is cut,
- Check the route and direction of issue (punched),
- Make sure the passenger had fully paid for the class of service (for example, a passenger transferring from a local to and extra-fare express route must pay the fare differential), and
- Be sure the passenger boarded at an established transfer point.

Reasons for not accepting a transfer include:

- Time period is expired.
- Passenger is reversing direction.
- Passenger has "stopped over" and is reboarding the same route in the same direction.

While the rules above are common to many transit agencies, the system is complicated by the fact that CT interchanges passengers with several private and public transit carriers. There are also emergency transfers issued to deal with breakdowns, passengers who miss their stop and have to ride back on the same route, or passengers boarding the wrong bus.

The conventional format of the transfer document is shown in Figure 13.

The traditional fare collection system was replaced with state-of-the-art electronic fareboxes in 1994, with TRiMs delivered in 1995. In addition to improved security, one of CT's objectives was to reduce the potential for confrontation between drivers and passengers by having the TRiM determine transfer validity.

One of the necessary tasks in obtaining a new fare collection system is to specify the programming. While many of the variable features of modern fareboxes are field settable, most transit agencies have some degree of customization that must be built into the operating software itself. This requires an intensive process of consultation with operating, marketing, and planning personnel to be sure that the new transfer system fits the needs of the agency. Often, this process reveals "quirks" and traditions in the tariff that solve specific problems, but don't fit well into a generalized set of decision rules.

Making the situation even more complex at CT was the fact that the TRiM procurement involved two additional public agencies. Thus, TRiMs were installed in five separate cities with

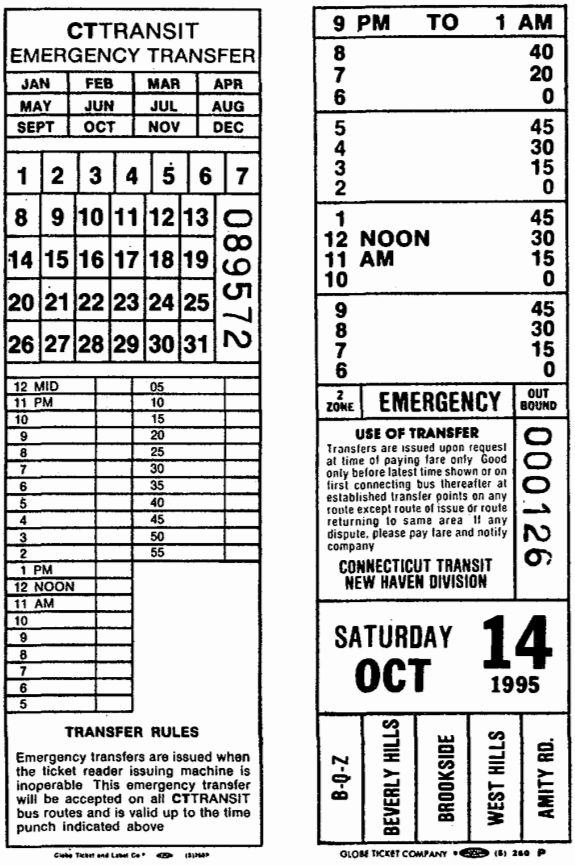


FIGURE 13 Connecticut transit transfer.

very different transit characteristics and somewhat different tariffs and transfer rules. Furthermore, when the tally was completed, it was found that CT fares involved more than 40 different types of documents (transfers, zone checks, strip tickets, 10-ride tickets, and passes). Each of these had to be dealt with by the farebox/TRiM system, and required software definition. This was in addition to the usual collection of cash fare levels (base fare, senior citizens, students, express surcharge, and zone charges).

The TRiM issues transfers from a stack of credit-card-sized paper tickets. As the cards are issued, the magnetic stripe on the card is encoded with information that includes issuing route, run, date and time, direction (inbound/outbound), and expiration time. Such tickets, as well as prepaid tickets and passes, can be inserted in the TRiM when a passenger boards the connecting bus. The TRiM evaluates them, using a set of rules similar to those in Figure 14. (The decision rules shown were one of several considered during the procurement.)

Software for the TRiM and farebox is generally customized for each agency. This requires that the transit agency make a series of decisions for each fare document used, including:

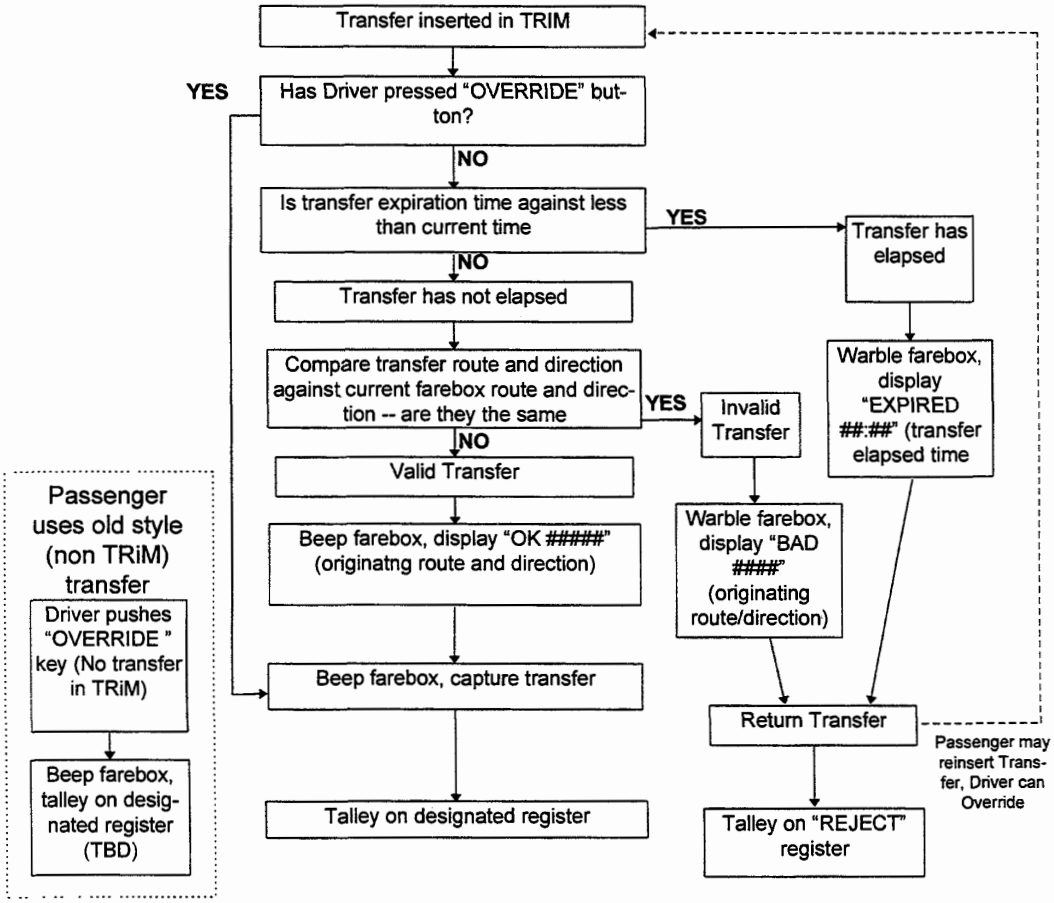


FIGURE 14 TRiM decision flow chart.

- Document name;
- Farebox button used to issue the document (if issued on the bus);
- How much money, if any, must be put in the farebox to authorize issuance of the document;
- What information to print on the document (information printed on transfers can be read by the receiving driver in case the TRiM fails or there is a question about a particular transfer);
- Number of rides allowed on the document;
- Expiration period;
- Boarding rules--whether to accept documents encoded with: the same route, another route, same direction, another direction;
- Fare rules--boarding allowed with: higher fare, different class of service, other special rules;
- Whether to hold the document in escrow pending action by the driver;
- What button, if any, for the driver to use to accept, reject, or override the action of the TRiM;
- Whether to capture the document in a waste bin;
- How to report data generated (passenger counts);
- What to display on the LED display facing the driver; and
- What to display on the LED display facing the passenger.

Clearly, the TRiM provides for very powerful data handling. However, this puts a burden on the transit agency to go through each tariff and variation in detail and be sure the whole functions in a way that makes sense.

Over time, CT discovered that the available decision rules did not entirely fit its operation. Two significant problems emerged. First, on routes with branches, passengers might ride inbound on one branch, then outbound on the other. If the TRiM was programmed to reject a transfer issued on the same route the driver would have to override the TRiM's decision in such cases. This would conflict with the objective of reducing driver involvement.

Second, there is a great deal of variation in the headways, with some routes operating every 10-15 minutes and others every 60 minutes, especially during off-peak periods. The TRiM normally encodes the transfer expiration time based on

firm rules such as "60 minutes after the time issued." If a passenger boarded a long route and transferred to one with infrequent service, it was quite possible that the allotted time would expire before a passenger could legitimately make the connection.

The solutions to these problems were quite different. In the first case, all of the route branches were given different numbers. CT recognized this was not a perfect solution; a passenger abusing the transfer system might successfully backride on the "trunk" of the route. However, such a passenger would have to understand how the TriMs check transfers for validity and be sure to board specific buses only. This would be difficult, as the route/branch numbers were not shown in the public timetable.

Solving the second problem was more difficult. Ultimately, CT decided to redesign the TRiM software to mimic the existing transfer process. GFI created an additional data field on the transfer, the "cut time." This is the time the bus is scheduled to arrive in the downtown area. Drivers are provided with a "paddle," providing detailed instruction on how the farebox/TRiM is to be set up for each trip. Passengers are given 60 minutes after the cut time to board the connecting bus. Again, this is not a perfect solution, since it means the driver has additional work to do and errors are possible.

