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TCRP Synthesis 17

Customer Information at Bus Stops

A Synthesis of Transit Practice

Transportation Research Board
National Research Council

TRANSIT COOPERATIVE RESEARCH PROGRAM

Synthesis of Transit Practice 17

Customer Information at Bus Stops

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Transportation Research Board
National Research Council

Research Sponsored by the Federal Transit Administration in Cooperation with the Transit Development Corporation

NATIONAL ACADEMY PRESS
Washington, D.C. 1996

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.

TCRP SYNTHESIS 17

Project SA-5
ISSN 1073-4880
ISBN 0-309-05873-2
Library of Congress Catalog Card No. 96-060633

Price $18.00

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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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Published reports of the

TRANSIT COOPERATIVE RESEARCH PROGRAM

are available from:

Transportation Research Board
National Research Council
2101 Constitution Avenue, N.W.
Washington, D.C. 20418

Printed in the United States of America

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, bus operations, facilities and maintenance, and marketing and customer service staffs, as well as to other municipal transportation and marketing professionals. It addresses user information systems and describes current transit agency practices regarding customer information at bus stops within the text and through tables and multiple graphic illustrations.

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 or closely related issue or problem.

This report of the Transportation Research Board covers types of signs and supplemental information displays, program implementation considerations, program effectiveness, and advanced technology applications. Selected transit agency case studies detail five different perspectives on the development and deployment of on-street programs.

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 areas 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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ACKNOWLEDGMENTS

John J. Dobies, Kansas City, Missouri, was responsible for collection of the data and preparation of the report.

Valuable assistance in the preparation of this synthesis was provided by the Topic Panel, consisting of Ronald E. Boenau, Transportation Management Specialist, Federal Transit Administration; Richard F. Davis, General Manager, Kansas City Area Transportation Authority, Kansas City, Missouri; Judith Leitner, Communications Manager, Metropolitan Transit Development Board, San Diego, California; G. Warren Miller, Coordinator, Sales and Information, Toronto Transit Commission, Toronto, Ontario, Canada; Richard F. Pain, Transportation Safety Coordinator, Transportation Research Board, Washington, D.C.; and Jack Reilly, Director of Planning and Development, Capital District Transportation Authority, Albany, New York.

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.

CUSTOMER INFORMATION AT BUS STOPS

SUMMARY

Many transit agencies have taken steps to increase and improve transit service information at bus stops in recent years. These steps reflect the growing awareness among transit agency managers that service information provided at bus stops is important to transit users and can be used effectively to increase ridership by retaining existing riders and potentially attracting new riders to the transit system.

A survey of selected transit agencies conducted for this synthesis indicates that, although the opinions of transit managers are divided with respect to the cost-effectiveness of on-street information displays, there is general agreement that such programs are needed in some form and contribute to a more "user friendly" transit system. A concern exists relative to the cost of providing and maintaining displays of service information that is subject to periodic change, such as bus route schedules. The pressures of reduced funding and resultant reductions in budget and staff support for on-street programs have caused most transit agencies to limit application of on-street displays to major downtown stops or transfer locations, a small percentage of the total number of bus stops on the system. The absence of conclusive evidence that the cost of these programs is justified by tangible payback in the form of increased ridership and passenger revenues was found to be a concern of transit industry practitioners.

On-street information displays are considered an important part of the transit agency's overall user information system, along with telephone information systems and various printed materials, such as route brochures and system maps. Information at bus stops can provide the "point of purchase" information that is believed to be a necessary ingredient.

The bus stop sign itself has become a means of providing limited service related information a departure from the bus stop signs generally in use before 1980 that served only as markers for designated bus stops. It is now common for bus stop signs to include information pertaining to the route number and name serving the stop. Some transit agencies have also used bus stop signs to convey limited service information on service days and span of service. Transit agency managers have been able to produce and maintain these upgraded bus stop signs without significant increases in costs and staffing.

More detailed transit service information is typically provided in special or supplemental displays. The additional information frequently displayed includes:

- schedule information,
- route maps,
- system maps, and
- fare information.

These supplemental displays were found to range from small display panels affixed to bus stop sign supports to large displays employing color graphics depicting route and system maps and other information believed to be useful to transit riders. Simple displays showing bus schedules in varied formats are much more common than larger displays.

The on-street information displays used by transit agencies are widely varied in design, with virtually no standardization. Transit agency managers report that program and display designs have evolved through a process of application and judging "what works." In some cases structured research has been used to assist in the design process, but for the most part only casual input from transit users has affected designs that are largely the product of staff from functional units such as planning, scheduling, and marketing.

Adaptive and even creative approaches to the tasks of designing, producing, and maintaining on-street information displays are the norm. Most transit agencies use existing personnel with primary responsibilities in other related areas to provide staff for on-street information programs. Various production methods are used, in some cases the "cut and paste" technique, to adapt information materials produced for other purposes, such as route brochures, to on-street displays. Advances in personal computer software, including spreadsheet applications, word processing, and graphic design packages have simplified the design, production, and revision of information displays, and have allowed the deployment of a greater number of displays without staff increases. The use of integrated automation, for example, tying into automated scheduling systems for schedule display production, was not found to be a common practice.

Nonetheless, most transit agencies have been able to deploy detailed information displays at five percent or less of their bus stops. A relatively small number of transit agencies have widespread on-street information programs. Smaller transit agencies, with fewer staff resources, are less likely to have well-developed programs.

The cost of providing on-street displays varies considerably among transit agencies. Materials, including display case hardware, are not as great a concern as the personnel costs. The entire process is very labor intensive, particularly the installation and ongoing upkeep of information in the field. Replacing revised information materials is considered the most difficult, time consuming, and expensive part of the program by most transit agencies.

Finally, although the application of advanced technology holds some promise for use at bus stops, changeable electronic signs have very limited distribution currently. The integration of automated vehicle location technology (AVL) with signage to provide real-time information to transit users at stops is currently being tested by some transit agencies.

The Federal Transit Administration is researching the application of variable message signs at transit stops, as well as other traveler information applications, and the system's full capabilities will be showcased in Atlanta during the 1996 Summer Olympics.

CHAPTER ONE

INTRODUCTION

BACKGROUND

Potential transit patrons require a considerable amount of information to use any transit system. For example, to effectively use a transit bus, an individual needs to know which route to take, where the bus goes, where the bus stops, when the bus arrives, and the travel time to the destination. To provide this information, transit agency managers have developed and made available a number of instruments and services including printed materials showing routing for entire systems, schedules and maps for individual routes, and all manner of supplemental brochures providing information on the use of transit services. Telephone information systems, both traditional and automated, are used by virtually every transit agency to provide more specific information relative to an individual's information needs. Recently, other media such as cable television, personal electronic devices, and even on-line computer services (e.g., Internet) have been used to assist in the task of providing information to transit agencies' customers.

Providing transit customer user information at bus stops can be a fundamental part of the transit agency's overall customer information mix. The bus stop is the customer's access point to the transit system. Therefore, properly designed and displayed information can fulfill the need for important "point of purchase" guidance to customers. Supplying user information at bus stops does not require active consumer participation, as is the case when printed materials and telephone information are required.

It is commonly held that ineffective user information systems are barriers to increased transit ridership, a belief that has been supported by various market research efforts *(1).* In recent years, more research and other efforts have increased to advance the state of the art for information systems for transit users. However, the bus stop sign, with its potential for displaying a wide range of user information, has been underutilized *(2).* Some transit agencies have invested considerable time and effort to develop signs and other displays that provide such a wide range. More typically, transit agencies do not provide this type of information at stops, or provide information at a relatively small number of stops.

Transit user information in and around rail transit stations has received substantial attention in recent decades. State-of-the-art technology and advanced graphic design techniques have been applied to the task of informing and directing transit patrons. Transit centers, where buses operating on multiple routes converge and patron volumes exceed those at typical bus stops, require the development of more sophisticated informational techniques. In these cases, considerable resources have been used to ensure that customers and potential customers receive sufficient information to effectively use the transit system.

But in most cities, the majority of transit users board buses at simple curbside bus stops with minimal information, sometimes only a sign indicating the presence of a designated bus stop. Transit patrons in this situation are in an environment devoid of information, without the benefits of transit agency staff and facilities to guide them to their destination.

In recent years, the potential of applying advanced technology to providing consumer information at the point of purchase has attracted considerable attention. The Advanced Public Transportation Systems (APTS) Program was created by the Federal Transit Administration (FTA) as part of the Department of Transportation's initiative regarding the application of advanced technology to traffic and transportation problems *(3).* APTS is part of the Intelligent Transportation System (ITS) Program. Through the APTS Program, a number of operational test programs are currently or will soon be underway to develop and evaluate technological solutions to the problems of providing transit user information *(3).*

This synthesis recognizes the advances that the APTS operational tests and other similar endeavors are making. Although the role of new technology is discussed, this synthesis focuses on the use of printed materials and static displays to provide information. This focus recognizes that (1) the APTS operational tests are generating considerable documentation for use by transit managers in evaluating programs, and (2) technology cannot be the answer in all cases because of budget constraints or the limits of its applications to the thousands of access points that exist in a typical transit system.

SYNTHESIS OBJECTIVES

The major focus of this synthesis project is to gather pertinent information on current transit industry practices and research activities related to the provision of customer information at bus stops.

The intent is to:

- Summarize and present the information in a manner that provides a clearinghouse of practical ideas for transit agency managers to develop or enhance their information program, and
- Provide information on practical matters such as costs, staffing requirements, design considerations, ADA (Americans With Disabilities Act) requirements, and other similar considerations.

Another important part of this synthesis addresses the cost-effectiveness, or the "pay back" on the transit agency's investment in these information programs and systems. Effectiveness is explored through the attitudes, judgment, and

practices of transit agency managers, as well as more formal research into the matter. Concerns about cost effectiveness increase as transit agency managers struggle with the competing pressures of providing more and better user information in the effort to increase ridership, and the need to limit and even eliminate programs in response to budgetary pressures.

Finally, this synthesis briefly reviews the application of technology to the task of providing information at bus stops. Other sources, many of which are named in the bibliography, provide considerable information on the state of the art with regard to technology application.

METHODOLOGY

A comprehensive survey questionnaire was developed to obtain information for the synthesis project from transit agencies regarding their practices relating to providing customer information at bus stops. A copy of this questionnaire is included as Appendix A. The survey was developed with input from Synthesis Topic Panel members, and was designed to support the initial objectives of the project.

The survey questionnaire was sent to approximately 45 transit agency managers in the United States and Canada. An attempt was made to obtain information from a representative sample of transit agencies. The selected sample included a similar number of agencies from various geographic regions. The sample equalized the number of small, medium, and large agencies based on number of vehicles operated, and the sample included bus only systems, as well as systems providing rail transit service.

Aside from these considerations, no other preselection criteria were used (e.g., systems were not selected because they were known to have well developed on-street information programs). Thus, the initial sample of transit agencies surveyed can be described as "randomly" developed, although not in the statistical sense. Responses were obtained from 21 of the transit agencies, representing a return rate of approximately 50 per cent. Table 1 shows a distribution of responding transit agencies by system size and region.

Some respondents provided additional information, such as drawings or photographs of bus stop signs and information displays. In other cases, survey respondents were requested to provide additional information, such as market research documentation. This supplemental information proved to be very valuable throughout the synthesis project. In addition to the basic survey, several transit agencies were identified as candidates for more thorough follow-up examination of information programs. Site visits were conducted to collect first-hand information on various details of on-street information programs in place at these transit agencies.

Finally, a literature search of relevant materials was conducted using, among other techniques, a Transportation Research Information Services (TRIS) search. In addition to published materials, transit agency managers also identified unpublished materials that were very helpful.

TABLE 1

TRANSIT AGENCIES RESPONDING TO SURVEY

City	Transit Agencies	System Size	Number of Modes	Region
Atlanta	Metropolitan Atlanta Rapid Transit Authority	Large	2	Southeast
Calgary	Calgary Transit	Large	2	Canada
Chicago	Pace Suburban Bus Division of RTA	Large	1	Midwest
Denver	Regional Transportation District	Large	2	Rocky Mountain
Milwaukee	Milwaukee County Transit System	Large	1	Midwest
Pittsburgh	Port Authority of Allegheny County	Large	3	Mideast
San Diego	San Diego Metropolitan Transit Development Board	Large	2	West Coast
Toronto	Toronto Transit Commission	Large	4	Canada
Washington	Washington Metropolitan Area Transit Authority	Large	2	East
Albany	Capital District Transportation Authority	Medium	1	East
Kansas City	Kansas City Area Transportation Authority	Medium	1	Midwest
Louisville	Transit Authority of River City	Medium	1	Mideast
Montgomery County, Md.	Montgomery County Division of Transit Services	Medium	1	East
New York	MTA Long Island Bus	Medium	1	East
Orlando	LYNX Central Florida Regional Transportation Authority	Medium	1	Southeast
Sacramento	Sacramento Regional Transit District	Medium	2	West Coast
Salt Lake City	Utah Transit Authority	Medium	1	Rocky Mountain
Reno	Regional Transportation Commission	Small	1	Rocky Mountain
Sarasota, Fla.	Sarasota County Area Transit	Small	1	Southeast
Sheboygan, Wis.	Sheboygan Transit	Small	1	Midwest
Topeka, Kan.	Topeka Metropolitan Transit Authority	Small	1	Midwest

Source: 1995 Survey of Transit Agency Managers

LITERATURE SEARCH

The subject of user information at bus stops received no substantial coverage in the literature during the past 15 years. Whereas considerable efforts have been made to test and develop effective roadway information systems used to simplify driver decision making, no similar effort has been directed at the transit user.

Bus stop signs and supplemental information displays at bus stops are only part of the overall information and communications systems that transit agencies employ to inform and direct their customers. Thus, technical journals and other sources in the literature have addressed information provision at bus stops within the broader concept of overall communications systems. A number of these sources date to the 1970s and early 1980s when transit providers moved from the private sector to the public sector and the transit industry began improving its marketing, advertising, and communications practices.

Some of the most interesting and useful research efforts are those conducted by individual transit agencies as transit managers attempted to deal with the task of developing effective signage and information systems. At times these efforts were documented for use by others; at other times the efforts were not documented beyond internal memoranda.

One such research effort that dates from the mid 1970s was a research project in Milwaukee, Wisconsin designed to specifically identify the factors that would lead to an effective bus stop sign. The demonstration project was conducted by the Milwaukee County Transit System (MCTS), Marquette University and University of Wisconsin, Milwaukee (4). The project included three parts: development of new bus stop signs, field demonstration of the signs along MCTS routes, and evaluation of the experimental bus stop signs. The project was set up as a rather rigorous research project, with before and after surveys of transit users and non-users as part of the evaluation.

One of the objectives of the project was to determine what type of transit service information at bus stops would be useful

The pictograph of the bus is used to identify all bus stops.

The sign is reflective

The sign is 12 by 30 inches.

Route numbers and route names are displayed for each route passing a bus stop.

The overall color scheme of the sign is white on a blue background. Blue is also used to designate all local stops.

Special messages are provided for each route.

The transit system information telephone number is displayed on all bus stop signs.

FIGURE 1 Bus stop sign recommended by Milwaukee research.

to riders. A second objective was to determine how this information could best be displayed and presented for effective use by transit riders. For example, a survey of bus riders concluded route number and name were most important, followed by hours (span) of service and waiting time for the bus.

In addition, the study also considered legibility factors, cost, and servicing issues. The result was a recommended sign type that employed a bus pictograph to identify the stop location, and a display of the bus stop name and number. Figure 1 is a drawing of the recommended sign for MCTS. This sign is still in use by the transit agency in Milwaukee. Consistent with findings of the research project, more detailed service information has not been included on the standard MCTS bus stop sign.

Another significant document is a handbook published by the American Public Transit Association (APTA) in May of 1983 entitled *Marketing On-Street Information (5).* The manual was the product of APTA's consumer information subcommittee

Rider Audiences

- Regular Riders
- New riders
- Special riders
  - Disabled
  - Non-English speaking
  - Students
  - Tourists

Non-Rider Audiences

- Transit Drivers
  - New drivers
  - Unfamiliar drivers
- Elected representatives
- Retail merchants

Informational Functions

- Bus stop identification
  - Mode identification
  - Logo
- Route(s) designation
- Route destination(s)
- Transfer points or centers
- Days/hours of operation
- Service frequency
- Handicapped accessibility on vehicles servicing route
- Route map(s)
- Telephone information number

Psychological Functions

- Promote corporate identity (name, logo, color scheme, etc.)
- Reinforce other consumer aids
- Rider reassurance
- Create impression of service quality
- Attract nonriders
- Create a positive image toward public transit

Operations Functions

- Decrease dependence on drivers for information
- Decrease dependence on telephone information service
- Promote additional ridership
- Improve driver morale
- Designate stops more clearly for new drivers

FIGURE 2 Transit information sign audiences and functions (adapted from APTA's *Marketing On-Street Information). (5)*

ELEMENTS OF THE TRANSIT STOP SIGN				
ELEMENTS	TYPE OF BUS STOP			
	SINGLE ROUTE	MULTIPLE ROUTE	HI-DENSITY ROUTE	SPECIALIZED ROUTE
Stop identification				
Mode identification				
Logo				
Route destination				
Route destination(s)				
Direction				
Service frequency				
Route map				
Stop timetable				
Route timetable				
Transit information telephone number				
System map				
Fare information				
General passenger information				
Accessibility information				
Pedestrian guides				
Local area map				
Special services				
Transfer points				
Zone identification				
Major destinations				

FIGURE 3 Illustration of bus stop hierarchy concept from APTA's *Marketing On-Street Information. (5)*

and represented, at the time, the most comprehensive treatment of "state-of-the-practice" bus stop signs and information displays. The on-street information manual was intended to be a resource document for transit practitioners responsible for managing and implementing communication and information systems.

The manual presented a systematic approach to the task of bus stop sign/display design, starting with an assessment of transit information sign audiences and transit information sign functions. Figure 2 shows audiences and functions as they were presented in the APTA manual.