A third problem was never entirely resolved. Passengers can board parallel routes to complete a round trip, and the TRiM would not detect the fare evasion because the route numbers are different. With the manual transfer system, the driver could see the transfer itself and challenge it. However, the CT TRiM captures valid transfers immediately. This prevents the driver from challenging them.

In addition to adding the cut time field, GFI made adjustments to its standard software to accommodate the large number of fare instruments in use at CT. Overall, the process of identifying all fare types and variations, deciding how they were to be represented, and developing the software required more than eight months. Six additional months were required to confirm that the TRiM software operated as specified and to identify and correct several minor "bugs" detected when the first test units went into service.

The conclusion from this experience is that transfer issuing and acceptance can be automated; workable technology is available. However, these systems cannot totally mimic the existing transfer system. Thus, a transit agency will be forced to update the operating rules and procedures accumulated over many years. Even without the incentive of implementing an automated system, this is a desirable process in itself.

However, it is not yet possible to totally duplicate existing transfer systems. Traditional systems depend on the driver's detailed knowledge of the route structure, as well as the schedule and current position of the bus. This could conceivably be done with an on-board computer and vehicle location system, but it would be a considerable task.

CHAPTER FIVE

CONCLUSIONS

Transit agencies have implemented a diverse collection of transfer systems designed around their specific operating needs. In general, they appear to be satisfied with their transfer systems; few have felt the need for detailed policy making or study of their transfer systems. This may reflect the greater importance of other problems and lack of understanding of alternatives.

From the study undertaken for this synthesis, the following conclusions can be drawn:

- Transit agencies rarely consider overall "policy" goals and objectives when establishing transfer rules.
- Transfer systems are rarely considered a part of the overall transit "product mix." As one of the survey respondents stated: "We don't obsess over this."
- The scope of transfer fraud and theft is still undetermined. Fragmentary information indicates that it may be a serious problem, but most transit authorities consider it no more than an annoyance.
- Technology is available to automate much of the transfer function, both in service design and document handling and verification. Such systems offer a great deal of promise for the future. However, they are complex and require a considerable amount of management time and attention to fully implement.

The following areas in which transfer programs can be improved were identified in this synthesis study:

- There are no national-level data on transfer usage rates. As more rail transit lines are added, it is normal to design service around a "hub and spokes" arrangement. Many passengers must connect to the rail service for the high-speed ride to the CBD. This increases the number of boardings (unlinked trips), with an as yet undetermined effect on actual number of transit users. It could be useful to quantify this effect.
- Day passes present a very attractive alternative to transfers and a number of transit agencies have successfully implemented them. It could be useful to evaluate such programs in more detail.
- Many transit agencies are considering or making a sizable investment in automated transfer handling equipment. Transit agencies (and manufacturers) justify this by citing their fraud reducing and confrontation reducing benefits, which improve the driver's work environment. However, it is not proven that the equipment really provides such an advantage. It would be desirable for transit agencies to have a methodology to determine whether there is going to be a payoff from such investments.
- The current automated transfer systems do not fully duplicate the capabilities of existing transfer systems in preventing back riding and other fare evasion tactics. Automated systems can conceivably be interfaced to "smart bus" technology. A potential project would attempt to implement such a system.
- From the passenger's point of view, the onerous part of transferring is waiting for the connecting bus. Many transit agencies provide shelters, transfer centers, and public information to afford more certainty for the passengers. However, none in the United States guarantees transfer connections in the timetable to the extent that some European systems do. It would be worthwhile to review whether these systems have actually promoted ridership growth, what effort is required to implement them, and what effects on service reliability result.
- Complying with ADA has strained transit agencies' finances. Programs such as Cleveland's MIDAS promise greater efficiency by using fixed-route buses for part of the handicapped passenger's trip. This system could be studied to determine if the savings are real and to provide guidelines for transit agencies in implementing such systems in the future. Such ADA transferring could also interface to "smart bus" automatic vehicle locator technology, possibly becoming even more efficient if scheduling can be done "on the fly."

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APPENDIX A

Respondent Questionnaire

TCRP PROJECT J-7
SYNTHESIS TOPIC SA-6
PASSENGER TRANSFER SYSTEM REVIEW
QUESTIONNAIRE

A Fact of Transit Life: The use of transfers by customers between transit vehicles is a fact of life in transit operations. However, the various elements of a transfer system -- policy, operating characteristics, cost, tune, etc., frequently arouse concerns among transit customers, bus operators and managers. Issues such as scheduling, transfer charges and transfer rules, inconvenience and transfer instruments need to be considered by agencies in developing an appropriate policy. Furthermore, changes in technology are evolving that can improve transfer systems.