The handbook also developed a listing of recommended information components, which included the following items:

Stop identification (pole, stripe, curb painting, sign location)
Mode identification (vehicle type, words/pictogram)
Logo (corporate seal, graphic, or name)
Route designation (number, letter, or name)
Route destination(s)/direction
Service frequency (includes days, hours, etc.)
Route map (or small group of routes for local area served)
Stop timetable (or headway information by time of day)
Route timetable (indicating entire route operation)

Transit information telephone numbers (possibly adding lost and found, complaints, etc.)
System map (or map of large group of routes for region)
Fare information (possibly with fare rules: exact change, transfer limits, etc.)
General passenger information (rider tips, where/how to obtain more information, etc.)
Accessibility information (for handicapped riders)
Pedestrian guides (indicating how to walk from stop to other local points)
Local area map (blowup-map showing transit stop's location relative to buildings and streets)
Special services (call-on-demand, shuttle, passes, etc.)
Transfer points (indicating where and how to make transfers)
Zone identification
Major destinations.

Along with these recommendations, the concept of bus stop hierarchy was introduced to rationalize the decision making related to placing information at stops. Bus stops have differing levels of importance and complexity, measured in terms of number of boardings, number of buses serving the stop, presence of interconnecting (i.e., transferring) routes, proximity to major generators, and other factors. More important and more

complex bus stops would be provided more detailed service information. Figure 3 shows how the APTA handbook related various types of bus stops to information provision.

The concepts and recommendations contained in APTA's on-street information handbook was the product of a considerable effort to collect information from transit agency managers, as well as relevant research efforts. The handbook remains of value today, more than 12 years after its publication.

More recently, the matter of user information at bus stops has been the subject of some limited research and study. Some of this interest has been generated by the Americans With

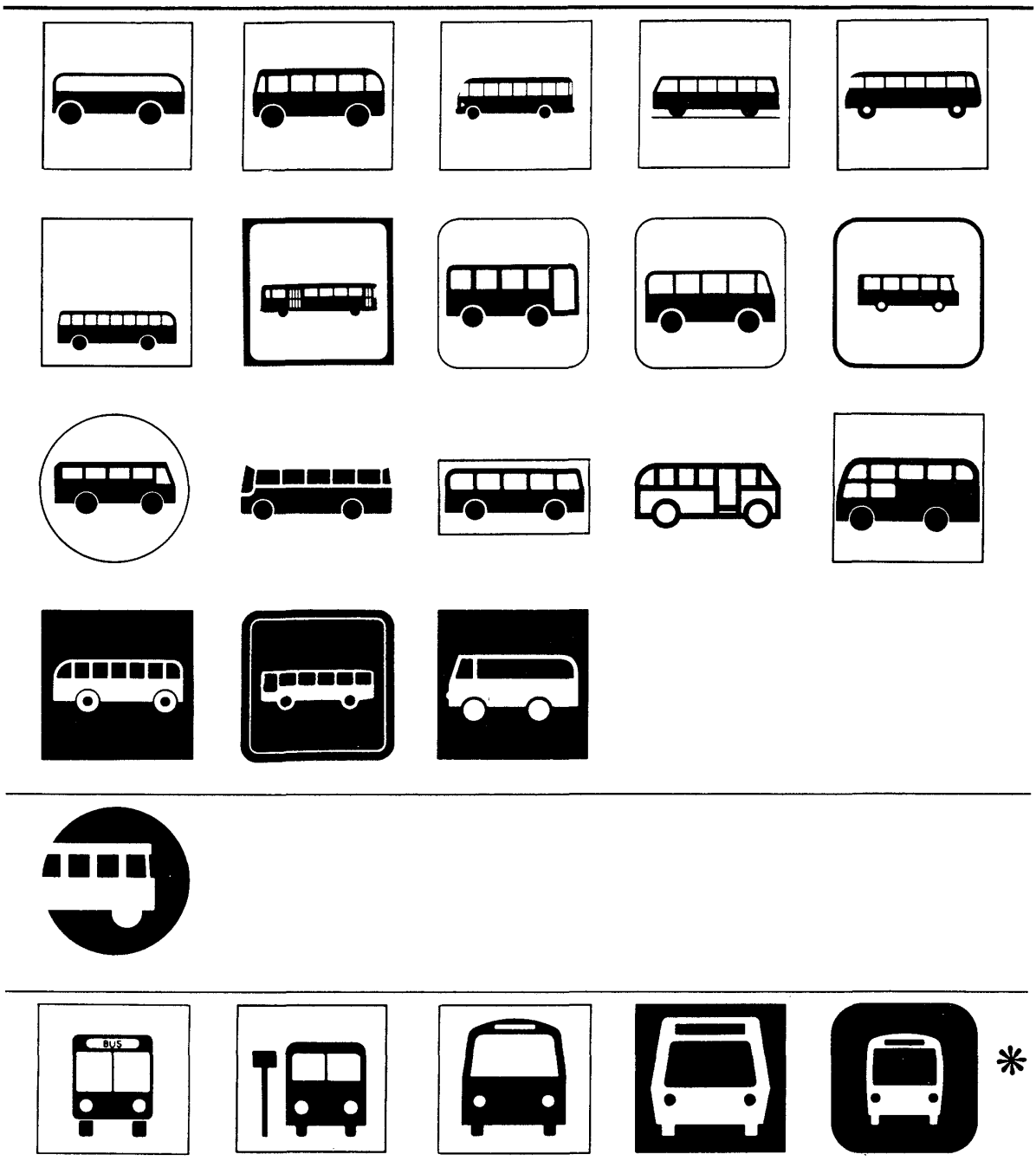


FIGURE 4 Bus identifier symbols considered in U.S. Department of Transportation study.

Disabilities Act (ADA). For example, a number of study efforts have focused on needs and accommodations for disabled persons in and around transit facilities, including bus stops *(6).* Chapter 3 of this synthesis provides additional information regarding ADA Regulations and related concerns as they apply to bus stop signage.

A report prepared for the U.S. Department of Transportation reviewed and recommended graphic symbols for use in various transportation-oriented signs and displays *(7).* Both front and side views of a bus were found to be relatively clear representations of the idea of bus transportation. Figure 4 shows the various bus symbols considered in the research. Because the front view is clear and fits well into the square format of a sign, the front view rather than the side view was recommended. The study went on to conclude that the drawing should avoid too much detail and should represent buses in general, avoiding any characteristics that would define a specific model bus. The symbol marked with an asterisk (*) in Figure 4 was selected as a standard.

A number of related Transit Cooperative Research Program (TCRP) projects are proceeding concurrently with the Synthesis project on customer information at bus stops.

TCRP Project A-10, *Location and Design of Bus Stops on Major Streets and Highways,* deals specifically with various design and operation issues of bus stops *(8).* Signage and information displays are addressed only briefly in Project A-10. There is, however, useful information regarding the placement of signage and information displays relative to other elements of bus stop design. The reader is referred to TCRP Project A-10 for detail on these design issues; they will not be duplicated in this synthesis.

Another related TCRP Project is A-9, *Signs and Symbols in Transit Facilities (9).* Although the focus of TCRP Project A-9 is transit facilities, such as stations and transit centers, the project offers the transit practitioner considerable useful information on matters such as graphic standards, legibility, and consistency. The objective of Project A-9 is to develop a graphics design manual for the use of signs and symbols that provide for the safe, secure, and efficient movement of passengers to and through transit facilities.

Recognizing that bus stop signage and information displays are only one part of a broader and more comprehensive communication and information system, and that this information system must reflect the needs and perspectives of transit users, market research is an important consideration.

TCRP Project B-2, *Integrating Market Research into Transit Management,* is another reference with respect to the design and display of user information at bus stops, if market research is used to assist with the design of the program and materials *(10).* Project B-2 has as its focus integrating the customer's perspective into transit plans and programs.

Another related TCRP Project, A-12, *Passenger Information Services,* began in January of 1996. The principle objective of this research project is to produce a clear and practical guidebook to assist transit professionals in making transit information more accessible and user friendly for transit agencies of varying complexity *(11).* The research is to address traditional media, including schedules, maps, and signage.

The Transit Cooperative Research Program is also active in the area of technology application to transit information systems. Project G-1, *Information Technologies--State-of-the-Art Applications for Transit Properties,* is nearing completion. The objectives of Project G-1 are:

- Review and critique state-of-the-art technologies and evolving real-time transit information systems,
- Establish criteria and develop evaluation procedures for use by transit agencies to indicate the value of the information systems,
- Demonstrate the usefulness of these procedures by evaluating several applications.

The evaluation procedures are intended to support decision making by transit agencies large and small regarding technology implementation.

The traffic engineering and highway design profession has conducted considerable research on traffic signs. This research deals with subjects including legibility, design and placement issues, and materials and installation. The *Manual on Uniform Traffic Control Devices* (MUTCD) is an excellent source of information regarding the design and placement of standardized traffic signs *(12).* Some of the concepts summarized in the MUTCD have application to bus stop signs, at least in general.

In addition, there have been many studies regarding the durability and maintainability of traffic sign materials. Some of this research has been conducted by municipal or state transportation agencies. Virtually every state transportation agency and most municipal street and highway agencies have manuals or other documents pertaining to all aspects of traffic signs. It is recommended that transit managers contact state and municipal agencies for specific information and assistance on such matters as material selection, installation, and costs.

Chapter 2 provides an overview of the types of information provided, and the presentation methods used. Chapter 3 provides program implementation considerations based on the experience of a number of transit agencies with costs, program organization and design, and other related factors.

CHAPTER TWO

TYPES OF USER INFORMATION PROVIDED AT BUS STOPS

All of the transit agency managers contacted during the survey phase of this synthesis were in at least general agreement that providing user information at bus stops is an important function. It was discovered that transit agencies have considerably different approaches to the matter of providing information at bus stops, including the type of information provided, presentation of information (formats, media, etc.), extent of information provided, program criteria, and organization of the function within the transit agency.

Throughout this synthesis, the discussion of information provision at bus stops is divided into two parts or types: bus stop signs and supplemental information displays.
This distinction is made because a number of important differences exist in the use of these instruments for communicating with transit users. However, this distinction does not suggest that signs and displays can be designed independently. Obviously the integration of these two components is necessary.

Virtually all transit agencies use some sort of bus stop signs to at least identify the location of designated stops. All transit agencies contacted as part of this synthesis project use bus stop signs, but not all use supplemental displays to provide additional service information.

BUS STOP SIGNS

Since the 1970s, bus stop signs in most communities have evolved from relatively simple signs designating the location of the bus stop using words, symbols, or graphics to signs that often include additional information. The most common additional information displayed on bus stop signs is route number and name and telephone information center number. Some systems also include span of service information and operating days. Figure 5 compares bus stop signs with and without supplemental information. Appendix B includes photographs of a variety of bus stop signs with and without this supplemental information. Table 2 summarizes sign types currently in use by transit agencies that participated in the survey for this synthesis.

Some transit agencies use different types of signs depending on the application. For example, signs that are located at stops served by multiple routes include route identification, whereas signs at single route stops do not include route identification.

A number of transit agency managers stated that they do not include service related information on bus stop signs because this information is subject to periodic change, which would require replacement or revision of the bus stop signs.

Unlike traffic signs, which are standardized with respect to shapes, size, color, wording and graphics, bus stop signs vary from community to community. There are, however, some generalizations that can be made regarding the design and information of bus stop signs.

FIGURE 5 Bus stop signs with and without service information.

TABLE 2
INFORMATION INCLUDED ON BUS STOP SIGNS

	Number of Systems	Percentage of Total
Only Stop Identification	5	24
Route Number and/or Name	15	71
Service Information	3	14
Phone Information Number	11	52

Source: 1995 Survey of Transit Agency Managers.
Note: Percentages add to more than 100 percent because of multiple responses.

Shape. The vast majority of bus stop signs are rectangular; other shapes, such as triangles and discs common in the past, have been replaced in most cities. This change is probably a concession to the sign fabrication process and related costs as much as any concern for standardization.

Size. Sign sizes vary with local preference and the amount of information included on the sign. Twelve in. is a common width, although narrower signs are used for "flag" mount installations to avoid encroachment on the roadway. Lengths vary from 18 in. to 36 in. Larger signs require more substantial supports, and often cannot use existing poles. One transit agency manager stated a preference for larger bus stop signs to allow the signs to be more visible in the sign "clutter" present in urban areas.

Color. The transit agency's color scheme is often reflected in the bus stop sign design. Some preference was stated for bright colors (e.g., red) so that the sign would be more visible. At least one system opted for more muted colors so that the bus stop signs would not be as visible, for aesthetic reasons. Colors are often used to convey service related information. For example, red for express services, and blue for local services. The pattern of colors used for bus stop signs is also used for other components of the user information system, reinforcing the use of colors. Some colors are more durable than others. For example, red is more subject to fading in sunlight than other primary colors.

Logos. Most transit agencies include their logo on the sign to reinforce the public's recognition of the logo.

Reflectorization. Most bus stop signs use reflective sheeting to improve nighttime visibility, more so for the benefit of bus operators than bus riders. One transit manager noted that reflective bus stop signs "looked better," and helped improve transit's visibility. Although more expensive than non-reflective sheeting, reflective signs are very common in all applications. One system that does not use reflective signs cited cost as a factor in the decision.

Graphics. The pictograph of the front view of a bus has become a standard of sorts as more systems adopt this symbol in some form. It was noted that this symbol provides some continuity from city to city (where the symbol is used), and eases problems of comprehension for persons who do not read English. The words "bus" and "stop" often do not appear on signs using the pictograph because these words are thought to be somewhat redundant. This allows more space on the sign for additional service related information.

Service Information. As shown in Table 2, identification of the route name and/or number on the bus stop sign is becoming a standard. Several transit managers indicated this information is the minimum that should be provided. It was noted that the identification of the route serving the stop makes the task of instructing non-riders on how to use buses easier for telephone information agents. Improvements in signage materials in recent years have made the display of specific information easier and less expensive than it once was. Some agencies are taking advantage of relatively low-cost, easy-to-deploy self-adhering vinyl "stickers" to add information on service limitations such as "No Weekend Service", "Rush Hour Service Only", etc. There is general agreement that bus stop signs should include only service information that is not subject to frequent change, because the signs should be in place for 7 to 10 years, and information on them is not easily revised.

The design of bus stop signs reflects the widespread thinking that the sign's function goes beyond simply identifying a place where the bus stops. The signs are one of the transit agency's most visible elements and can be used to "advertise" the presence of transit service to nonusers, reinforce logos and color schemes, and generally add to the transit agency's image. Large transit agencies have 6,000 to 15,000 bus stop signs. Several managers noted that no other businesses have an opportunity to place signs at so many high-visibility locations. To take best advantage of this opportunity, the sign should be well-designed and integrated with other information system components.

SUPPLEMENTAL INFORMATION DISPLAYS

For the most part, transit agencies that provide more detailed service related information at bus stops use some type of display case or module. The most common types of supplemental displays are small information display cases that can be affixed to the support that holds the bus stop sign. These display cases are of various sizes, ranging from about 6 in. x 12 in. x 1 in. to 8 in. x 24 in. x 2 in. The display cases are available commercially from a number of manufacturers, or in some cases, are custom fabricated by the transit agency.

Some transit agencies also use larger display cases designed to house service related information for multiple routes and a broader range of information types. These display cases typically are custom designed and manufactured as freestanding kiosks, and are installed at more important bus stops, such as downtown stops, transfer locations, and transit centers.

A number of transit agencies have used information display cases that are incorporated into bus passenger shelters. Typically these cases are large enough to house service related information on multiple routes, and a broader range of information types. The shelter structure provides a convenient support for the information display, as well as some degree of protection from the elements. The type of information provided at bus stops in these display cases varies considerably among transit agencies, and even among locations within a system. Table 3 summarizes the type of information provided by transit agencies that responded to the survey.

TABLE 3

TYPE OF INFORMATION PROVIDED AT STOPS IN SUPPLEMENTAL DISPLAYS

	Number of Systems	Percentage of Total
Route Number and/or Name	18	86
Route Destinations	13	62
Route Map	14	67
Exact Schedule Information	12	57
Service Span and/or Frequency	7	33
Fare Information	11	52
Telephone Information Number	13	62

Source: 1995 Survey of Transit Agency Managers.
Note: Percentages add to more than 100 percent due to multiple responses.

These supplemental displays typically include information that changes frequently, such as schedule information. The displays also provide information that cannot reasonably be provided on the bus stop sign, such as route maps. Bus stop signs usually are mounted at a height of about 7 ft from the ground. Supplemental displays typically are mounted at eye level, allowing for greater detail, and smaller print and graphics. Appendix C includes photographs showing various types of supplemental information display cases.

Supplemental displays also are used at bus stops served by a large number of routes, for example in downtown areas, where even basic route number/name information cannot be displayed on a sign because of space limitations.

For a number of reasons, mostly cost related, most systems use supplemental displays at a small number of bus stops. Only four of the 21 transit agencies responded that they do not have supplemental information programs and three of these are preparing to initiate programs. Most of the remaining 17 agencies have supplemental displays at only five percent of their stops or less; 11 of these agencies indicated that a very small number of stops (less than one percent) were so equipped. Typically, displays are located at major downtown stops, key transfer points, park-and-ride lots, bus/rail interface stops and other high activity locations.

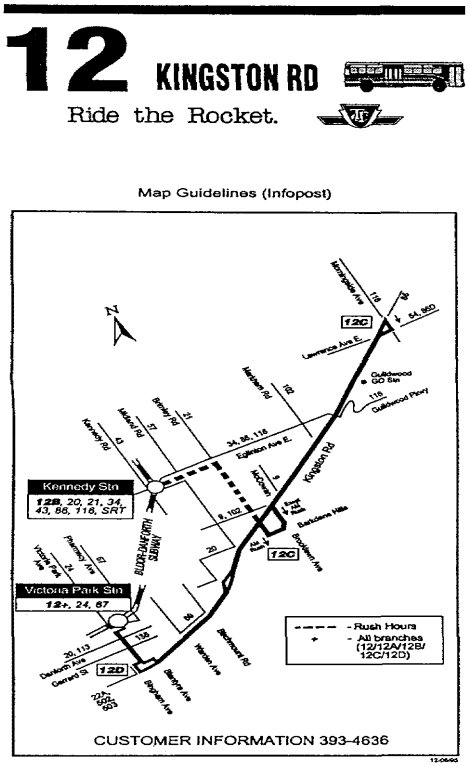
There are notable exceptions, however. Washington Metropolitan Area Transit Authority (WMATA) in Washington, D.C. reports that approximately 1,300 of the agency's 13,000 stops are equipped with supplemental displays showing schedule times, and the agency planned to increase the number to 3,500 by the end of 1995. In addition to installation at high activity stops (transfer points, etc.) WMATA uses the displays as part of targeted promotional campaigns. The Toronto Transit Commission (TTC) provides displays with route maps and schedule times at approximately 4,000 (40 percent) of its 10,000 bus stops.

As noted previously, the type and design of the information provided at bus stops vary considerably. The material that follows summarizes the information provided.

Service Schedules. Perhaps the most frequently provided information (other than route number/name) is some form of schedule information. Only one of the 17 agencies providing supplemental information reported that it does not provide schedule information in some form. The information is provided in a number of different formats.

Exact schedules are most commonly displayed. In a few cases time tables or system maps with schedule information are used as is, or adapted to the on-street display. Most transit managers believe that a stop-specific schedule is more effective. This format, sometimes referred to as "point schedules" or "corner schedules," shows only the time the bus is scheduled to arrive at the stop, so the user does not have to interpret a timetable with several timepoints for the route. It was noted that although this format is simpler, the user cannot determine travel time to or arrival time at their destination.

A difference of opinion among transit managers was found regarding the use of "bus stop times" versus scheduled timepoints. Some systems estimate the approximate time between timepoints and note these stop-specific times on the display.



TO STEELES - 57

FS (Frequent Service) - under 10 minutes

MONDAY THROUGH FRIDAY

A M	A M	P.M.	P.M	P M	P M
5 20	FS	2 30	ev 7-	8 30	10 20
40	8 36	42	10 mins	45	ev 20
57	45	FS	6 30	9 00	mins
6 11	ev 15	5 43	40	20	A M
19	mins	51	ev 10	40	12 20
26			mins	10 00	50

SATURDAY

A M.	A M.	A M.	P.M.	P.M.	A M.
5.15	8 15	ev 15	6 45	ev 30	12 45
ev 20 mins	30	mins	7 15	mins	

SUNDAY

A M.	A M.	A M.
7 45	ev 30 mins	12 45

FIGURE 6 Toronto Transit Commission schedule display combining exact schedules and frequency.

Other transit agencies do not subscribe to this practice because of the added difficulty of interpolating between timepoints, and the practical concern that bus operators are not required to adhere to schedules except at timepoints. The risk

with estimating times between timepoints is that buses may not adhere to the posted times. One system simply avoids placing schedule displays at stops other than at timepoints. More typically, the scheduled time for the previous timepoint is displayed. Thus, the bus rider may wait a few minutes longer for the bus than expected, but will not miss the bus if it arrives sooner.

Opinions also differ as to whether frequency information ("buses arrive every 15 minutes") or exact schedules are more useful to transit riders. The display of exact schedules was found to be far more common than frequency information. Some displays combine the two formats, using frequency information when trips are closely spaced (e.g., every 10 minutes), and exact schedules for lower service periods (e.g., every 30 minutes). An example of this is shown in Figure 6, one of the Toronto Transit Commission's schedule displays.

Route Maps. Route maps are used in displays by some agencies, but not as frequently as schedule information. The maps usually are adapted from route brochures. Some agencies use route maps only when additional space remains in a display panel after schedule information is displayed.

System Maps. The display of system maps was found to be quite common, usually adapted from materials developed for other purposes. High-quality graphics and this inclusion of user information make for suitable displays.

Specialized Maps. One agency has developed maps showing the area in the vicinity of the bus stop with sufficient detail to be of use to patrons alighting at the stop. This map can be used to assist riders unfamiliar with the area to access their final destination, or transfer to another mode. Figure 7 is an example of an area map used by the MTDB in San Diego.

FIGURE 7 Metropolitan Transit Development Board area map.

CHAPTER THREE

PROGRAM IMPLEMENTATION CONSIDERATIONS

This chapter summarizes information collected through the survey and during the site visits to assist transit managers in implementing or improving on-street information programs.

TYPES OF INFORMATION TO DISPLAY

As shown in Table 3 (Chapter 2), the most frequently displayed service information is route number and/or name, followed closely by route map, route destinations, and telephone information number. Exact schedules were found to be displayed by nearly 60 percent of the transit agencies surveyed.

Research such as the study conducted in Milwaukee can provide insight into program design from the user's perspective. Transit users are likely to want a wide variety of information available at bus stops, probably more than can be provided within the limits of funding and budget.

Transit agency managers were found to make decisions regarding program design based on a number of inputs, including systematic and casual inputs from transit riders. In most cases the program design reflected the judgment of experienced transit agency staff, particularly from the service planning/scheduling, planning, and marketing functions. Several transit agencies indicated that design decisions were the product of interdepartmental committees or work groups, with representatives from these functional areas.

In some cases the medium or type of display is important to the decision regarding the type of information to be presented. For example, on bus stop signs themselves the following information is typically displayed:

- route number and/or name
- service limitations
- span of service
- telephone information number.

More detailed information was not found on bus stop signs for several reasons. Signs have limited space available for details, and the mounting height of the signs would render lettering or graphics unreadable. As previously noted, information subject to frequent change, such as schedules, is not regarded as suitable for inclusion on signs.

Route maps, exact schedules, and fare information are provided only when display cases are mounted at or near the bus stop. Schedule information is the most frequently provided in these supplemental displays. Some displays combine route maps, either as part of the standard design, or when space permits.

When schedule information is displayed, the most frequent format was found to be exact schedules, rather than a more general representation such as frequency (e.g., "buses arrive every 30 minutes"), Transit users are believed to prefer schedule information showing exact trip times. Most transit agencies publish public timetables showing exact trip times and transit users are accustomed to using schedule information in this format. Although it is more difficult to provide exact schedules, some transit managers feel strongly that this is the information that is most useful to transit riders.

Another decision regarding the formatting of schedule information relates to providing timepoint times versus estimates of specific stop times (if the stop is not at a timepoint). Typically a bus route has six or seven designated timepoints at which bus operators are not permitted to be ahead of schedule. Timepoints are typically 5 to 12 minutes apart. Market research conducted by Calgary Transit specifically addressing posted information confirmed this preference. When asked directly, 70 percent of respondents to the Calgary survey said it was very or somewhat important to include schedule-specific information for each.

A problem exists related to estimating the time for specific stops between timepoints according to some transit agency managers. Because bus operators are not required to adhere to schedules other than at timepoints, the posting of estimated schedules between timepoints may result in providing the transit rider with unreliable information. The worst-case result is that a bus will depart prior to the posted schedule, causing the customer to miss the bus. It was found that the majority of transit posting information at stops only use timepoint information to avoid the problem, and to simplify schedule display production.

WHERE TO PLACE INFORMATION DISPLAYS

The transit agencies using supplemental information displays generally did not indicate that they used formal or set criteria in locating the displays. Five of the respondents simply indicated they did not use criteria with respect to locating signs. Three others indicated that the judgment of agency staff was the basis for locational decisions.

Other agencies cited informal criteria used to guide these decisions:

- The number of passenger boardings was mentioned most frequently. Higher-activity bus stops are given greater consideration for the placement of displays.
- Transfer locations were included frequently as priority locations.
- Passenger shelter locations were offered by several agencies because these locations combine two important considerations: high passenger activity and a structure to support

a display case. In many instances, passenger shelters are located at transfer points as well.

- Locations requiring a change of mode, including park-and-ride lots and bus/rail interface stops, were also cited as priority locations for displays.

The conclusion is that passenger activity at a stop is the primary consideration, because the displays will benefit the greatest number of users. In addition, bus stops with interchange activity, such as park-and-ride lots and transfer points, are considered priority locations. Rather than adopting formal policies for the placement of displays, transit agency managers use these general guidelines and effectuate the "policy" with staff discretion.

Although the practice is informal, most transit agency managers have the concept of bus stop hierarchy in mind as they make locational decisions, similar to the concept illustrated in Figure 3. A common response in this regard was the need to prioritize the placement of information displays given the realities of limited funding, and to avoid overextending the capabilities of staff to maintain the displays.

PROGRAM ORGANIZATION AND MANAGEMENT

The responsibility for on-street displays was found to vary considerably among transit agencies. The marketing, planning, scheduling, and public information functions were cited as having responsibility for program design and production. Maintenance was cited most often as the functional area with responsibility for installation and upkeep. Every transit agency contacted had multiple departments involved in the on-street program, requiring coordination with two or more organizational units, and alignment of priorities, work schedules, and activities. The location of program responsibility within transit organizations was found to be influenced by factors such as staff expertise, staff availability and resources, bargaining unit work classification, and consideration of the department's primary responsibility.

The involvement of multiple departments in the implementation of on-street information programs was cited as a problem by two of the transit agencies contacted. The problems involved conflicting priorities resulting in production delays and other impediments. Organization concerns were not a focus of the synthesis research.

Table 4 summarizes how the surveyed agencies have organized on-street information programs.

One of the requirements for effective program management cited by most of the transit agencies is a current, well-maintained inventory of bus stops. A bus stop sign program using signs with even basic information such as route number and/or name cannot be planned, implemented and maintained without an inventory of stops, according to transit managers responsible for these programs.

The inventories used for this purpose are automated, allowing for easy updating and information retrieval. The inventories use spreadsheet programs or custom designed software programs. In some cases the bus stop inventory is designed to interface with automated scheduling systems and automatic vehicle location systems. Typically the inventory of bus stops assigns a unique identification number to the stop and includes the following information:

- location of the stop by street intersection or street address
- type of stop (i.e., nearside, farside, midblock)
- direction of the stop
- routes serving the stop
- type of bus stop sign
- type of sign mounting

TABLE 4

ON-STREET INFORMATION RESPONSIBILITIES WITHIN TRANSIT AGENCIES

Program Function	Organizational Units	Number of Responses
Design	Marketing	9
	Public Information, Communication, etc.	3
	Planning	3
	Graphics	1
	Architecture	1
	Vendor	1
Installation	Maintenance	6
	Planning	4
	Operations	4
	Marketing	3
	Customer Services	2
	Schedules	1
Servicing/Updating	Maintenance	6
	Operations	4
	Planning	4
	Marketing	3
	Customer Services	2
	Schedules	1

Source: 1995 Survey of Transit Agency Managers.

- type of information display
- passenger amenities (e.g., bench, shelter)
- historical summary of work performed
- wheelchair lift-accessible.

Information available from the inventory allows staff responsible for the program to direct installation, maintenance, and upkeep activities. For example, the inventory should be capable of producing a listing of schedule displays requiring revision, given a list of routes undergoing service changes for an upcoming period.

The graphic design tasks for on-street displays were found to be accomplished by in-house staff in most cases. Large- and medium-sized transit systems were found to have the required in-house graphics capability. The proliferation of personal computer-based graphics software and even word processing allows virtually all of the work for on-street displays to be done by agency staff. In a small number of cases where special purpose displays were required, vendors were used for all or part of the design and production.

A common procedure used to expedite the production of on-street displays involves "borrowing" graphics from materials produced for other purposes. Route maps and timetables produced for route brochures are easily adapted for use in the on-street displays. This practice not only reduces the cost and time for production, but allows a continuity of design among user information pieces.

Techniques used by transit agencies range from standard office duplicating equipment and "cut and paste" production to customization using graphic design software. Frequently, materials such as system maps were included "as is" in on-street displays. Creative and adaptive approaches making best use of available materials and resources were part of the process used by the transit agencies contacted.

One of the tasks required for programs that include the display of exact schedules is the preparation of schedule lists or stop-specific schedules. Some transit agencies avoid this task by posting timetables taken from route brochures. These displays show scheduled times for all timepoints on the route, rather than just the times for the specific stop.

Most agencies produce the schedule lists manually, even in cases where the transit agency uses an automated scheduling system. These transit agencies report that either the software is not set up to produce schedule lists, or the operating schedules (headways) are complicated and are not readily convertible into schedules suitable for the public.

Denver RTD uses an automated scheduling system developed in-house to produce schedule lists that combine the departure times for all routes serving a stop, in time sequence order. Toronto TTC produces stop schedules using a commercial scheduling/runcutting system. With 4,000 locations, the on-street schedule display program in Toronto would be very difficult to maintain were it not for the automated production of schedules.

A marketing representative for another commercially available automated scheduling system states that the system is capable of producing timetables and stop schedules from the schedule database. One transit manager familiar with automated scheduling processes observed that the data required for the production of the stop schedules is available in the data files. The task is creating routines to extract the information in the desired format.

All transit agencies that use manual processes to create the stop schedule use some type of software, word processing, or spreadsheet programs to store the document and revise formats, print type and size, and combine with map graphics. Generally, the personnel who produce the stop schedules report that initial set up is time consuming, but subsequent revisions required as schedules change are made easily and quickly. For example, at one transit agency using this production technique, initial set up required about 30 minutes per location, but revisions to adjust for service changes required "minutes."

Prior to embarking on a program that includes the posting of exact schedule information, it would be prudent to determine whether the schedule lists can be produced directly through an automated process. Production time is a consideration, as is the accuracy of the information. An additional step requiring manual input of schedule times increases the risk of inaccuracies.

Findings showed that the installation task was the most frequent source of delay in displaying newly revised information. Transit systems had a variety of problems with the installation of materials, such as

1. Work, being cyclical, makes it difficult to provide additional labor when activity peaks as a result of service changes.
2. Work assignments are more complicated when the personnel with overall program responsibility are assigned installation staff from different departments.
3. Flexibility to address peak workloads is reduced because installation of informational materials is often classified as work restricted to specific bargaining unit employees, and conflicting priorities, often related to service changes, limit available staff.
4. Work is time consuming because of the travel time involved.

Installation is critical to the success and effectiveness of on-street information programs. Although all surveyed transit managers agreed that it is important to have accurate information available and that service changes should be addressed quickly, it was reported that delays in revising information ranged from "a few days" to several weeks in some cases.

Some transit agencies reported that they have developed techniques to address the problems associated with information installation. In response to the cyclical nature of the work, staff from other work units are assigned on a short-term basis. Assistance was found to be provided by supervisory personnel, (particularly operations field supervisors), administrative personnel and labor from other work units. One agency reported using temporary employees on infrequent occasions when service changes affected an unusually large number of displays. In one case, contractors are used to assist in providing the necessary labor when work loads dictate.

BUS STOP SIGN PROGRAM COSTS

The costs associated with implementing and maintaining a bus stop sign program can be categorized as follows:

- Design of signs and program elements,
- Acquisition of sign materials and decals,
- Acquisition of installation hardware, including sign supports,
- Installation of signs, including preparation of stop specific sign elements (e.g., route names and/or numbers), and
- Ongoing maintenance and upkeep of signs.

Design tasks are usually performed by in-house marketing and design staff, although some transit agencies reported using a consultant to assist with initial design functions. Of the transit agencies surveyed, seven (33 percent) reported some involvement by consultants. The size and expertise of the transit agency's support staff is a consideration in the decision to involve consultants or other non-staff assistance. Costs associated with design functions were minimized by transit managers, either because they were performed by in-house staff, or were small relative to other elements of the project.

Transit agencies that have bus stop sign programs that include service information on the signs reported that the additional time and expense associated with the individualized signs was not excessive. The additional tasks have been readily incorporated into the program. In every case the additional effort was believed to be justified by the increased benefits to transit users.

Acquisition costs vary with factors such as sign size, complexity of design, local supply factors and the number of units ordered. Transit systems quoted individual sign costs in the range of $25 to $50 per sign. Installation hardware costs can be expected to add an additional $5 to $10 per sign, on average. Hardware for customized installations can be expected to be two to three times this amount.

Installation costs represent a significant proportion of the total program cost, and consist primarily of labor costs. Individual sign installations vary substantially in the amount of time required to accomplish the task. Some locations involve installing the sign on an existing support and can be accomplished in approximately 15 minutes, plus travel time to the location. Other locations that require the installation of new supports in concrete may take up to several hours, and require specialized equipment and materials.

Local conditions and practices are very important in determining installation costs. For example, some communities require bus stop signs to be installed on new supports. This can be dictated by local ordinance or transit agency policy. In other locales, bus stop signs can be affixed to utility poles and traffic sign supports, significantly reducing the materials and installation costs. Larger bus stop signs, with route name and number designations, for example, are more likely to require their own support, thereby increasing costs.

Most transit agencies use designated staff to install bus stop signs. Typically the work is covered by the collective bargaining agreement and provides for a wage rate close to the top bus operator wage rate. The labor component of sign installation therefore is a function of the average installation time and the wage rate.

SUPPLEMENTAL INFORMATION DISPLAY PROGRAM COSTS

The costs of implementing and maintaining supplemental information displays are much more difficult to estimate because transit agencies operate such a diversity of programs. Additionally, these programs were found to be supported by staff with a variety of other responsibilities. An important variable is the frequency of service changes that require revision to the displays. The frequency and magnitude of service changes varies among transit agencies and is even difficult to predict and control for a single transit agency.

The costs of these programs can be categorized as two different types: initial program costs, which are largely capital expenditures, and the ongoing costs of maintaining the displays.

Initial costs consist of acquisition of the display cases, initial development of the materials, and installation. Display cases in use range in cost from as low as $40 per unit for small displays to several hundred dollars for larger panels. The initial preparation of information displays required from 1 to 3 hours in most cases. Larger, more complex displays would require more time for development and production.

Installation time and costs for small schedule displays have requirements similar to bus stop signs, often requiring as little as 15 minutes to affix the display to an existing structure or support. Again, larger more complex displays require additional time.

Transit agencies planning on-street information displays should be able to readily estimate initial costs given the specifics of the program. Much of the initial cost of on-street information programs, such as hardware acquisition, is eligible for funding through the FTA.

The ongoing costs of maintaining these programs can be determined by estimating the time requirements for revising the displays and installing the revised displays. Generally, transit managers experienced with these programs report that revisions require significantly less than an hour per location when only schedule revisions are required. Revisions to route maps, if used, and other information add to the time required.

Field installation of the revised displays is regarded as the greatest cost by most transit agencies. As with other elements, the time, and therefore the cost, vary with each type of application. Installation is very labor intensive, adding to the burden of transit agencies already involved with labor-intensive activities.

Staffing requirements for a given transit agency vary with particulars regarding available labor and staff capabilities. Some level of on-street displays can be supported with existing staff in most cases, experience has shown. However, a threshold exists such that additional staffing will be required. This threshold can only be determined on a case-by-case basis, and even then it may be determined only after the capabilities

of the current staff are tested by implementing a program. Most of the transit managers indicated that existing staff were supporting the maximum number of on-street information displays.