What We Want to Know: The Transportation Research Board wishes to collect information from your agency on passenger transfer policies and procedures. What are your policies? How are then enforced and admiistered? What problems have you encountered and how are you solving them. What technology are you using or considering?

How We Want to Know It: You can complete most of the questionnaire by simply checking off your preferences. However, transfer systems are remarkably complex, and vary much between authorities. Therefore, many of the questions are "open ended", and have space for you to add information -- feel free to add pages and whatever additional comments you wish. If you have already-produced materials such as reports and forms that would cover these types of questions, please feel free to attach those documents to make this exercise more convenient. We also invite you to submit comments and additional information such as transfer rule books, transfer forms, etc.

Not Just Buses: We recognize that most of the questions in this survey refer to bus transit systems. However, there are important policy issues that affect rail systems, such as interagency transferring, facilities, service design, etc. We would therefore appreciate considered input from rail as well as bus systems.

Please send your completed questionnaire by June 30, 1995, to the address below. If you have any questions, please feel free to contact myself, Rick Stem, at 513-729-1051 (by fax to 513-729-0350 or Internet e-mail to STERN_RICHARD@BAH.COM). You may also contact Donna Vlasac or Sally Liff at the Transportation Research Board, 800-424-9818 or 202-334-3242.

Richard Stem
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595 Cody Pass
Wyoming, Ohio 45215

TCRP PROJECT J-7, SYNTHESIS TOPIC SA-6
PASSENGER TRANSFER SYSTEM REVIEW
QUESTIONNAIRE

Your Name: _____
Your Title: _____
Organization Name: _____
Telephone: _____ Address: _____

BACKGROUND INFORMATION:

1. Number of vehicles:

Bus	
Commuter Rail	
Heavy Rail (e.g. Rapid Transit subway or elevated)	
Light Rail	
Paratransit	
Other (Describe service type)	

2. Annual unlinked passenger boardings:

Bus	
Commuter Rail	
Heavy Rail	
Light Rail	
Paratransit	
Other (Describe service type)	

3. Annual transfers (between):

	Bus	Commuter Rail	Heavy Rail (Rapid Transit)	Light Rail	Paratransit	Other (describe)
Bus						
Commuter Rail						
Heavy Rail						
Light Rail						
Paratransit						
Other (describe)						

4. Annual Revenue:

Bus	$
Commuter Rail	$
Heavy Rail	$
Light Rail	$
Paratransit	$
Other (Describe)	$

TRANSFER POLICY:

5. Do you have a formal transfer policy?
❑ Yes ❑ No
If "YES", please provide a copy of the policy.

6. Briefly, what is the objective of your transfer policy (formal or informal)
❑ Promote ridership
❑ Coordinate schedules to make transfer-ring easier
❑ Collect correct fare amount
❑ Prevent back-riding and other abuse
❑ Reduce difficulty for passengers
❑ Provide off-street transfer facilities
❑ Provide regional transfer locations (transit centers)
❑ Other (Describe):_____
_____

7. In developing your transfer policy, did you use the following techniques:
❑ Public hearings
❑ Passenger focus groups
❑ Market surveys
❑ Driver input
❑ Other (Describe) _____
_____

8. Do you have any "marketing" oriented programs that are intended to make transferring less unattractive to passengers (such programs might include "frequent riders" rewards, reducing transfer charges if included with tickets, guaranteed transfer connections for certain critical services, etc.)
❑ Yes ❑ No
If "Yes", Please describe:_____
_____
_____

9. Has your transfer policy been successful
❑ Yes ❑ No
Why? _____
_____

10. Have you changed your transfer policy m the last three years?
❑ Yes ❑ No
If "Yes", Why did you change the policy? _____
_____
_____
If "Yes", What change did you make in the policy? _____
_____
_____

11. Do you have a written transfer rule book or guide for your drivers?
❑ Yes ❑ No
If YES, please attach a copy when you return this questionnaire.

12. Have you changed your transfer rules in the last three years?
❑ Yes ❑ No
If "Yes", Why did you change the rules?_____
_____
_____
If "Yes", What change did you make in the rules?_____
_____
_____

TRANSFER TARIFFS:

13. What is your basic fare:
Adults $____ E&H $____

14. Do you charge for transfers?
❑ Yes ❑ No

15. How much do you charge for transfers:
Adults $____ E&H $____

16. Do you sell fare instruments such as multi-ride tickets, tokens, strip tickets, etc., that include a transfer privilege, or do such fare instruments require passengers to pay additional amounts if they transfer?
❑ Fare instruments include the transfer privilege (describe) _____
_____
_____
❑ Passengers pay additional deposit for transferring (describe) _____
_____
_____

17. Do you have different transfer charges for different types of service (express, rail, etc.)
❑ Yes ❑ No
If "Yes", please explain:_____
_____
Do passengers have to pay "top up" or "make up" fares when transferring from a cheaper service to a more costly one?
❑ Yes ❑ No