The ability to outsource maintenance tasks can help to control ongoing costs. Outsourcing, although restricted by practice and labor agreements, may be possible in the case of new programs where it cannot be argued that traditional work is being taken away from existing employees. The cyclical nature of the work lends itself to outsourcing.

The transit agency's willingness to revise information over a period of time, rather than requiring that the displays be updated at the time of service changes affects staffing requirements. While the prospects of having outdated and inaccurate information posted is unattractive, tradeoffs with cost are apparent and most transit agencies tolerate some lag between the effective date of service changes and the revision of the posted materials.

Transit agencies with on-street schedule displays reported estimated annual maintenance costs ranging from about $15 to $70 per display. This wide range reflects the variability of factors affecting costs from program to program.

The conclusion is that on-street information programs have very definite ongoing costs associated with their upkeep. The larger, more complex and sophisticated the program, the greater the cost. Case studies reported in Chapter 6 include more specific information that may be of value in assessing program costs.

EFFECT OF AMERICANS WITH DISABILITIES ACT (ADA) REGULATIONS

As is the case with many of the other elements of the provision of transit service, ADA regulations effect the design of bus route identification signs. There appears to be some misunderstanding, even confusion regarding the specifics of ADA regulations as they pertain to bus stop signage. Concern was expressed by some industry representatives that ADA would substantially change the provision of information at bus stops, even to the extent of affecting the general public by limiting the type and amount of information that could be displayed at stops. For example, one transit manager stated that his agency could not come near supplying the minimum level of information required in their program and meet ADA guidelines.

In actuality, ADA regulations pertaining to bus route identification signs have a very limited effect on the design of information at bus stops. Moreover, it is likely that the application of ADA regulations will result in improved signage for the general public, as well as persons with disabilities.

The regulations specifically pertaining to bus route identification signs are included in 49 CFR 37: Section 4.30 of Appendix A. These regulations require that all bus route identification signs that are installed in new locations, or that replace old signs, meet the requirements of the ADA regulations which follow.

Bus route identification signs must have a background that contrasts well with the lettering, either dark on light or light on dark. The signs must also be matte, eggshell, or another non-glare finish (reference 49 CFR 37: Section 4.30.5 of Appendix A).

To the maximum extent practicable, route identification signs should comply with the specifications for character size and proportion. For signs mounted overhead, the minimum height of the sign is 80 in. from the floor. The minimum character height is 3 in. to the maximum extent permitted by the sign allowed by local codes (Reference 49 CFR 37: Section 4.30.3 of Appendix A).

The letters and numbers on the signs must have a width-to-height ratio between 3:5 and 1:1. The stroke width-to-height ratio of the letters must be between 1:5 and 1:10 (Reference 49 CFR 37: Section 4.30.2 of Appendix A).

Perhaps the most significant of these regulations is the requirement that the minimum character height is 3 in. Many existing bus stop signs do not meet this standard for at least some of the information included on the sign. Typically, supplemental information, such as bus route numbers and names, and destinations, are not shown with letters of this size. Meeting this standard does require designers to use available space more effectively, but should not result in a reduction of the displayed information.

Research into the proper bus stop signage design has long regarded sign legibility from certain distances one of the key elements of proper design. Adherence to the ADA standards will ensure improved legibility for all transit users.

Regulation 49 CFR 37: Section 10.2.1 of Appendix A specifically excludes items such as bus schedules, time tables, and route maps posted at the bus stop. Information of this type does not have to meet the requirements for letter and character sizes previously detailed. Therefore, transit managers can continue to provide detailed supplemental information on transit service in the same manner that is now employed.

When bus stop signage or supplemental information displays are used to identify accessible service (e.g., bus trips provided by lift-equipped buses), the international symbol of accessibility should be incorporated into the message. This is consistent with 49 CFR 37: Section 4.30.7 of Appendix A.

To an extent, ADA regulations and their implementation are subject to local interpretation. Thus, there is considerable flexibility with respect to ADA regulations, as long as the basic requirements outlined previously are met.

HOW TRANSIT AGENCIES HAVE DEALT WITH ADA

Based on responses to the survey, there is an awareness of ADA regulations pertaining to the provision of transit service information at bus stops. However, fewer affirmative responses were received to the question pertaining to whether the agency has begun the process of incorporating ADA regulations into programs. Table 5 is a summary of responses pertaining to awareness and implementation of ADA regulations.

The Santa Clara County Transportation Agency is one of the transit agencies that recently completed the conversion of all bus stop signage to new signage compliant with ADA

TABLE 5

TRANSIT AGENCIES EXPERIENCE WITH ADA REGULATIONS ON SIGNAGE

	Percent of Agencies Indicating Familiarity With ADA Regulations	Percent of Agencies Indicating ADA Regulations Are Being Implemented
Large Systems	100	83
Medium Systems	75	75
Small Systems	100	
TOTAL	88	76

Source: 1995 Survey of Transit System Managers.

regulations *(13)*. It should be noted that the Agency's bus stop signs do include specific route number and route name information.

During the design process, Santa Clara County Transportation Agency staff responsible for the signage project established a committee to oversee the design of the new bus stop signs. The committee was made up of representatives from a number of agency departments, including marketing, service development, operations, customer services, contract services, and construction operations. The committee adopted a proactive approach, relying heavily on input from Agency customers, including members of the general public and the disabled community, including organizations specifically representing blind and visually impaired persons, and seeking input through displays and presentations at a number of public sites. Representatives of these groups participated in the design process by reviewing and commenting on prototype signs.

It is common for transportation systems to have developed relationships with disabled community advocacy groups as a result of working on issues such as accessible fixed-route service, complementary paratransit service, bus stop facility design, and other elements of the ADA regulations, and Section 504 regulations. Transit agency managers can utilize existing relationships and techniques developed in working with disabled communities to improve the design and implementation of bus stop signage and information programs.

CHAPTER FOUR

PROGRAM EFFECTIVENESS

Do on-street information programs result in measurable benefits?—this is one of the most important questions regarding the provision of user information at bus stops versus program costs. Before the question of effectiveness can be addressed, it is necessary to understand the objectives of these programs. Based on information provided by transit managers, transit agencies have a number of different objectives in implementing these programs as follows:

- To increase ridership by providing easily accessible information, making the transit system easier to use;
- To maintain current riders by providing more easily accessible information, particularly at key points such as transfer locations;
- To reduce reliance on other information sources, particularly those with incremental costs such as telephone information centers;
- To reduce the reliance on bus operators as a source of information; and
- To serve as advertising for the transit agency to non-users.

On-street displays are often located in high-visibility locations frequented by potential transit users.

The discussion of program effectiveness will be largely focused on supplemental information displays inasmuch as the need for bus stop signs to identify locations of bus stops is generally accepted in the industry. Bus stop signs, to the extent they include additional user related information are included in the question of effectiveness.

For the most part, transit system managers who have been involved with on-street information programs have not relied on research to justify the programs. The need for such programs, and their effectiveness appears to be generally accepted in the transit industry. Table 6 is a summary of responses to the survey question on program effectiveness. As can be seen from the survey responses, the majority of transit managers believe on-street information programs are effective and necessary components of a transit agency's overall user information program. None of the survey respondents indicated that on-street information displays are ineffective or not worth the effort.

MARKET RESEARCH FINDINGS

Transit managers offer a number of qualitative and anecdotal responses to the question of program effectiveness. Only three of the agencies responding to the survey indicated that they have undertaken research to determine the cost-effectiveness of bus stop information programs. WMATA and TTC, both with extensive programs, have conducted such research. RTD in Denver recently conducted a pilot project to test the feasibility of placing schedule displays at every bus stop along a route.

TABLE 6

TRANSIT MANAGERS' OPINION ON PROGRAM EFFECTIVENESS

	Number of Responses	Percent
Very effective, necessary component	14	67
Useful, but too costly	5	24
Effective in some applications	5	24

Source: 1995 Survey of Transit System Managers.
Note: Percentages add up to more than 100% because of multiple responses.

In Denver, the conclusion was that exact schedule information could not be provided at all of RTD's 9,500 bus stops without significant increases in staffing. RTD currently provides schedule information at approximately five percent of its bus stops.

WMATA concluded that its program of providing schedule information has enhanced ridership and has the potential to reduce timetable printing and distribution costs.

The previous research in Milwaukee referred to an evaluation to determine if the installation of the improved bus stop sign contributed to an increase in transit ridership. Follow-up surveys found that *three percent of the sample of riders indicated they had started using the bus as a result of the new bus stop signs.* Almost five percent used the bus more frequently. The conclusion drawn was that improved bus stop sign information could have a small but noticeable impact on transit ridership.

The Milwaukee study also found a small but significant shift in transit information source use as a result of the new signs. Transit users relied less on the bus operator as a source of information, with a simultaneous increase in the use of the bus stop sign for information such as bus routes and transfers.

In the fall of 1994 the Toronto Transit Commission conducted a study of its passengers to determine attitudes toward information displayed at bus stops, among other matters. The study determined that about 63 percent of the sample used the information. Of this group, 36 percent found the information to be "very useful" and 45 percent responded "somewhat useful" to the question "How useful respondent finds bus route information displayed at bus stops in planning trips on the TTC?" The TTC research also concluded that the vast majority of respondents found the information easy to understand, easy to read, and easy to use. Figure 6 is an example of a supplemental information display used by TTC.

A similar research effort was conducted in 1990 by Calgary Transit of the usage patterns of all components of the information system, including pocket schedules, transit map, an automated telephone information system, a traditional telephone information system and the information posted at transit stops. Generally, with respect to posted information the research concluded (1) more respondents were aware of posted information (83 percent) than any other type of information, (2) posted information was second to the automated phone information system in terms of usage per month, and (3) posted information was used significantly less often than the two telephone information systems and the pocket schedules (in response to the question "Which one source of Calgary Transit information do you use most often?").

The research in both cities seems to indicate that the posted information is well used. Although these findings do not directly address the question of cost-effectiveness, the fact that the on-street information is so well used by transit patrons suggests that the information has considerable value. The last conclusion listed above from the Calgary research suggests that the on-street information is used along with or as a supplement to other components of Calgary's transit information system.

In a number of cases, transit riders requested the display of service information at bus stops through ridership surveys and other efforts to get input from users. In Sarasota, Florida, requests from the public were offered as the reason for the transit system's extensive on-street information program, and its expansion over the years. Recent market research conducted by the KCATA in Kansas City concluded that the provision of bus schedules and other information at stops would make use of the transit system more convenient for existing and potential riders. Participants in focus groups stated that the absence of on-street information materials was a deficiency in the transit system's information program.

Part of the question of effectiveness is whether there is a farebox return on the investment in on-street information displays. The Milwaukee research suggests that there was an increase in transit usage attributable to the new bus stop signs with additional information. Isolating the effect of information displays from the myriad of factors affecting transit ridership is a difficult task.

DISCUSSION OF PROGRAM BENEFITS

As previously explained, transit managers believe that on-street information displays are very important and effective, whether or not they can support their position with "hard" data.

In San Diego, it was suggested that one only needed to observe how frequently individuals waiting at the main downtown bus stops consulted the schedule displays to understand the program's benefits. Several of the major bus stops along Broadway in downtown San Diego include schedule information for all of the bus routes that service the stops. During the midday period it was observed that there was literally always someone consulting the schedules posted at the stop.

A representative of San Diego's Metropolitan Transit Development Board (MTDB) stated that it was their belief that the schedule displays in particular were very well used, a qualitative but important measure of its effectiveness. MTDB has not attempted to quantify the benefits or effectiveness of their on-street display programs.

Representatives of the Sarasota Transit System offered the same observation. The measure of the displays used, and therefore, the program's effectiveness, can easily be ascertained by observing how frequently the displays are used.

The following is a listing of specific comments offered in response to the question "What benefits have you realized?"

- Enhanced ridership
- Increased awareness and usage
- Better image
- Rider satisfaction
- Improvement in making transfer connections
- Improvement in discovering alternative routes for trips
- Improvement in identifying routes serving each stop
- Complaints reduced
- Increased and more frequent ridership.

Significantly, only three of the survey respondents offered increased ridership as a benefit that the transit system has realized. It is not clear whether this can be construed that on-street displays do not contribute to increased ridership, or whether the respondents simply do not know whether increased ridership is one of the benefits of such programs.

CHAPTER FIVE

TRANSIT SYSTEM CASE STUDIES

To provide additional detailed information relative to on-street user information programs, five transit agencies were visited to learn more about such programs first hand. Three large transit agencies in San Diego, Denver, and Milwaukee. The transit agencies in San Diego and Denver are multi-modal, with light rail systems as well as large bus operations. San Diego is somewhat unique in that several different transit operators provide service in the metropolitan area, with services coordinated by the MTDB. Both San Diego and Denver have comprehensive on-street programs that include bus stop signs with service related information and supplemental information displays including schedule information.

The Milwaukee County Transit System (MCTS) offers a different perspective on the development and deployment of on-street programs. In consideration of costs and staffing requirements, the on-street program is not as comprehensive as the programs in San Diego or Denver. The on-street program does include a bus stop sign with service information, and the overall user information, and the overall user information program's development was guided by the market research effort referred to previously.

Two smaller transit agencies were also included in the site visits: Sheboygan Transit and Fond du Lac Area Transit, both in east central Wisconsin. The needs of transit users may differ in urban areas with smaller transit operations, and there are likely to be fewer resources available for on-street information programs.

DENVER REGIONAL TRANSIT DISTRICT

The Regional Transportation District (RTD) in Denver operates 825 buses on 162 routes. RTD also operates a light rail line, which opened in 1994. Average weekday ridership is approximately 174,000. During the post 10 years RTD has developed a comprehensive on-street information program that has two distinct elements: bus stop signs and supplemental information displays in passenger shelters.

Bus Stop Signs

In the mid 1980s, RTD began to develop a bus stop signage program to identify routes serving each stop, and more recently, to provide limited service information. The signs are of modular design in that each sign consists of a standard component (refered to as the "logo") and smaller appliqués ("stickers") with specific route names and numbers that individualize the signs. The standard component includes a bus pictograph and RTD's logo name, "The Ride." The sign uses white lettering on a bright red background. Figure 8 shows a typical RTD sign.

The route name and number stickers are different colors to differentiate among service types. Light blue is used for local service routes, red for express, and purple for limited stop routes.

RTD uses several sign sizes. All are 10.5 in. wide and lengths include 17 in., 30 in. and 6.5 ft. The 17-in. sign can accommodate route stickers for up to four routes. Stops serving more routes require the larger 30-in. sign. The 6.5 foot sign is actually a pylon fabricated from stainless steel. This unit is used in the downtown area and other locations such as park-and-ride lots and transit centers where a need exists for more information than can be displayed on the smaller signs. This unit also allows the display of information at eye level. Figure 9 shows an RTD pylon sign in downtown Denver.

In response to customer comments regarding a lack of information on service limitations (i.e., when buses do not operate on a particular route) RTD developed a program to display information on service restrictions. As shown in Figure 10, this information is also conveyed using stickers, with messages such as "No Sunday Service" and "Rush Hour Service Only." The service restriction stickers have a black background to distinguish them from the route stickers.

RTD designs and manufactures all of its signs in-house and maintains a fully equipped sign shop working from sign conception stage through installation. Graphic designs are prepared on a personal computer by a graphic designer. Camera-ready art is produced using photographic copy equipment. Signs are produced using a direct screen printing process.

The images are screen painted on a white reflective sheeting material. The sheeting is self-adhering and is applied using a cold contract process.

The route and service restriction stickers are produced on an automated sign making machine with a composition feature that allows the technician to design and alter signs as part of the production process. The stickers are produced on self-adhering vinyl.

RTD began to produce signs in-house in the mid 1980s. RTD officials believe the in-house capability is beneficial because it reduces lead time for sign preparation, especially for unique signs. In-house production is also believed to be less expensive for the quantity of signs RTD requires. RTD's sign requirements are greater than might be expected because their unusually large service area requires more signs, service has been substantially revised and somewhat expanded, and the light rail system has required a large number of new signs.

The RTD sign shop produces virtually all of the signage needed by the RTD, including facility related signs and all manner of specially and promotional signs. Thus, the sign

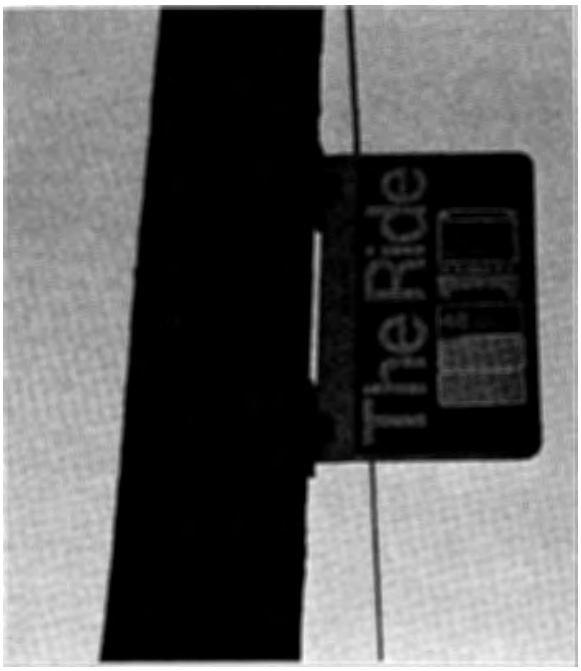


FIGURE 8 Typical regional transit district bus stop sign.

FIGURE 9 Denver Region Transportation District downtown pylon information sign.

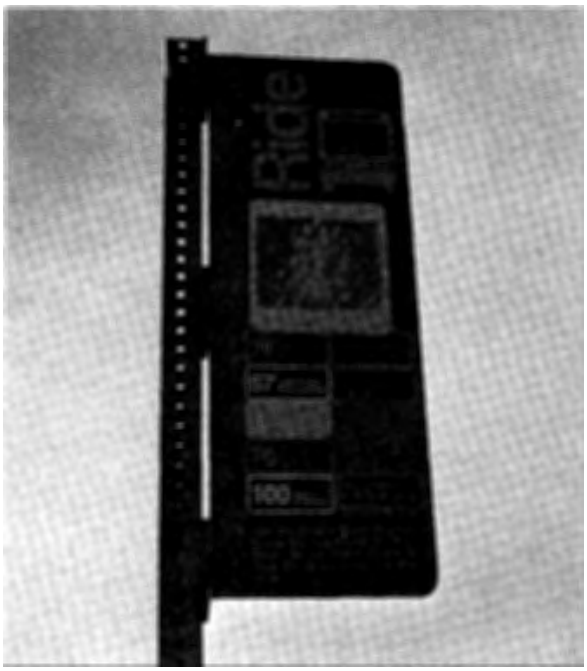


FIGURE 10 Denver Regional Transportation District sign with service limitation information stickers.

shop is maintained by the RTD for functions other than the bus stop sign program. The graphic designer, one of two sign shop employees, estimates that 60 percent of his time is spent on bus stop signs; the remainder on other types of signage.

Implementation

RTD maintains a sign crew of three sign installers, each with a truck equipped with power tools such as compressor, power drills and jack hammers. Virtually all RTD signs are mounted on their own supports, increasing the likelihood that a concrete installation will be required. RTD uses 2-in. square tubular supports, making installation a bit more difficult than the more common "U" channel supports.

Bus Stop Sign Costs

Because RTD produces its signs in-house, its sign costs will vary somewhat compared with signs acquired from vendors. RTD breaks down the sign costs as follows:

Finished sign with graphics	$ 7
Support	$17
Installation labor	$21
Total	$45

This is an average for typical sign installations; most of RTD's 9,500 signs are the smallest size (17 in. long), and require route stickers for one or two routes. Larger signs with more information have a higher cost. The pylon signs used in the downtown area cost about $220 apiece, and require specialized installation.

RTD estimates that it costs no more than $3.00 per sign for the additional information provided on the route and service restriction stickers. The material is very inexpensive and the production labor is low with the use of the automated sign making equipment. Depending on the specifics of the sign and installation, the stickers are usually applied by the sign installer. For larger or more complicated jobs, the stickers are applied by sign shop personnel.

It should be noted that this low figure is an estimate of incremental cost with the sticker program already in place. Initially, RTD had to create all the stickers needed for each sign, and install the stickers on the existing signs. The cost does not include the additional administration required to support a program that has individualized bus stop signs at 9,500 locations. The bus stop inventory program developed by RTD is discussed later in this section.

In summary, RTD has a seven-person unit responsible for bus stop signs, and all other signs used by the RTD. The unit includes a manager, an administrative assistant, a graphic designer, a sign maker, and three sign installers. They perform other duties in addition to those related to bus stop signs, and the percentage of time dedicated to bus stop signs varies from 25 to 30 percent for the manager to 60 percent for sign shop employees to "most of the time" for sign installers, who also perform snow removal duties, which occur when sign installation is impractical.

Supplemental Information Displays

RTD uses large (41 in. x 34 in.) displays to provide additional information, including exact schedules, at 450 bus stops. These displays are referred to as "shelter boards" because they are installed in RTD passenger shelters. Figure 11 shows a typical shelter board installation. The display is custom made for each location, showing schedule times for the routes serving the location, route maps, and fare information. Figure 12 is a display used in one of the shelter boards at a location with four routes.

A unique feature of the schedule information is that the display shows trip times for each route combined, arranged in time sequence order. Similar schedule displays used by other transit agencies show trip times for each route separately. This format was developed in 1991 to simplify the presentation of schedule information. Combining times for all routes serving a location is especially helpful to passengers whose trip can be served by more than one route. The display also shows route number, destination, and arrival time at the route's terminus, as shown in Figure 12.

Schedule lists for the displays are produced by the Scheduling/Service Planning Department using RTD's computerized scheduling system. RTD uses a scheduling system developed in-house (adapted from RUCUS) referred to as "Computer Assisted Scheduling System" (CASS). The routes with schedule

FIGURE 11 Typical Denver Regional Transportation District shelter board installation.

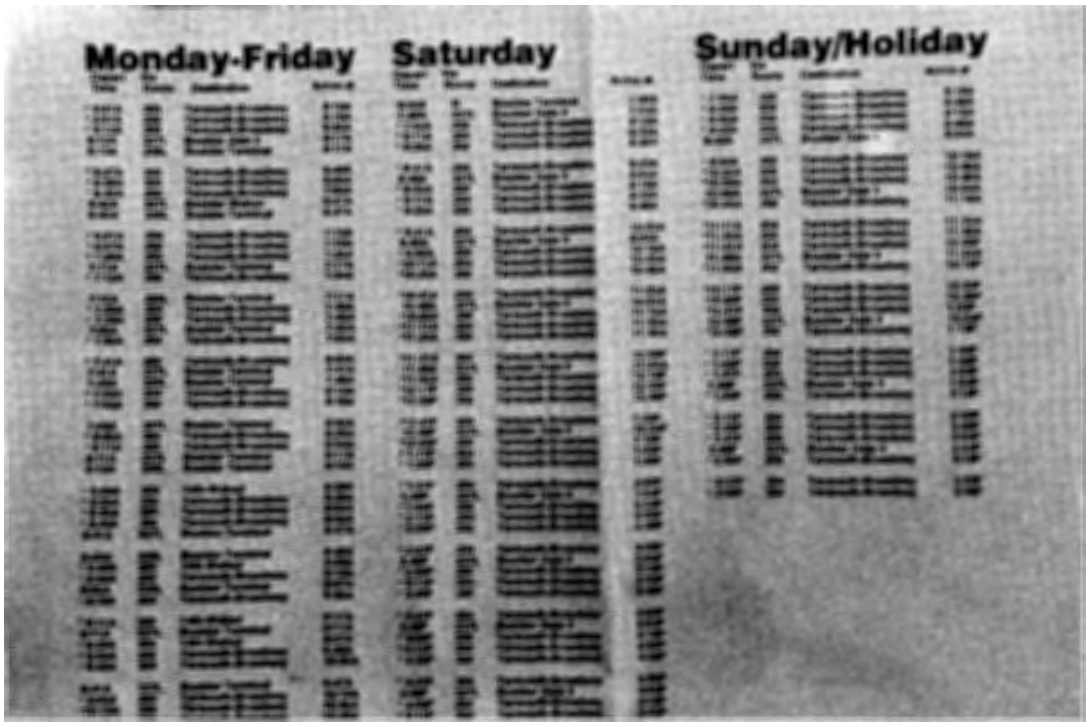


FIGURE 12 Denver Regional Transportation District shelter board information display.

09/22/95 BUS SHELTER LOCATIONS AFFECTED BY SEPT. 95 SERVICE CHANGE

CITY	STOP #	ON STREET/AT STREET	LOC.	BD. #	ROUTES SERVING THIS SHELTER	TYPE	UAREA	
Boulder	0	Sioux Dr/East Boulder Community Cntr	eb/0	1	203	Daytech	.K	9
Denver	10045	10th/Federal	wb/f	1	10	Daytech	.J	3
Boulder	10726	28th/Hwy 119	nb/n	1	205 208 209 M	B/O-Dayte	.K	25
Boulder	10732	28th/Walnut	sb/f	1	M	Daytech	.K	41
Denver	11124	44th/Eaton	wb/f	1	44 51	Daytech	.I	18
Denver	11132	44th Ave./Federal	eb/f	1	44	Daytech	.I	4
Denver	11162	44th/Meade	eb/f	1	44 50	Daytech	.I	19
Denver	11195	44th/Wadsworth	eb/f	1	44 44L	Daytech	.H	11
Denver	11196	44th/Wadsworth	wb/n	1	44 44L	Daytech	.H	12
Denver	11252	47th/Paris	eb/f	1	44	Daytech	.A	19
Denver	11253	47th/Paris	wb/n	1	44	Daytech	.A	18
Denver	11256	Albrook/Quentin	wb/n	1	44 53 47x	OldStyle	.A	17
Denver	11508	64th/Ward Road	eb/f	1	52 72 CCP	Daytech	.H	19
Denver	11548	East 6th Ave/Fulton	wb/f	1	6	OldStyle	.C	14
Denver	11873	8th Ave./Washington	wb/f	1	2 6	Daytech	.C	21
Denver	11896	East 9th Ave/Clermont (Univ. of Colo.)	wb/f	1	10	OldStyle	.C	17
Denver	11900	E. 9th Ave./Colorado Blvd	wb/n	1	10	OldStyle	.C	18
Denver	11903	9th Ave/Dahlia	wb/f	1	10	Daytech	.C	16
Denver	11916	9th Ave./Ivy	wb/n	1	2 10	Daytech	.C	15
Denver	11957	Alameda/Broadway	wb/f	1	3 11 52	OldStyle	.E	3
Denver	11973	Alameda/Colorado Blvd.	wb/f	1	3 3L 79L 83L	Daytech	.D	8
Denver	11977	Alameda/Dahlia	wb/f	1	3 3L	OldStyle	.C	4
Denver	11991	Alameda/Federal	eb/f	1	3	Daytech	.G	38
Denver	11992	Alameda/Federal	wb/f	1	3	Daytech	.J	5
Denver	12045	Alameda/Moline	wb/f	1	3 3L	B/O-Dayte	.C	9
Denver	12047	Alameda/Monaco	wb/f	1	3 3L	Daytech	.C	6
Denver	12085	Alameda/Sheridan	eb/f	1	3	Daytech	.G	37
Denver	12094	Alameda/Teller	wb/n	1	3 76	Daytech	.G	35
Denver	12095	Alameda/Teller	eb/f	1	1 3 11 17 76 75x	Daytech	.G	36
Denver	12118	Alameda/Yuma	wb/f	1	3	Daytech	.G	39
Denver	12131	Alameda Parkway/Mississippi	nb/f	1	14 19	Daytech	.G	20
Denver	12140	Alameda Service Rd./Xenon Ct.	wb/n	1	3 14 19 93x	Daytech	.G	19
Denver	12156	Albrook/Tulsa Ct.	wb/f	1	44 47x	OldStyle	.A	16
Boulder	12197	Arapahoe/11th	wb/f	1	203	Daytech	.K	36
Boulder	12212	Arapahoe/29th	wb/f	1	207 209 226L	Daytech	.K	44
Boulder	12222	Arapahoe/55th	wb/f	1	207 226L	Daytech	.K	17
Boulder	12227	Arapahoe/9th	wb/n	1	203	Daytech	.K	37
Boulder	12233	Arapahoe/Commerce	wb/f	1	206 207 210 226LS	Daytech	.K	18
Boulder	12237	Arapahoe/Old Tale Rd	wb/f	1	207	Daytech	.K	16
Boulder	12240	Arapahoe/38th	wb/f	1	206 207 210 226LJ S	Daytech	.K	19
Denver	12264	Arapahoe Rd./Forest	eb/n	1	105 66x	Daytech	.D	21
Boulder	12357	Baseline/Mohawk	wb/f	1	203 209 225L	OldStyle	.K	8
Denver	12427	Broadway/13th	sb/f	1	0 6 0L 3L 46L 79L 83L	Daytech	.D	3
Denver	12427	Broadway/13th	sb/f	1	24x 36x 59x 66x 77x 78x 85x 90x 91x 116xC E P Z	Daytech	.D	3
Denver	12430	Broadway/West 14th Ave.	sb/n	4	0 6 8 10 50 52 25x	OldStyle	.D	2
Boulder	12431	Broadway/College	nb/n	1	202 204 225L227L	Daytech	.K	53
Boulder	12432	Broadway/Euclid	nb/n	1	202 204 225L227L	Daytech	.K	48
Boulder	12433	Broadway/16th	sb/f	1	202 203 204 225L227LAB B D G	Daytech	.K	47
Boulder	12434	Broadway/20th	sb/n	1	202 203 204 225L227LAB B D G	Daytech	.K	49
Boulder	12438	Flatiron Park-n-Ride	nb/f	1	202 204 227LJ	OldStyle	.K	52
Boulder	12439	Broadway/27th Way	sb/f	1	202 227LAB B D G	OldStyle	.K	54
Boulder	12465	Broadway/Alpine	nb/f	1	202 208 Y	Daytech	.K	33
Boulder	12475	Broadway/Alpine	sb/n	1	202 208	Daytech	.K	32
Boulder	12478	Broadway/Baseline	sb/f	1	202 204 227LAB B D G	Daytech	.K	5
Boulder	12490	Broadway/Canyon	sb/f	1	202 204 225L227L	Daytech	.K	35

FIGURE 13 Output from Denver Regional Transportation District bus stop inventory program.

revisions are identified in a spreadsheet file. This is entered into the mainframe computer system to interface with the bus stop inventory file using a program developed by RTD. The result is a listing of each shelter board location affected by the schedule change, along with other pertinent information. (This output is shown in Figure 13.) This file is then interfaced with

the trip files from CASS to produce the schedule list for the combined routes, in time sequence order. The schedule list is output to a disk as an ASCII file for use on a personal computer with graphics software. In the future, machine-to-machine communication will replace the disk transfer of the schedule list.

The graphics unit of the Communications Department produces the display by combining the schedule list with route maps developed for route brochures. The display is printed on paper, which is laminated by a vendor to give the piece durability and protection from moisture.

Before the displays are installed they are returned to the Scheduling/Service Planning Department to be checked for accuracy. Although some errors are found relating to the assembly of the various components of the display, the schedule lists themselves are consistently accurate because they are developed directly from the same data base used to create RTD's operating schedules. In similar fashion, the route maps are accurate because they derive from the same computer files that are used to produce RTD's schedule brochures and bus operator route guides. RTD officials report that it is rare that shelter boards are installed containing inaccurate information.

Automation of the schedule list has reduced the time required to prepare the schedule component of the shelter board displays. However, the entire process has two "bottlenecks" that delay the provision of current information, particularly when a large number of locations are affected by a service change. Graphic design is one, usually relating to workloads and competing priorities. Installation is the other source of delays. Two external distribution clerks are responsible for installation of the schedule boards. Each clerk can install approximately 25 displays per day, but the clerks also have other assignments that preclude full attention to the shelter boards.

As a result, revised schedule boards are not updated until days or even weeks after schedule changes become effective if a large number of locations require change. Recently for example, a system-wide service change affected 316 (70 percent) of the shelter boards. This volume of change cannot be handled by the staff assigned and the result is that current information is not available in some locations. To mitigate this situation, locations with substantial changes, or where schedule information is more critical, are serviced ahead of other less critical locations. RTD has identified this as a problem and is working toward more timely installation of updated sign boards.

It should be noted that the situation requiring 316 revised schedule boards is atypical; usually schedule changes affect fewer than half of the schedule boards. The current procedures accommodate most changes more effectively.

Bus Stop Inventory Program

An important tool the RTD uses to administer both the bus stop sign program, and the shelter program is an automated inventory of all bus stops. The inventory system, developed by RTD, contains information about each bus stop, including location (municipality and street intersection), direction (traffic flow and bus route), routes serving the stop, type of sign and mounting. The inventory also includes the amenities that have been installed at the location, including passenger shelters, and the presence of shelter board information displays. ADA information is included indicating whether the bus stop meets ADA accessibility standards and whether the stop meets a less restrictive RTD accessibility standard. This suggests if the stop can be used by a person in a wheelchair. Satellite data collected by RTD and Westinghouse as part of the Radio/Automatic Vehicle Location (AVL) project, which notes the latitude and longitude, and the X and Y coordinates of each bus stop is also included. The data are then communicated by computer to Dispatch, in order to plot bus stops along bus routes displayed on the AVL screens. Each stop is assigned a five-digit identification number that is used in all systems that involve bus stops. Each bus stop sign and each shelter board display includes a sticker with the bus stop identification number to assist in installation.

The inventory system provides transit managers with current specific information regarding each bus stop, and the program is interfaced with other automated processes in support of the stop related programs. Work orders for bus stop signs are produced by the system, which also maintains a historical record of all work performed at each location. RTD officials believe the inventory system is a key to effective management of the on-street information programs.

Costs and Staffing

The direct costs associated with the schedule board display program are difficult to assess because the work is performed by staff in several functional areas along with a variety of other duties. Material costs are low, and not significant compared with the intensive labor requirements.

Primary responsibility for the displays is within the Scheduling/Service Planning Department. One staff person has responsibility for general program oversight, determining which locations require updating, developing the schedule lists, proofing the new displays, and directing and overseeing installation. It is difficult to generalize about time requirements because they vary with the level of the service change, the number of displays that must be changed, and the complexity of the change. The staff person with these responsibilities estimated that the time involvement for 316 locations is approximately 6 weeks (240 person hours), or about 12 percent of total time available. RTD changes schedules three times per year, however, the service changes are usually less extensive than the recent change that affected 316 locations. A reasonable estimate of staff involvement is 20 percent of a professional level position.

In addition, the graphic design task required for assembly of the displays averages approximately one hour per display. The final labor input, for installation, averages 20 minutes per location.

The shelter board program in Denver, with 450 locations, assuming each display will require changing once during the year, is estimated to have the following labor costs:

Scheduling/planning professional staff	340 hours
Graphics technician	450 hours
Installation labor	150 hours
Total	940 hours

Recognizing that labor rates vary from transit agency to transit agency, and that the labor requirements are estimates, labor costs average about $60 to $70 per location. Acquisition costs for the display cases, materials, and initial setup costs are in addition to this figure.

Program Design Considerations

RTD's on-street information program was started in response to a realization that transit users desired specific information on service availability at bus stops. This realization was supported by focus group studies conducted by RTD in the late 1980s which concluded that the lack of specific schedule information was the largest deterrent for first-time bus riders to try the bus. The support procedures evolved as staff became more experienced with the process, and in response to the need to make the entire process more efficient.

RTD has adopted a standard that states, "Every bus shelter will be equipped with a schedule information board." Shelters are installed in locations with high levels of passenger boardings, which include transfer points. All transit centers, park-and-ride lots and light rail transit stations are also equipped with shelters and schedule displays. The shelters provide a convenient support for the display cases.

As is the case with many activities and functions, the on-street information program has become part of the service offered by the RTD, and a balance exists between the level of service and the staff support. In response to interest from the public and members of the governing board, RTD recently experimented with a program to substantially increase the number of schedule displays at stops. A pilot program was created involving the installation of trip schedules at approximately 50 stops in Boulder along an arterial roadway. The conclusion was that a significant expansion of the on-street information program could not be accomplished without a significant increase in staff support. Moreover, the lack of favorable public reaction led to the conclusion that the program would not be cost-effective.

As an alternative, RTD is considering the possibility of increasing the amount and detail of information provided on bus stop signs. A prototype sign, shown in Figure 14, would show span of service (first bus and last bus), service frequency, and days of service. The thinking is that this type of sign would provide a higher level of service than the current signs, but would not require as much maintenance as displays with specific schedules, which are subject to more frequent change than service span information.