18. Have you changed the transfer price during the last three years?
❑ Yes ❑ No
If "Yes", why did you change the transfer price?_____
_____
How did you change the price? _____
_____

ROUND TRIPPING AND STOPOVER POLICIES:

19. Do you allow "round tripping" (e.g. return to point of origin) with a transfer?
❑ Yes ❑ No

20. Do you allow round tripping with some restrictions?
❑ Yes ❑ No
If "Yes", please describe restrictions: _____
_____

21. Do you allow stopovers with transfers (e.g. passenger may get off and later board a bus going in the same direction on the same route)?
❑ Yes ❑ No
If "Yes", please describe restrictions and policies on stopovers: _____
_____

22. How much time do you allow from issuance of a transfer until completion of the passenger's trip (e.g. for how long is the transfer valid)? _____

FRAUD AND ABUSE

23. Rate the following types of transfer fraud experience on a scale of "1" to "5" with "1" being *negligible* or unimportant and "5" being *serious*. Several lines are provided for additional types of fraud that we might not have considered:

Type of Fraud	serious	⇔			negligible
Round Tripping	5	4	3	2	1
Stop-overs	5	4	3	2	1
Passengers "pass-back" or give transfers to other passengers after having already used the transfer	5	4	3	2	1
Passengers give unused transfers to boarding passengers	5	4	3	2	1
Use of expired transfers	5	4	3	2	1
Theft of transfers	5	4	3	2	1
Counterfeiting of transfers	5	4	3	2	1
Drivers or other employees selling transfers on the "black market"	5	4	3	2	1
Drivers or agents not collecting transfer charges	5	4	3	2	1
Other (Describe) _____	5	4	3	2	1
_____	5	4	3	2	1
_____	5	4	3	2	1

24. Countermeasures: for any fraud or abuse problems you have marked "3", "4" or "5", please describe any countermeasures you have taken or are taking, and what the results have been: _____
_____
_____
_____

25. Do you experience disputes between drivers and passengers relating to transfers?
❑Yes ❑ No
If "Yes", are these disputes serious -- leading to injury or major altercations between drivers and passengers?
❑ Yes ❑ No
What actions do you take to reduce the frequency and seriousness of such disputes?_____
_____
_____

26. Are your transfers serial numbered?
❑ Yes ❑ No
If transfers are serial numbered, do you record the serial numbers of transfers issued to drivers each day?
❑ Yes ❑ No

27. How do you determine how many transfers to issue to each driver or run?_____
_____

28. Do you "recycle" unused transfers by giving them to drivers on a later date?
❑ Yes ❑ No

29. Do you store transfers **in** secured areas?
❑ Yes ❑ No

POLICY ALTERNATIVES TO TRANSFERS

30. Do you have some way of providing for passenger transfers, other than the "traditional" transfer slip and associated privilege:
❑ No transfer slips used -- passengers must pagers must pay a new full fare on each vehicle boarded.
❑ Long period passes (indicate how much additional charge, if any: $_____)
❑ All day passes (indicate how much additional charge, if any: $_____)
❑ Other (Describe: _____
_____

INTERAGENCY TRANSFERS

31. Do you participate in any interagency transfer arrangements (whereby passengers can use a transfer slip issued by one agency to transfer to vehicles of another)?
❑ Yes ❑ No
If "'No" skip to question 38.
If "Yes", Please answer the following:

32. What agencies participate m this arrangement? _____
_____
_____

33. Is the interagency transfer arrangement formalized m a contract or other written agreement between the participating agencies?
❑ Yes ❑ No
If "Yes", what are the major provisions of the agreement? _____
_____
_____
_____
_____
If "Yes", please provide a copy (copies) of the agreement(s).

34. Do different agencies involved m your interagency agreement have different fares for the services involved?
❑ Yes ❑ No
If "Yes", do passengers have to pay a "top up" or "make up" fare to cover the difference?
❑ Yes ❑ No

35. Is there a formal mechanism for allocating revenue between agencies for transfer passengers
❑ Yes ❑ No
If "Yes", please describe:_____
_____
_____

36. Are you satisfied with the terms of the interagency agreement?
❑ Yes ❑ No
If "No", what are the problems with the agreement and how should they be corrected?_____
_____
_____
_____
_____

37. What issues should be addressed m developing an interagency transfer agreement? _____
_____
_____
_____

SERVICE DESIGN

38. In scheduling your service, do you consider passenger transfers, e.g. do you establish certain "guaranteed meets" so that passengers will have minimum tune to wart for the connecting vehicle?
❑ We have guaranteed meets scheduled throughout the day
❑ We have guaranteed meets scheduled only during off peak periods
❑ We have guaranteed meets scheduled only at night or other times when passenger security is a concern
❑ Some (but not all) routes or schedules have guaranteed meets, based on our understanding of the needs of our passengers
❑ We have drivers or others contact dispatch to arrange guaranteed meets for transferring passengers
❑ We will hold vehicles for transferring passengers (dynamic scheduling)
❑ We have automated systems to guarantee or arrange some transfers (describe):_____
_____