SAN DIEGO MTDB

The Metropolitan Transit Development Board (MTDB) in San Diego is the regulatory authority and coordinator for five bus operators and the San Diego Trolley Inc. Together, MTDB and the transit operators provide coordinated transit service throughout the metropolitan area referred to as the Metropolitan Transit System (MTS). Transit ridership averages about 190,000 weekday trips.

FIGURE 14 Denver Regional Transportation District prototype bus stop sign.

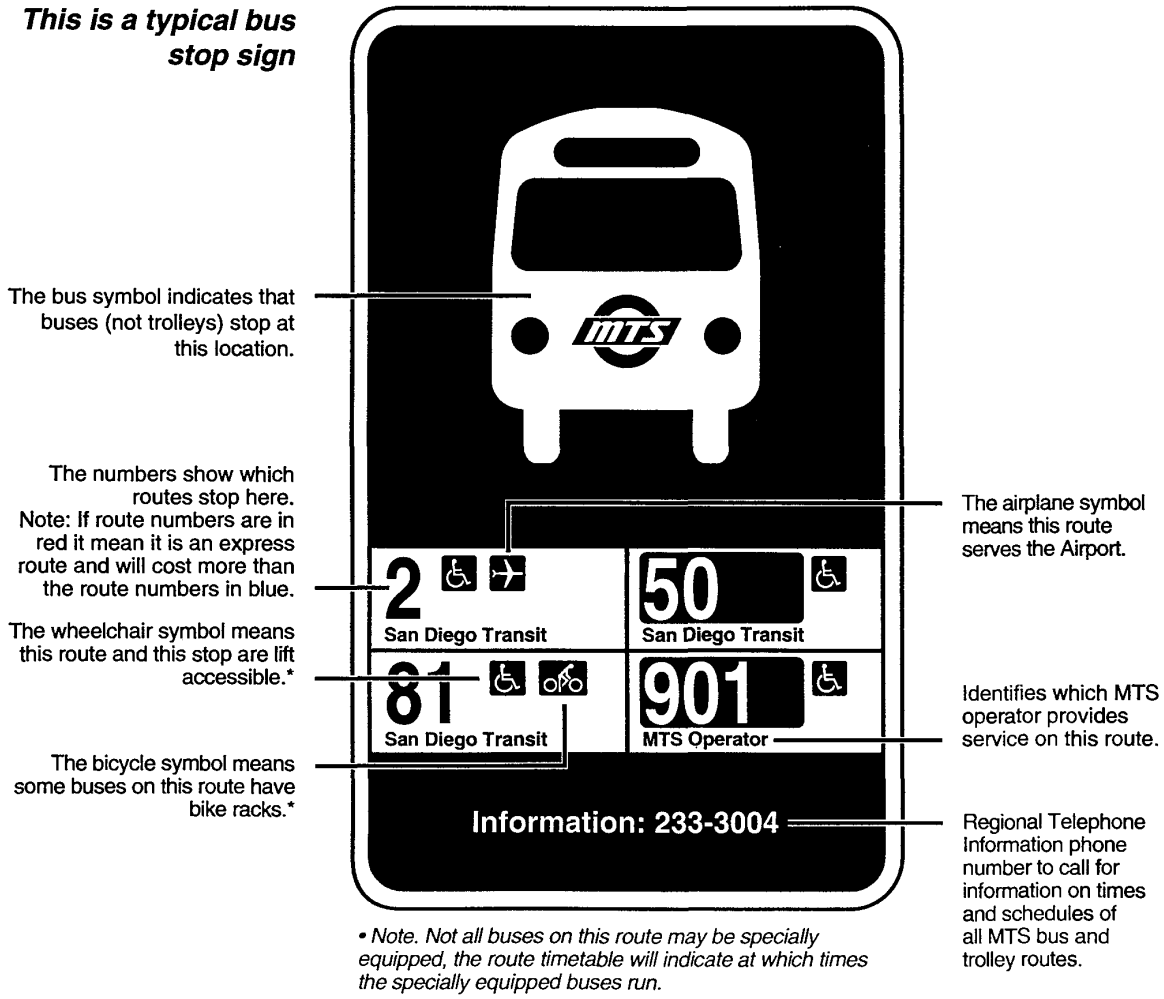


FIGURE 15 San Diego Metropolitan Transit Development Board bus stop sign components.

Historically, transit operators in San Diego have provided user information at bus stops. MTDB has continued this tradition, working to coordinate the efforts of the various operators to ensure continuity in the information. In some respects, the task of providing on-street information in San Diego is more difficult because several operators have responsibility for service in the metropolitan area.

Bus Stop Signs

Prior to the mid 1980s, various transit operators had their own signs, with little consistency of design. In many cases, two or more signs for different operators were posted at a single stop. MTDB began a bus stop sign program to develop a single sign for all transit operators.

The sign was initially designed with the assistance of a consultant and included a pictograph of a bus front bearing the MTS logo. Additional information included route name and number for the routes serving the stop, along with the operator of the service. The consultant advised that it was not necessary to include the MTS logo on the sign. However, MTDB considered the logo an important design feature and made it part of the sign. The thinking was that MTDB's transit service is a product, and the bus stop is a good place to relate the product name (MTS) to the conveyance (through the bus pictograph). In most cities, including San Diego, transit does not have good name recognition, thus the logo needs to be emphasized on all advertising and information displays. In some larger metropolitan areas, transit has good name recognition, and the inclusion of the logo may not be important. Some cities, like Boston, use the "T" logo for both functions.

Figure 15 is a drawing of the bus stop sign used in San Diego showing various design components. Routes that serve the airport are designated by inclusion of an airplane symbol. Stickers with symbols are also used to advise the public which routes are lift accessible, and which routes are operated by buses with racks for bicycles. The sign uses white graphics

and figures on a blue background. The sign is screen painted on reflective white sheeting.

The bus stop signs are being updated to conform with ADA regulations; new decals have been produced with 3-in. high numerals identifying routes that serve the stop. The new decals include the service days for the route, adding to the information provided by the bus stop sign. The new version of the MTDB bus stop sign, shown in Figure 16, is being phased in to replace older or more maintenance-intensive signs.

FIGURE 16 San Diego Metropolitan Transit Development Board bus stop sign-new version.

Three different sizes of signs are used depending on the number of routes serving a location, and thus the amount of information that needs to be displayed on the sign. All signs are 16.5 in. wide with lengths of 23, 26, and 32 in.

MTDB is responsible for about 1,000 of the MTS bus stop signs, the remainder are installed and maintained by the transit operators, primarily San Diego Transit Corporation. MTDB contracts with a private firm for the installation and maintenance of the signs they are responsible for. MTDB staff responsible for signage direct the activity of the contractor through the issuance of work orders. The MTDB work order, shown in Figure 17, includes the specification of route name/number decals as well as other work relevant to the specific sign. MTDB staff provide quality control by field checking every installation performed by the contractor.

Bus Stop Sign Costs

MTDB purchases bus stop signs made according to their specifications. The signs cost about $30 apiece when purchased in large quantities. The route name/number decals are also purchased from vendors at a small unit cost. The cost of a typical bus stop sign at MTDB is as follows:

Sign	$30
Support	$38
Installation	$30
Total	$98

The additional cost of the route name/number decals is insignificant compared to the overall cost of the sign and installation.

MTDB contracts with a small construction firm for bus stop sign installation and maintenance. Sign installation costs range from $25 for simple installations to $35 for installations in concrete, according to the service contract. MTDB has a complete schedule of unit costs for various sign maintenance tasks.

Supplemental Information Displays

MTDB and San Diego Transit provide considerable information at bus stops using several different presentation techniques:

- Route identification kiosks at downtown stops,
- Service information displays mounted in passenger shelters,
- Small pole-mounted schedule displays,
- Large free-standing displays at trolley (light rail) stops.

In the downtown area major stops have free-standing kiosks with route name and number for the routes serving the stop, as shown in Figure 18. This display does not have service information such as exact schedules or span of service. Rather, the display simplify identifies the routes serving the stop in the same way that MTDB's standard bus stop does for other stops. The large number of routes at the downtown stops requires this larger display.

At bus stops with passenger shelters throughout the transit system, schedule information is provided in the form of timetables or point schedules. The information is displayed inside panels affixed to the shelter frame as shown in Figure 19. The shelter provides a means to mount the display case, and shelters are located at stops with higher level boardings, justifying the provision of service information. MTDB has approximately 425 shelters with the service information displays.

Each shelter display is custom designed, and typically includes schedule information and route maps adapted from MTDB's route brochures. In some cases of locations with multiple routes, route maps are not displayed because schedule information requires all the available space.

The shelter displays are produced by MTDB's Operations and Planning Department. All the displays are produced by "cut and paste" technique, adapting service information materials developed for other purposes (e.g., route brochures). The

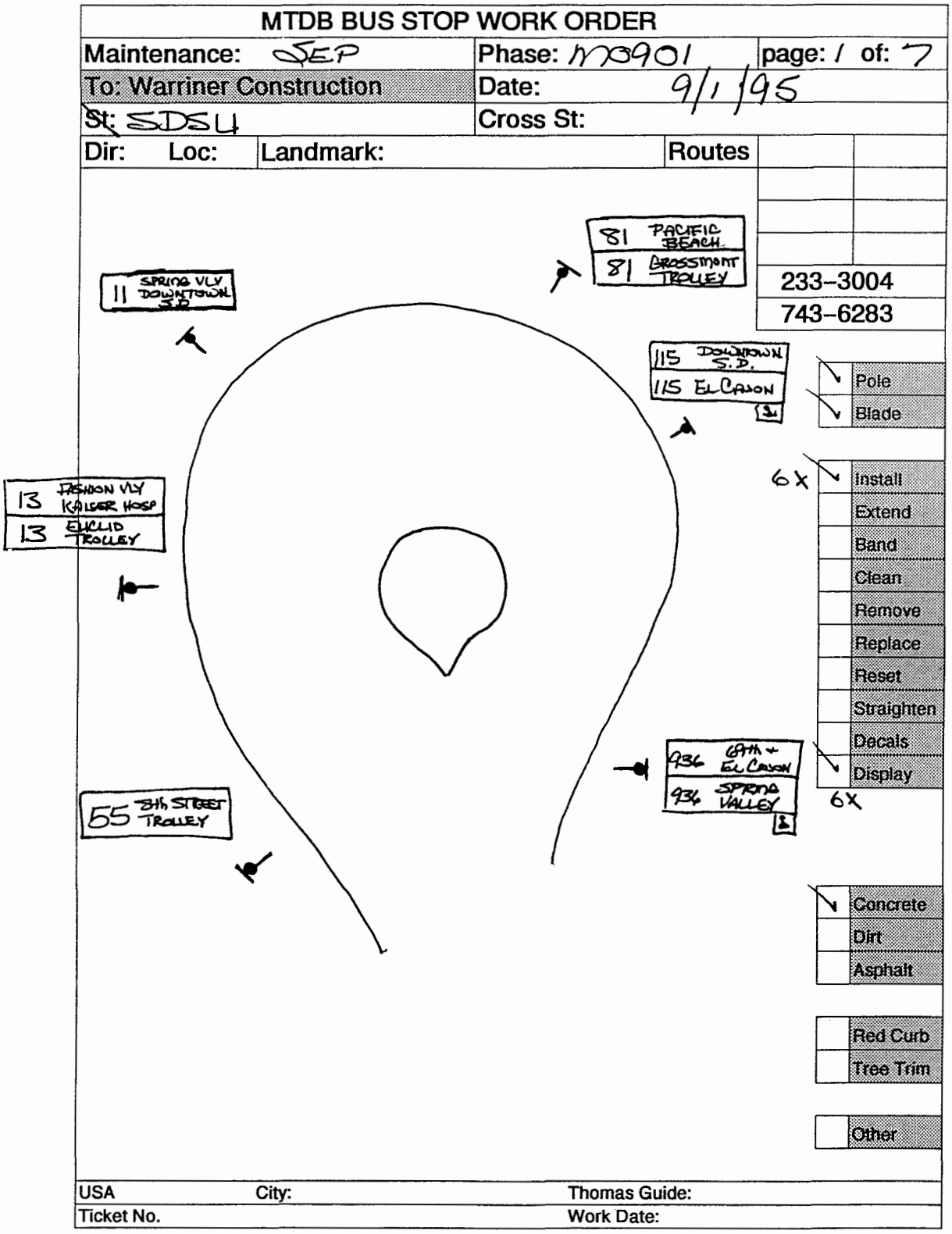


FIGURE 17 San Diego Metropolitan Transit Development Board bus stop sign work order.

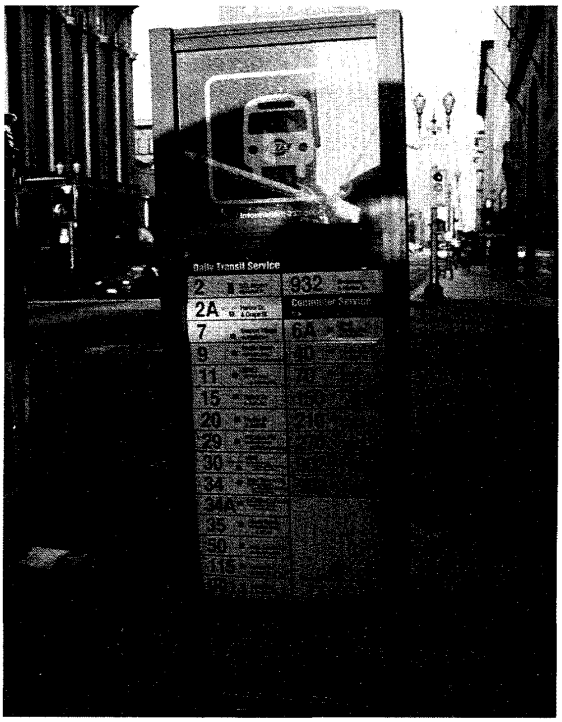


FIGURE 18 San Diego Metropolitan Transit Development Board downtown route kiosk.

use of common office photocopying processes, and black and white reproduction keep production costs low. The materials in each display are estimated to cost less than $5.00. MTDB is preparing to use a graphic software package for design rather than the cut and paste technique.

MTDB contracts with a national outdoor advertising firm for the placement of the passenger shelters. Each shelter has two large advertising panels that the company sells for paid advertising. The firm is responsible for maintenance of the shelter and upkeep of the transit service information displays. MTDB provides the display boards to the company for installation, which is performed along with shelter cleaning and maintenance. In this manner installation costs are kept at a minimal level. The MTDB staff responsible for display production spot checks the installations for quality control.

A third type of supplemental display is a small (8.5 by 12 in.) pole-mounted single panel display used to house exact schedule information. The actual displays are adapted from timetables in some cases, and in other cases are custom made point schedules. Figure 20 is a photograph showing a typical application of this type. MTDB has installed 45 units and San Diego Transit has approximately 160.

MTDB's 45 units are maintained by the same staff person responsible for bus stop signs and shelter displays. Some stop displays are simply reproductions of the timetable from the appropriate route brochure. Some displays list only the scheduled times for a particular stop. These schedule lists are produced on a spreadsheet program using manually input schedule times.

San Diego Transit, the largest operator in the system, uses word processing software to produce stop-specific schedules for their 160 units. Responsibility for the schedule displays rests with the agency's schedule function. Although each display can be produced in a short time (about 10 minutes), the task is burdensome because staff reductions have limited the department's capabilities. In addition, schedule production is regarded as work restricted to members of the bargaining unit, making it difficult to assign additional staff to the task when required. It was noted that the number of stop displays has declined from more than 300 units to the current 160 in recent years. When service changes require a large number of display revisions, the pressure of competing priorities and duties results in outdated service information remaining in the displays.

San Diego Transit uses a commercially available scheduling and runcutting system. However, the users have not been able to adapt output from this system for the on-street schedule information displays. The prepared displays are installed by field supervisors and office personnel. Unlike the case with schedule preparation, work restrictions are not in place for installation of the schedules.

Costs and Staffing

MTDB's on-street information program is staffed by an employee who is also responsible for bus stop signs and other information displays. It was estimated that approximately 10

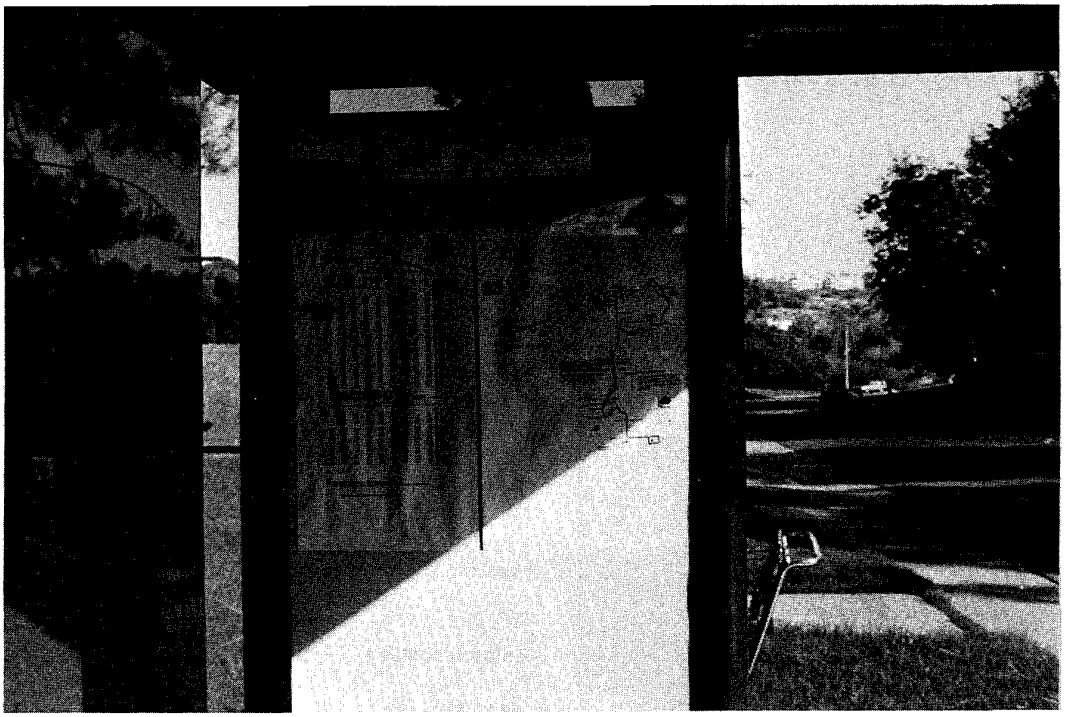


FIGURE 19 San Diego Metropolitan Transit Development Board shelter display.