❑ We use other strategies to make transferring more convenient for passengers (Describe):_____
_____
_____

39. If you schedule vehicles to guarantee transfers, what types of service are involved)

	Bus	Express Bus	Commuter Rail	Heavy Rail (Rapid Transit)	Light Rail	Para-transit	Other (describe)
Bus							
Express Bus							
Commuter Rail							
Heavy Rail							
Light Rail							
Paratransit							
Other (describe)							

40. Many transit agencies combine routes running into the downtown area (or through major service "nodes") -- this practice is called "interlining" or "through routing" Many factors can be used to decide which routes to combine m this way. Rank the following factors on a scale of "1" (unimportant) to "5" (most important) m your interlining decisions:

Decision Factor	**Important**		⇔		**Unimportant**
Routes that have substantial numbers of transferring passengers	5	4	3	2	1
(How do you determine this?) _____					
Routes with similar frequency	5	4	3	2	1
Routes with "complimentary" running times	5	4	3	2	1
Minimize turning movements	5	4	3	2	1
Minimize total running time	5	4	3	2	1
Other (Describe) _____	5	4	3	2	1

41. Do you have "walking transfers" between stops that are not directly adjacent?
❑ Yes ❑ No
If "Yes", how far is an acceptable distance to require passengers to walk?_____

TRANSFER FACILITIES

42. Do you provide special facilities, such as "transit centers", shelters, etc., for transferring passengers?
❑ Yes ❑ No
If "No", skip to question 49.

43. Do you have formal standards that help you decide where to provide such transfer facilities and what type of facilities to provide at each location?
❑ Yes ❑ No
If "Yes", please provide a copy of the standards.

44. These standards are based on

❑ Number of passengers transferring at each location
❑ Intermodal transfers (e.g. at all imtermodal transfer locations)
❑ Security considerations
❑ Presence of adjacent activity centers
❑ Other (Describe):_____
_____

45. Do you have some method of prioritizing transfer locations to determine what amenities to provide?

❑ Yes ❑ No

If "Yes", please describe or provide a copy of any policy used for this purpose: _____
_____
_____

46. What typical amenities do you provide at transfer locations or transit centers?

❑ Off street loading and unloading
❑ Covered waiting area
❑ Lighting
❑ Enclosed and heated or air conditioned waiting area
❑ Rest rooms
❑ Ticket, token or pass sales office
❑ Ticket, token or pass vending machines
❑ Other types of vending machines (food, snacks, etc.)
❑ Concessionaire sales space (newsstands or other)
❑ Passenger information (printed schedules, etc.)
❑ Video passenger information displays
❑ Real time information (inked to automatic vehicle location)
❑ Adjacent park and ride facility
❑ Other (describe)_____
_____

47. Is security or criminal activity a significant concern at your transfer facility?

❑Yes ❑ No

Has your transfer facility experienced serious security or criminal activity (e.g. involving injury to passengers or employees and/or property damage m excess of $1,000.

❑ Yes ❑ No

What actions have you taken to combat or prevent security or criminal activity:

❑ Regular patrolling by city or other non-transit police
❑ Patrolling by transit police or contract security
❑ Closed circuit security cameras
❑ Telephones, emergency alarms or other communications arrangements
❑ Secured accessway to the facility
❑ Limited hours of operation
❑ Other (Describe): _____
_____
_____

48. If you have bus transfer facilities, do you use any type of passenger flow control devices (turnstiles or gates, fences, etc.)

❑ Yes ❑ No

If "Yes", please describe:_____
_____

TRANSFER DOCUMENTS

49. Please indicate which of the following common elements of transfer documents are used on your transfers and rate the "usability" of the element on a scale from "-2 to "+2" "-2" should be most unusable or unsatisfactory, "+2" should be the most satisfactory. Please take a "broad" view of *usability:* Consider the driver's point of view, how the transfer element promotes the goal of your transfer policy and tariff, conflicts between drivers and passengers, etc.