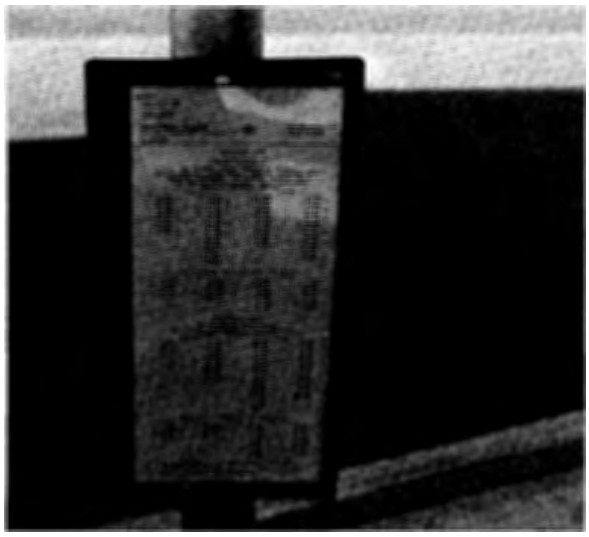


FIGURE 20 San Diego Metropolitan Transit Development Board bus stop schedule display.

percent of the employee's time is spent on the information displays. The time involvement is concentrated around "shakeups," scheduled service changes. It is very difficult to determine the cost of the supplemental information displays because the employee incorporated tasks related to the on-street information display program with a number of other similar duties; labor time is not directly allocated to any specific activity. Additionally, the work varies considerably depending on the nature and extent of the service changes.

An inventory of bus stops is maintained with information relating to the type of signage and information displays (if any), along with the routes serving the stop. The inventory uses spreadsheet software, and is not currently interfaced with other automated systems.

As previously explained, installation is performed by contract shelter cleaning crews at little or no additional cost beyond the cost of maintaining the shelter. MTDB does not realize this cost because the cleaning crews are otherwise scheduled to be at the shelters on a regular basis.

MILWAUKEE COUNTY TRANSIT AGENCY

The Milwaukee County Transit System (MCTS) in Milwaukee operates 535 buses on 70 routes with an average weekday ridership of 210,000. As previously noted, MCTS conducted a comprehensive market research study of the need for and presentation of on-street user information in the late 1970s. The current bus stop signs are a direct result of this research, and to an extent MCTS' philosophy regarding public information in general, and on-street information in particular, has evolved from the research over the past 15 years. MCTS has a somewhat limited on-street information program compared with some transit agencies, a result of cost and staffing concerns. However, any void that exists is filled by integration of all elements of the public information program.

Bus Stop Signs

In the early 1980s, MCTS started the bus stop sign replacement program recommended by the research conducted a few years earlier. Because the signs were to be customized for each stop, the first step was to prepare an inventory of each one of the 6,500 bus stops on the MCTS. The inventory would be needed to determine the number and type of sign required at each stop location. Installation of signs would be directed with the assistance of the inventory.

The inventory information was initially collected by MCTS route supervisors and compiled by an automated data base prepared by a consultant. The inventory included information such as street intersection, direction, nearside/farside, routes serving the stop, type of mounting, and other information relevant to sign installation. The bus stop inventory is now maintained on software that is part of the automated scheduling system used by MCTS.

Initially, the bus stop signs were made to specifications regarding exact route name and number legend for each location, ready for installation. Since the initial installation, MCTS has switched to a blank sign and uses separate decals for route names and numbers to individualize the stop signs.

Initially, five different sign sizes were identified to accommodate route strips at stops with multiple route service; today only four sizes are used. All signs are 12 in. wide, with lengths of 18, 24, 30 and 36 inches. The largest sign can

accommodate five routes; the majority of signs on the system are 18 in. in length as required at stops served by one route.

MCTS bus stop signs have a white vinyl background and blue screen painted lettering and background for the bus pictograph. Figure 21 shows an MCTS bus stop sign. Route names and numbers are on 5.5-in.-wide vinyl strips. The route decals have a blue background for local service routes, and a green background for express routes. Unlike signs in many cities, the signs are not reflectorized. Apparently the decision was made for cost considerations (reflective sheeting being more expensive than non-reflective), and because it was believed most bus stop locations would be well lit by street lights. The original research did recommend reflectorized bus stop signs.

FIGURE 21 Milwaukee County Transit System bus stop sign.

MCTS has added service information to the sign by producing smaller (2.5 by 7 inch) decals with specific messages such as "Limited Rush Hour Service" and "Operates on School Days Only." The supplemental information stickers are applied on a sign-by-sign basis where needed.

Implementation

MCTS has one staff position in the Facilities and Grounds Maintenance Department dedicated to the installation of bus stop signs. When the new sign program was being implemented, MCTS contracted with a private firm for the installation of the 6,500 signs.

When MCTS bus stop signs are installed on their own support, 2-in. diameter aluminum tubing is used. It is MCTS practice to install bus stop signs on utility poles and other supports as appropriate.

Cost

As previously explained, MCTS purchases bus stop signs from vendors. The aluminum sign blanks are purchased from one vendor, then shipped to another vendor for application of the vinyl and for screen painting. Route name and number strips are purchased on an "as needed" basis, and the sign is prepared by the sign installer prior to installation.

Current materials cost for signage is:

Aluminum sign blank (12 in. x 18 in.)	$ 6.40
Base vinyl sheeting, screen painted and applied (two sides)	5.73
Route name/number strip	3.56
Total	$15.69

The larger signs are more expensive. Thirty-inch sign blanks cost $9.85 apiece and additional route name/number strips increase the total cost accordingly. All costs vary with order quantity, as well as other factors.

Aside from the additional cost of the route name/number strips, MCTS staff do not believe the individualized bus stop signs add significantly to the cost of the signs. The addition of the route strips has been incorporated into the routine of the sign maintenance function.

Supplemental Information Displays

The bus stop sign research project recognized that transit users viewed service hours and frequencies as important information elements. However, it was concluded that user comprehension would suffer, and the goal was to provide a sign that was more informative yet still easy to use. It appeared that this type of information would be impractical and costly to maintain as part of the bus stop sign.

The 1975 study recommended that auxiliary signs be developed to convey service frequency and other more detailed information on the available transit service. However, MCTS concluded that the best way to present this detailed service information was through route brochures and the telephone information system.

MCTS maintains this philosophy today. The basic concept is to use on-street information displays for user information that is least likely to change. The bus stop sign is the primary on-street display, and other more detailed displays are used in limited applications. This philosophy and the resultant programs have been developed and guided by an interdepartmental working group with representatives from planning and scheduling, transportation, and maintenance.

The cost of upkeep and maintenance is the principal concern. MCTS made an effort to integrate all elements of the user information system to provide information more effectively. The various elements are:

- On-street information, including bus stop signs,
- Transit guide (system map with user information aids),
- Route timetables,
- On-bus signs (destination signs), and
- Telephone information system.

Since 1980, the route brochures (timetables) have been redesigned, and graphic elements and colors used for the timetable are similar to the bus stop signs. The on-bus destination signs have been reworked so that the sign readings correspond with destinations presented in the route brochures, rather than simply restating the route names from the bus stop signs. The transit guide contains printed user information aids, including a section on how to read and use bus stop signs.

MCTS has installed 37 supplemental information displays at high-activity bus stops, mostly in the downtown area. These displays, 6.5 in. by 24 in., are contained in cases mounted on sign supports or in shelters as shown in Figure 22. MCTS began to use the supplemental displays because stops served by a large number of routes were not provided the same level of information provided at other bus stops because of a lack of space on the bus stop sign. Stops serving more than five routes have signs displaying only route numbers.

FIGURE 22 Milwaukee County Transit System supplemental information display.

The displays include route number, name, and service day and span information. Depending on the availability of space, additional information of use to transit users is provided. Figure 23 shows two examples of the inserts used for these displays. The information included on the service provided by individual routes is the type that does not change regularly, thus the displays do not require much maintenance. MCTS does not provide specific schedules or service frequency information in on-street displays.

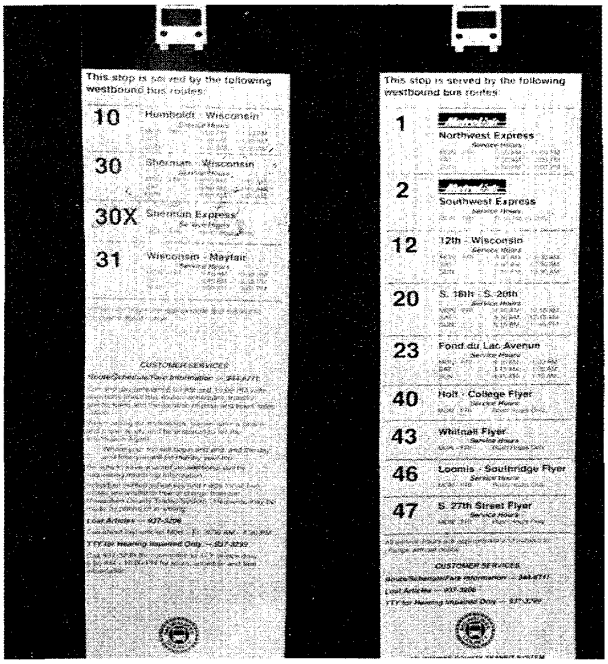


FIGURE 23 Milwaukee County Transit System supplemental information display inserts.

Recently, MCTS has begun to display some information in a limited number of passenger shelters. Display cases have been installed in about 40 of the 800 shelters on the MCTS system, mostly near the downtown area, or at transfer locations. The information displays have been adapted from the MCTS Transit Guide (system map), thus additional development and production costs are not incurred. The map of the routes and other information from the transit guide does not change frequently, minimizing upkeep costs.

Costs and Staffing

The cost and staffing requirements of the on-street information program have been kept very low due to the "policy" of (1) inclusion of information not subject to frequent change, (2) the limited scope of the program and, (3) the incorporation of related tasks into existing staff with similar responsibilities.

FIGURE 24 Fond du Lac Area Transit bus stop sign.

FIGURE 25 Sheboygan Transit bus stop sign.

The design of the information displays was developed in-house, making extensive use of materials developed for other purposes (e.g., the MCTS Transit Guide). The marketing department has responsibility for the design of the materials and their production. The information displays shown in Figure 23 were designed on a personal computer using a graphics software and are printed directly on PMT film, which is used in the display cases. The PMT material is believed to be more durable than paper stock, and avoids a step in the printing process. Labor and materials for these displays is less than 10 dollars per location.

Installation is handled by existing staff in the Facility and Grounds Maintenance Department responsible for bus stop sign installation and maintenance.

SHEBOYGAN TRANSIT AND FOND DU LAC AREA TRANSIT

To gain insight into the unique circumstances of small transit operators a site visit included small transit agencies in east central Wisconsin-Sheboygan Transit and Fond du Lac Area Transit.

Sheboygan's transit agency has a fleet of 33 buses operating on seven routes serving approximately 3,200 daily riders. Fond du Lac Area Transit operates fixed-route service on five routes with a fleet of 20 buses.

Bus Stop Signs

Fond du Lac's bus stop sign features route number and name and is patterned after the MCTS signs in Milwaukee. The system's manager feels strongly that it is important to maximize the "advertising" potential afforded by bus stop signs. Identification of the route number and name is an important consideration in this regard. Figure 24 shows the Fond du Lac sign. The bus pictograph identifies the sign as a bus stop sign, consistent with signage in other cities. The sign is yellow and white.

Fond du Lac places signs about every two or three blocks along the route, although the operating practice is to stop at any intersection on demand.

Sheboygan's bus stop sign is much more simple in design, as shown in Figure 25. Bus stop signs are not of sufficient priority to have received management's attention that could lead to redesign. Only about 300 of Sheboygan's bus stops are marked with signs. As is the case with many smaller transit agencies, flag stops are made at any intersection where a bus can safely stop. Local ordinance requirements make the installation of bus stop signs difficult, and there is some indication that aesthetic considerations are a determining factor.

In the case of both transit agencies bus stop signs are installed by the city's public works department, a common practice in smaller municipal operations.

Sheboygan reports signage costs similar to other transit agencies:

Sign	$ 25
Post/hardware	55
Installation labor	20
Total	$100

FIGURE 26 Fond du Lac Transit shelter display.

FIGURE 27 Sheboygan Transit shelter display.

Other Information Displays

Both Sheboygan Transit and Fond du Lac Area Transit make limited use of other information displays. Both systems produce system maps with schedules for each of the routes operated. It is possible to provide all of this information on one piece because of the small number of routes and the relative simplicity of the system. The system map has been adapted for use in passenger shelter display boards in both cities. Figure 26 shows this display in Fond du Lac and Figure 27 is a photograph of a shelter display in Sheboygan.

The transit service in both cities is based on a pulse system with a downtown transfer point. In Sheboygan the transfer center is an extensive facility with 12 bus bays. Fond du Lac's center is of simpler design, consisting of curb space along one of the downtown streets, a shelter, and several benches.

The transfer center is an area where specialized on-street information is required to assist riders in transferring from one route to another. Also, since many of the transit agency's patrons use the facility, the transfer center is considered an effective location to provide user information. The facilities and structures present at the location provide space and support for information displays.

Program Design Considerations

Both transit agencies are hampered by a lack of specialized staff and limited resources for any type of marketing and information displays. The transit agency managers have had to accept responsibility for the development and production of the information displays. Often, competing priorities result in minimal attention being given to these activities.

CHAPTER SIX

ADVANCED TECHNOLOGY APPLICATIONS

A small number of transit systems have used electronic displays at bus stops. The use of technology to inform users at rail transit stations is widespread. Techniques include video displays, electronic signage and programmed audio announcements, suitable for high-volume facilities with relatively controlled environments. LED electronic wayside signs mounted above a bus shelter are more visible than most static displays, and messages can be changed much more easily. Although initial costs are higher, the lower operating costs for revising and updating information make electronic signs attractive.

The transit system in Tampa, Florida, Hillsborough Area Regional Transit Authority (HART) or HARTLINE, has used video monitors since 1989 at seven downtown bus stops to display bus arrivals at the stop. Two video monitors are located in each bus passenger shelter along a 13-block transit mall in the downtown area. The system includes a total of 14 separate monitors. The display shows the next three scheduled arrivals by route, and indicates any delay for the first scheduled bus. The information on arrivals is provided by HARTLINE's master schedules, and delay information is a product of a small area automatic vehicle locator (AVL) system that is designed to track the progress of buses along the transit mall.

The system requires considerable attention because the specific buses assigned to each run must be input daily. The system is also reported to have some reliability problems and has required more maintenance attention than initially anticipated. Vandalism, however, has not been a problem.

Tri-Met in Portland, Oregon uses a similar application of video displays at high use stops on the transit mall in the downtown area.

Denver, Colorado RTD uses electronic signs at the bus transfer terminals at either end of the 16th Street transit mall to inform transit users of the location and departure times of buses leaving the terminals. Buses operating on different routes depart from several gates, or stop locations, within the terminals. The signs use light emitting diode (LED) technology and are integrated with RTD's automated scheduling system, and each sign is separately controlled by a personal computer-sized processor. The LED signs replaced dot matrix signs which had maintenance and reliability problems. The LED signs are believed to provide better visibility and legibility. Figure 28 is a photo of one of RTD's electronic passenger information signs.

One mall terminal station has 10 electronic signs at gates, and one large electronic sign consolidating information for the

FIGURE 28 Denver RTD electronic display sign.

entire terminal. The other terminal uses nine individual gate signs, but no large terminal wide sign. The signs provide route number, gate number (location), and scheduled departure time for the next three departing buses.

Although the RTD terminal signs are very specialized applications, they do demonstrate the potential application of electronic signage at transit stops. Future plans include integrating the electronic signs with the RTD AVL system to provide real-time information rather than the scheduled information currently used.

The Federal Transit Administration's Advanced Public Transportation Systems Program (APTS), a component of the Departmental initiative in intelligent transportation systems (ITS), is researching the application of variable message signs at transit stops and other traveler information systems applications. The other components of APTS are:

- Transit fleet management systems,
- Electronic fare payment systems, and
- Transportation demand management.

The basic concept is the integration of automatic vehicle location (AVL) systems with various information media. Media that can be accessed conveniently by individuals in homes, offices, shopping malls, and other remote locations seem to have received more attention than on-street displays. Automated telephone systems, on-line computer systems, and video display terminals are examples of information devices being tested. In some applications travel information on all available modes is available at a single source, simplifying the individual's decisions with respect to mode choice.

FTA is assisting in the development of this technology by conducting a number of operational tests throughout the country. System applications involving the provision of transit service information at transit stops are included as APTS operational tests. The use of video display terminals, interactive kiosks, and electronic signs at high-activity transit stops will be tested in Los Angeles, Denver, Minneapolis/St. Paul, and New York.

An important current project is the Atlanta Traveler Information Showcase, which will be debuted at the 1996 Olympics in Atlanta. Travelers will be able to make educated transportation decisions based on real-time information provided by electronic wayside signs, cable and interactive television, telephones, kiosks, personal electronic devices, and on-line services.

The Transit Cooperative Research Program is also active in the area of technology application to transit information systems. Project G-1, *Information Technologies-State-of-the-Art Applications for Transit Properties,* is nearing completion. The objectives of Project G- 1 are:

- to review and critique state-of-the-art technologies and evolving real-time transit information systems,
- to establish criteria and develop evaluation procedures for use by transit agencies to indicate the value of the information systems,
- to demonstrate the usefulness of these procedures by evaluating several applications.

The evaluation procedures are intended to support implementation decision making by transit systems large and small.

Recent advancements in electronic message signs make the application of electronic signage more practical. One of the most attractive potential benefits of this type of technological application is the capability to display a wide variety of service related information, making revisions as necessary, without the labor-intensive support activities required for static printed displays. The greatest disadvantages appear to be the high initial cost of sign and hardware acquisition and integration with other information systems.

At this time, questions related to the viability of widespread electronic signage displaying real-time transit service information have not been answered. As technological applications emerge and the APTS operational and demonstration field tests conclude, more information will be available.