Element		**Usability** Poor ⇔ Good				
Current day's date printed on transfers	Not Used	-2	-1	0	1	2
Letter or number code changed daily	Not Used	-2	-1	0	1	2
Punched to show the date issued	Not Used	-2	-1	0	1	2
Other daily code system (describe) _____	Not Used	-2	-1	0	1	2
Time Code:						
Tom to show the time issued	Not Used	-2	-1	0	1	2
Punched to show the time issued	Not Used	-2	-1	0	1	2
Other time code system (describe) _____	Not Used	-2	-1	0	1	2
Route Code:						
Preprinted route	Not Used	-2	-1	0	1	2
Punched to show route	Not Used	-2	-1	0	1	2
Other route code (described) _____	Not Used	-2	-1	0	1	2
Direction Code:						
Punched to show direction of travel	Not Used	-2	-1	0	1	2
Other system for showing direction of travel (describe) _____	Not Used	-2	-1	0	1	2
Other Common Elements:						
Indication of distance traveled (punched map, zone issued, etc. – Please describe) _____	Not Used	-2	-1	0	1	2
Graphic (Describe) _____	Not Used	-2	-1	0	1	2
Advertising (transit authority)	Not Used	-2	-1	0	1	2
Advertising (commercial or other outside organization)	Not Used	-2	-1	0	1	2
Transfer rules	Not Used	-2	-1	0	1	2
Other (Describe) _____		-2	-1	0	1	2
Other (Describe) _____		-2	-1	0	1	2

50. **Please provide a sample (or samples if you use multiple types) of your transfer slip.**

AUTOMATION

51. Do you use any of the following transfer Issuing devices (please indicate the manufacturer and rate your experience with the equipment on a rating scale from -2 [poor] to +2 [excellent]):

Type of Machine		Manufacturer and Trade Name	Experience Poor -2	-1	0	+1	Good +2
Fixed location (at stations or transfer centers) mechanical or electro-mechanical transfer printer	Not Used		-2	-1	0	+1	+2
Fixed location electronic transfer printer	Not Used		-2	-1	0	+1	+2
Fixed location electronic transfer printer with magnetic encoding to be read by a receiving transfer device	Not Used		-2	-1	0	+1	+2
Fixed location electronic transfer reading device.	Not Used		-2	-1	0	+1	+2
On-vehicle mechanical or electromechanical transfer printing device	Not Used		-2	-1	0	+1	+2
On-vehicle electronic transfer printing device	Not Used		-2	-1	0	+1	+2
On-vehicle electronic transfer printing device with magnetic encoding	Not Used		-2	-1	0	+1	+2
On-vehicle electronic device to read magnetic encoded transfers	Not Used		-2	-1	0	+1	+2
Proof of payment devices that include a transfer function (Describe): _____ _____	Not Used		-2	-1	0	+1	+2
Other electronic transfer handling equipment (Describe): _____ _____	Not Used		-2	-1	0	+1	+2

52. If you have Implemented automated transfer handling, what difficulties have you experienced with this system? _____
_____
_____
_____

53. What changes m policy or procedure were necessary to implement the technology? _____
_____
_____

54. What benefits have you obtained from the transfer handling technology? _____
_____
_____

55. Do you use or are you considering any application of "smart cards" (e.g. cards carrying an electronic memory other than magnetic stripe) as part of your fare collection or transfer system?
❑Yes ❑ No
If "Yes"', please describe current or *contemplated* application: _____
_____
_____

56. Are you currently considering any application of automation to the transfer handling process?
❑Yes ❑ No
If "Yes", please describe the contemplated technology and benefits you expect to receive:
_____

YOU'RE ALMOST DONE!!!

Please enclose copies of any items requested m questions 5, 11, 33, 43, 45, 50. If there are several versions of any document, select one that you feel is most representative, or feel free to include multiple examples.

Return this survey and all documents by June 30, 1995, to:

Richard Stem
Booz*Allen & Hamilton, Inc.
595 Cody Pass
Wyoming, Ohio 45215

THANK YOU FOR YOUR HELP!

APPENDIX B

Respondent Profile

Location	Organization Name	Vehicles						Riders							Transfers		Fares	
		Bus	Commuter Rail	Heavy Rail	Light Rail	Para-transit	Other	Bus	Commuter Rail	Heavy Rail	Light Rail	Paratransit	Other	Total	Transfers	Percent of ridership	Passenger Revenue	Average Fare
Albany, NY	Capital District Transportation Authority	225				25		10,500				100		10,600	2,000	19%	$8,000	$0.75
Alexandria, VA	Alexandria Transit Company	33						2,196						2,196	974	44%	$1,469	$0.67
Allentown, PA	Lehigh and Northampton Transit Authority	70				70		4,000				272		4,272	360	8%	$3,381	$0.79
Ann Arbor	Ann Arbor Transportation Authority	66				8		3,765				320		4,085	628	15%	$2,139	$0.52
Atlanta, GA	Metropolitan Atlanta Rapid Transit Authority	669		240		45		72,817		69,885		60		142,762	78,500	55%	$74,954	$0.53
Baltimore MD	Mass Transit Administration	844	75	100	35	20		8,385	5,052	10,470	6,229	51		30,187	11,000	36%	$87,971	$2.91
Champagn-Urbana, IL	Champagne-Urbana MTA	80						8,400						8,400	220	3%	$2,600	$0.31
Charlotte, NC	Charlotte Transit System	160						9,600				78		9,678	2,000	21%	$0	$0.00

Location	Organization Name	Vehicles						Riders							Transfers		Fares	
		Bus	Commuter Rail	Heavy Rail	Light Rail	Para-transit	Other	Bus	Commuter Rail	Heavy Rail	Light Rail	Paratransit	Other	Total	Transfers	Percent of ridership	Passenger Revenue	Average Fare
Chicago (PACE)	Pace Suburban Bus	558				368	210 Van pool	39,433				1,563	567	41,562	11,191	27%	$27,660	$0.67
Columbus, OH	Central Ohio Transit Authority	310				26		17,200				42		17,242	2,600	15%	$10,590	$0.61
Connecticut Transit	Connecticut Transit	379						32,532						32,532				
Dallas, TX	Dallas Area Rapid Transit	855				145	8	45,000						45,000	9,500	21%	$21,582	$0.48
Denver CO	Regional Transportation District	654			11			47,900			4,015			51,915				
Honolulu, HI	Honolulu Public Transit Authority	495				92		80,000				676		80,676	4,200	5%	$25,675	$0.32
Houston, TX	Metropolitan Transit Authority of Harris County, TX	1,293				98		83,014				869		83,883	24,240	29%	$43,792	$0.52
Long Beach, CA	Long Beach Public Transportation Company	177				20		23,201				91		23,292	4,396	19%	$8,865	$0.38
Louisville, KY	Transit Authority of River City	362				62		15,000				300		15,300	0	0%	$6,100	$0.40
Miami, FL	Metro-Dade Transit Agency	634		136	29	46		63,766		14,328	3,588	756		82,438	18,799	23%	$62,077	$0.75

Location	Organization Name	Vehicles						Riders							Transfers		Fares	
		Bus	Commuter Rail	Heavy Rail	Light Rail	Para-transit	Other	Bus	Commuter Rail	Heavy Rail	Light Rail	Paratransit	Other	Total	Transfers	Percent of ridership	Passenger Revenue	Average Fare
Milwaukee, WI	Milwaukee County Transit System	540						59,890						59,890	9,422	16%	$32,006	$0.53
Ottawa, ON	OC Transpo	825				140		102,200				700		102,900	24,200	24%		
Peoria	Greater Peoria mass Transit District	42				7		950				76		1,026	586	57%	$522	$0.51
Phoenix, AZ	City of Phoenix Transit System	385				162		33,252				759		34,011	9,843	29%	$6,845	$0.20
Portland, OR	Tri-Met	619			26	153		50,808			8,100	696		59,604	11,964	20%	$27,980	$0.47
Reno, NV	Regional Transportation Commission/Citifare	63				33		8,050				197		8,247	1,027	12%	$4,791	$0.58
Riverside, CA	Riverside Transit Agency	160						4,990				598		5,589	750	13%	$2,466	$0.44
Sacramento, CA	Sacramento Regional Transit District	200			36	70		15,975			6,958	283		23,216	5,850	25%	$15,376	$0.66
Salt Lake City	Utah Transit Authority	465				84	29 van pool	24,343				315		24,658	10,000	41%	$8,800	$0.36
Savannah, GA	Chatham Area Transit	61				14		3,441				45		3,486	664	19%	$2,992	$0.86
Seattle, WA	King County Department of Metropolitan Services	1,155			5	143	844 van pool	78,816			437	1,210	2,101	82,564	24,139	29%	$49,786	$0.60

Location	Organization Name	Vehicles						Riders							Transfers		Fares	
		Bus	Com-muter Rail	Heavy Rail	Light Rail	Para-transit	Other	Bus	Com-muter Rail	Heavy Rail	Light Rail	Paratransit	Other	Total	Trans-fers	Percent of ridership	Passenger Revenue	Aver-age Fare
Sioux Falls SD	Sioux Falls Transit	26				17		538				118		656	0	0%	$197	$0.30
Washington, DC	WMATA	1,450		720				169,000		195,800				364,800	123,200	34%	$297,759	$0.82

THE TRANSPORTATION RESEARCH BOARD is a unit of the National Research Council, which serves the National Academy of Sciences and the National Academy of Engineering It evolved in 1974 from the Highway Research Board, which was established in 1920. The TRB incorporates all former HRB activities and also performs additional functions under a broader scope involving all modes of transportation and the interactions of transportation with society. The Board's purpose is to stimulate research concerning the nature and performance of transportation systems, to disseminate information that the research produces, and to encourage the application of appropriate research findings. The Board's program is carried out by more than 270 committees, task forces, and panels composed of more than 3,300 administrators, engineers, social scientists, attorneys, educators, and others concerned with transportation; they serve without compensation. The program is supported by state transportation and highway departments, the modal administrations of the U.S. Department of Transportation, the Association of American Railroads, the National Highway Traffic Safety Administration, and other organizations and individuals interested in the development of transportation.

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