CHAPTER SEVEN

CONCLUSIONS

This synthesis project on providing information to transit users at bus stops has found a developed but rather informal practice among transit systems surveyed. On-street information programs at most transit agencies are limited, usually reflecting limited resources rather than a question regarding the need for such programs. The value and effectiveness of on-street information programs is accepted, but there is not agreement regarding their specific value related to program costs.

Based on information provided by transit agency managers the following conclusions can be drawn:

Most transit agencies are involved in at least some provision of on-street information. The practice is very widespread, reflecting the perceived value of on-street displays and the public's desire for such information. As a result, a significant body of experience is being developed that can be used to advance the state of the practice.

Bus stop signs have become instruments providing higher levels of information and are effectively used by most transit agencies. The provision of route number and/or name is becoming a minimum, at least in cases of multiple routes serving a bus stop. Other information, such as service type, service day, and span of service information, not subject to frequent revision, is being used to significantly increase the distribution of service information at bus stops.

A limited number of research studies have concluded that on-street information programs have a return on investment. The research findings are subject to interpretation; however, studies that have quantified usage of on-street information displays have identified tangible benefits.

Information displays vary widely and often are custom designed for specific applications. This reflects the needs and differences among transit systems and even among individual bus stops on the same system. The ability to custom design displays is a positive feature, as long as program costs are not increased, and users are not confused by varied formats and presentation methods. On-street displays are considered one element of a comprehensive transit user information system. Continuity of design should include the other elements of the information system as well as on-street displays.

Sufficient knowledge appears to exist regarding the type of information that is most useful to transit users. The experience throughout the industry, aided by market research efforts, has provided transit managers with sufficient knowledge regarding the type of information that is useful to transit users. This awareness needs to be better shared throughout the industry.

North American transit agency managers can broaden their perspective of on-street information displays by studying techniques and applications in other countries. Transit systems in Western Europe, Japan, and other parts of the world have greater experience in the deployment of user information at bus stops. This experience includes both advanced technology applications and traditional static information displays.

There have been a number of creative and adaptive approaches to the task of implementing on-street programs. The industry has developed many techniques for accomplishing these programs with appropriate levels of cost and staff support. Examples are low-cost decals used to provide route and service information; shelter boards to display exact schedules in passenger shelters; and automated bus stop inventory systems. These and other techniques in practice are described in more detail in chapter 5.

Implementation of ADA regulations should benefit, not hurt, the design of bus stop information displays. The benefits result from improved legibility for all users. The provision of detailed service information is not affected by the regulations.

Research into the need for and the development of bilingual signs and displays is needed. Space limitations and other constraints have limited the application of bilingual on-street displays, whereas other transit user information devices, such as route brochures and on-bus displays, are frequently bilingual.

Use of automation has streamlined production but there is a lack of integration with other automated systems, especially automated scheduling systems. The experience of a few transit agencies has shown that integration with other automated processes used by transit agencies can improve program effectiveness. Software firms are addressing this area by adapting automated scheduling systems for this purpose.

Low-cost measures can be used to upgrade the information capacity of a bus stop sign. The use of inexpensive decals and a modular design is a technique adopted by a growing number of transit systems to customize signs to individual bus stop locations.

The private sector appears to have done a sufficient job developing and supplying usable hardware for information displays. Transit system managers have a variety of reasonably priced products and materials to choose from in implementing theses programs.

A number of appropriate research efforts are already underway to test technology applications for on-street displays.

Advanced Public Transit Systems (APTS) represents an important research effort that can lead to significant improvements in the deployment of transit user information. APTS and other similar programs should continue to consider applications that can assist all users.

Further information-sharing efforts can improve the industry's development and use of on-street information programs. For example, research can be used to address a range of questions and differences of opinion regarding information presentation details. It can address the cost-effectiveness of on-street information displays to provide transit system managers guidance on the investment of limited funding and staff time, and whether on-street programs actually contribute to increased ridership.

One question concerning how bus schedules can be best displayed at bus stops is whether specific stop times are sufficiently more effective than time point information to justify the additional schedule preparation time and operating policy implications. Another question is how to develop methods and techniques to address the cyclical peaking of labor requirements when transit service changes are implemented. In many cases the inability of transit system managers to address this matter results in outdated on-street information.

Transit managers also appear to need assistance in integrating automated systems to expedite the production of schedule displays for use at bus stops.

Research scheduled to begin in the near future as part of the Transit Cooperative Research Program may meet some or most of these needs. TCRP Projects B-10, *Role of Passenger Amenities and Transit Vehicle Characteristics in Building Ridership* and A-12, *Passenger Information Services,* appear to be especially relevant.

A need appears to exist for a compilation of information relating to bus stop signage and supplemental information displays. This need could be addressed through the development of a manual designed for use by transit system managers charged with responsibility for on-street information programs. This recommendation could be viewed as an update of the *On-Street Information Handbook* developed by the American Public Transit Association (APTA) in 1983.

The issues of return on investment and value to transit users are very important to transit agency managers. Although there has been some research directed at these issues, many practitioners remain uncertain of the tangible benefits of on-street information programs. One approach would be to perform observational studies to validate preference studies and compare individual's behavior in use of various levels of bus stop information.

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GLOSSARY

ADA	Americans With Disabilities Act, legislation passed in 1990, to ensure the rights of individuals with disabilities
APTS	Advanced Public Transportation Systems, a program developed as part of the Intelligent Transportation Systems initiative
CDTA	Capital District Transportation Authority (Albany, NY)
ITS	Intelligent Transportation Systems, a program created by the Department of Transportation to evaluate and promote the application of advanced technology to traffic and transportation problems
KCATA	Kansas City Area Transportation Authority
MARTA	Metropolitan Atlanta Rapid Transit Authority
MCTS	Milwaukee County Transit System
MTA	Metropolitan Transit Authority (New York, NY)
MTDB	Metropolitan Transit Development Board (San Diego, CA)
PAT	Port Authority Transit (Pittsburgh, PA)
RTC	Regional Transportation Commission (Reno, NV)
RTD	Regional Transportation District (Denver, CO)
SCAT	Sarasota County Area Transit (Sarasota, FL)
SRTD	Sacramento Regional Transit District
SUPPLEMENTAL INFORMATION DISPLAYS	Any type of display mounted at or near a transit stop that provides transit user information in addition to information provided on a sign identifying the bus stop location
TARC	Transit Authority of River City (Louisville, KY)
TMTA	Topeka Metropolitan Transit Authority
TTC	Toronto Transit Commission
UTA	Utah Transit Authority (Salt Lake City, UT)
WMATA	Washington Metropolitan Area Transit Authority

APPENDIX A

Questionnaire

Customer Information at Bus Stops
TCRP Project J-7
Topic SA-05

QUESTIONNAIRE

INDIVIDUAL FILLING OUT QUESTIONNAIRE:

NAME: _____
TITLE: _____
DEPARTMENT: _____
ORGANIZATION: _____
ADDRESS: _____
TELEPHONE: _____

PLEASE DESCRIBE YOUR TRANSIT OPERATION

Modes operated:	Bus	❑
	Light Rail	❑
	Heavy Rail	❑
	Other	❑ (Please specify) _____
Number of Vehicles:	Bus	_____
	Light Rail	_____
	Heavy Rail	_____
	Other	_____
Number of Routes:	Local Bus	_____
	Express Bus	_____
	Limited Stop	_____
	Rail	_____

Average Weekday Ridership: _____
Annual Operating Budget: _____
Approximate Number of Bus Stops: _____

NATURE OF BUS STOP SIGNAGE/INFORMATION PROGRAM

1. *Has your agency pursued a comprehensive program to provide service information at bus stops? (Please explain)*

_____
_____

If not, what are the reason:

- ❑ Cost considerations
- ❑ Inadequate staffing
- ❑ Program not cost effective
- ❑ Other (Please explain)

_____
_____

2. *Does your Agency provide service information at bus stops?*

❑ No ❑ Yes

If yes, please specify:

	Major Stops	Medium Stops	Minor Stops
Route Number and/or Name			
Route Destinations			
Route Map			
Schedule Information			
Fare Information			
Other			

Major stops are generally stops in the downtown area, or near major generators, served by more than one route, Includes transfer points

Medium stops are stops at major generators or other high activity locations.

Minor stops are stops in residential neighborhoods.

3. *Please explain your agency's policy and/orpractices regarding the placement of service information at bus stops.*

_____
_____
_____

4. *Does your agency use supplemental information displays? (e.g., Guide-a-Ride, Kiosks, etc.) to show specific information about the transit service?*

❑ No ❑ Yes
If yes, what percentage of stops are so equipped? _____

If yes, please briefly explain the type of displays:

_____
_____
_____
_____

5. *Specific information regarding Bus Stop Signage/Information Program.*

   Does your agency employ specific criteria to guide the placement of information at bus stops? (Please explain)

   _____
   _____
   _____

6. *How does your agency accomplish graphic design tasks? Is this service performed by vendors, or do you have in-house staff: If a combination, please estimate the percentage of work performed by vendors.*

   _____
   _____
   _____

7. *How is the responsibility for bus stop signage/informational programs organized within your agency? Please indicate department or functional unit.*

   Graphic Design and Production: _____
   Installation:_____
   Servicing:_____
   Updating Information:_____
   Customer Outreach (i.e., informing customers how to use displays):_____

PROGRAM BENEFITS AND COST EFFECTIVENESS

8. *Has your agency conducted any form of research, including surveys, etc., to determine design elements of the bus stop signage/information program? If so, when was this research undertaken?*

   _____
   _____

9. *To the best of your ability, please indicate approximate program costs:*

   Sign and other hardware acquisition costs:_____
   Installation costs:_____
   Ongoing maintenance costs:_____
   Use of external funding (e.g., FTA grants):_____

10. Do you regard vandalism as a significant problem? (Please explain)

    _____
    _____
    _____

11. *If known, please provide the name of the supplier for various hardware items:*

    Sign materials (e.g., decals)

    _____
    _____

    Information display modules (e.g., Guide-a-Rides):

    _____
    _____

12. *Has your agency undertaken research to determine the cost effectiveness of bus stop information programs? (Please explain)*

13. *Irrespective of research on the subject, please briefly state your opinion on the effectiveness of programs to place transit service information at bus stops.*

- ❑ Ineffective, not worth the effort.
- ❑ Effective in some applications.
- ❑ Useful, but too costly to install and maintain.
- ❑ Very effective, necessary component.

What benefits have you realized?

14. *Does your agency have future plans for expanding or upgrading bus stop signage/information programs? (Please explain)*

AMERICANS WITH DISABILITIES ACT (ADA) REGULATIONS

15. *Are you aware of ADA regulations pertaining to the provision of transit service information displays?*

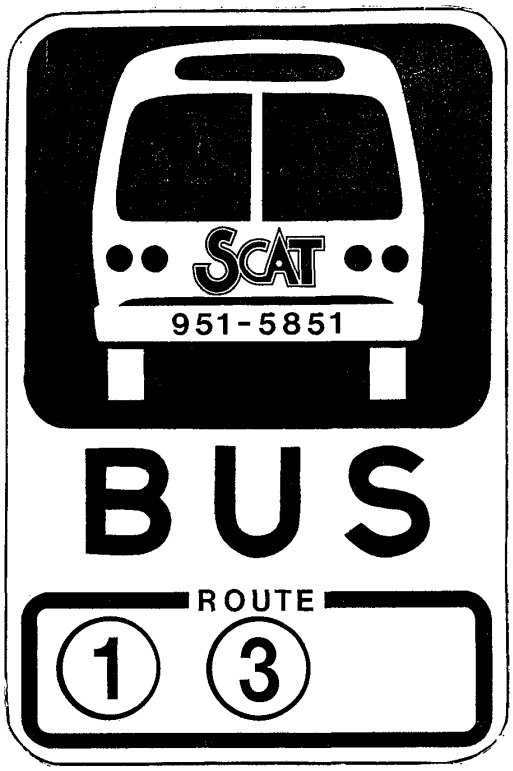
16. *Has your agency begun the process of incorporating ADA regulations and guidelines into the on-street information program?*

17. *If your agency has experience with the implementation of ADA regulations, please provide an explanation as to the effect of these regulations on on-street information programs.*

PLEASE PROVIDE ANY PHOTOGRAPHS, SKETCHES OR OTHER GRAPHICAL INFORMATION SHOWING YOUR AGENCY'S BUS STOP SIGNS AND INFORMATIONAL DISPLAYS.

APPENDIX B

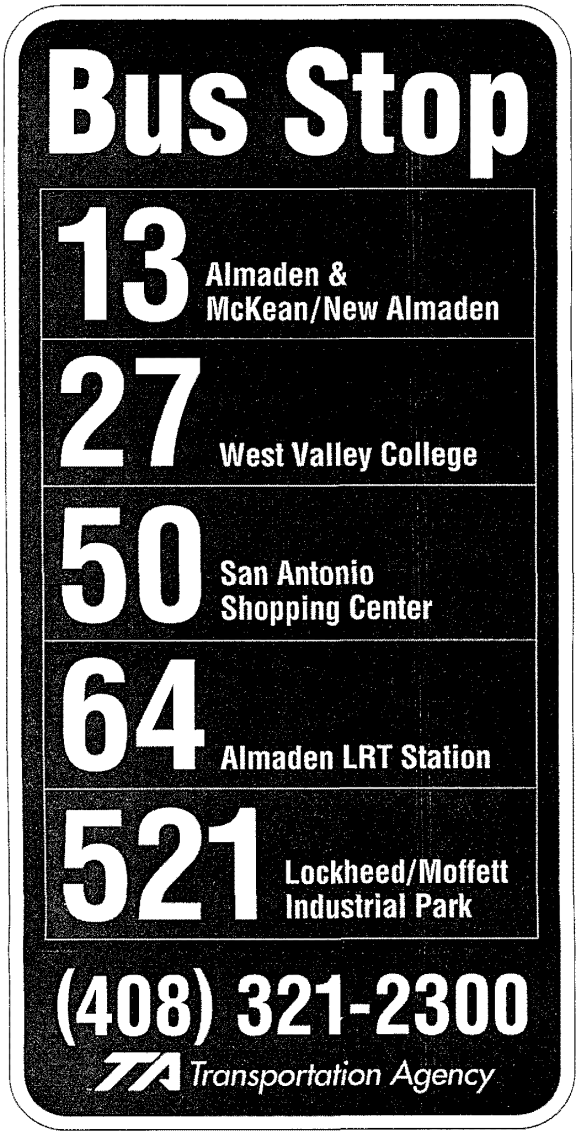
Bus Stop Sign Examples



Sarasota, Florida, SCAT bus stop sign.

Suburban Chicago PACE bus stop sign.

Santa Clara County Transportation Agency bus stop sign without route identifier. This sign is placed at stops serving one route.



Santa Clara County Transportation Agency bus stop sign with route identifier. This sign is placed at stops serving multiple routes.

Milwaukee MCTS multiple route bus stop signs.

San Diego MTDB bus stop sign route identifiers, pre ADA and ADA compliant.

Pittsburgh PAT bus stop sign.

APPENDIX C

Bus Stop Information Display Examples

Route 936

EFFECTIVE SEPTEMBER 3, 1995

MONDAY THROUGH FRIDAY	
To 69th St. & El Cajon Bl.	**To Spring Valley**
6:00am	9:21am
6:30	6:51
7:05	7:31
7:35	8:01
8:20	8:48
9:05	9:33
9:50	10:18
10:35	11:03
11:20	11:48
12:05pm	12:34pm
12:50	1:19
1:35	2:04
2:20	2:49
3:05	3:34
3:50	4:19
4:35	5:04
5:20	5:49
6:05	6:28
6:45	7:18
7:45	8:18
8:45	9:18
9:45	10:18
SATURDAY	
To 69th St. & El Cajon Bl.	**To Spring Valley**
6:18am	6:58am
7:18	7:58
8:20	8:56
9:20	9:56
10:22	10:56
11:22	11:56
12:22pm	12:56pm
1:22	1:56
2:22	2:56
3:22	3:56
4:22	4:56
5:20	5:56
6:20	6:59
7:20	7:59
8:20	

There will be no service on Sundays and the following Holidays:
(New Years Day, Memorial Day, Independence Day, Labor Day,

San Diego MTDB bus stop schedule display, showing specific stop times.

ROUTE 936
EFFECTIVE SEPTEMBER 5, 1995

Route 936 — Monday through Friday

69th & El Cajon → SDSU → Mkt Place At Grove → Spring Valley

69th St. & El Cajon Blvd Depart	SDSU Transit Center	College Ave. & El Cajon Blvd.	Marketplace At The Grove	Broadway Trolley Station (Lemon Grove)	Carlisle Dr. & Cardiff St.	Gillespie Dr. & Jamacha Blvd. Arrive
—	—	—	6:02am	6:12am	6:16am	6:21am
6:12am	6:21am	6:25am	6:32	6:42	6:46	6:51
6:42	6:51	6:55	7:02	7:12	7:19	7:25
7:22	7:31	7:35	7:42	7:52	7:59	8:07
7:52	8:01	8:05	8:12	8:22	8:29	8:37
8:38	8:48	8:52	9:01	9:12	9:19	9:27
9:23	9:33	9:37	9:46	9:57	10:04	10:12
10:08	10:18	10:22	10:31	10:42	10:49	10:57
10:53	11:03	11:07	11:16	11:27	11:34	11:42
11:38	11:48	11:52	12:01pm	12:12pm	12:19pm	12:27pm
12:23pm	12:34pm	12:38pm	12:47	12:58	1:05	1:13
1:08	1:19	1:24	1:33	1:43	1:50	1:58
1:53	2:04	2:09	2:18	2:28	2:35	2:43
2:38	2:49	2:54	3:03	3:13	3:20	3:28
3:23	3:34	3:39	3:48	3:58	4:05	4:13
4:08	4:19	4:24	4:33	4:43	4:50	4:58
4:53	5:04	5:09	5:18	5:28	5:35	5:43
5:38	5:49	5:54	6:03	6:13	6:19	6:25
6:20	6:28	6:32	6:39	6:48	6:55	7:01
7:10	7:18	7:21	7:28	7:36	7:43	7:50
8:10	8:18	8:21	8:28	8:36	8:43	8:50
9:10	9:18	9:21	9:28	9:36	9:43	9:50
10:10	10:18	10:21	10:28	10:36am	10:43	10:50

All buses provide wheelchair lift service.

Route 936 — Saturday

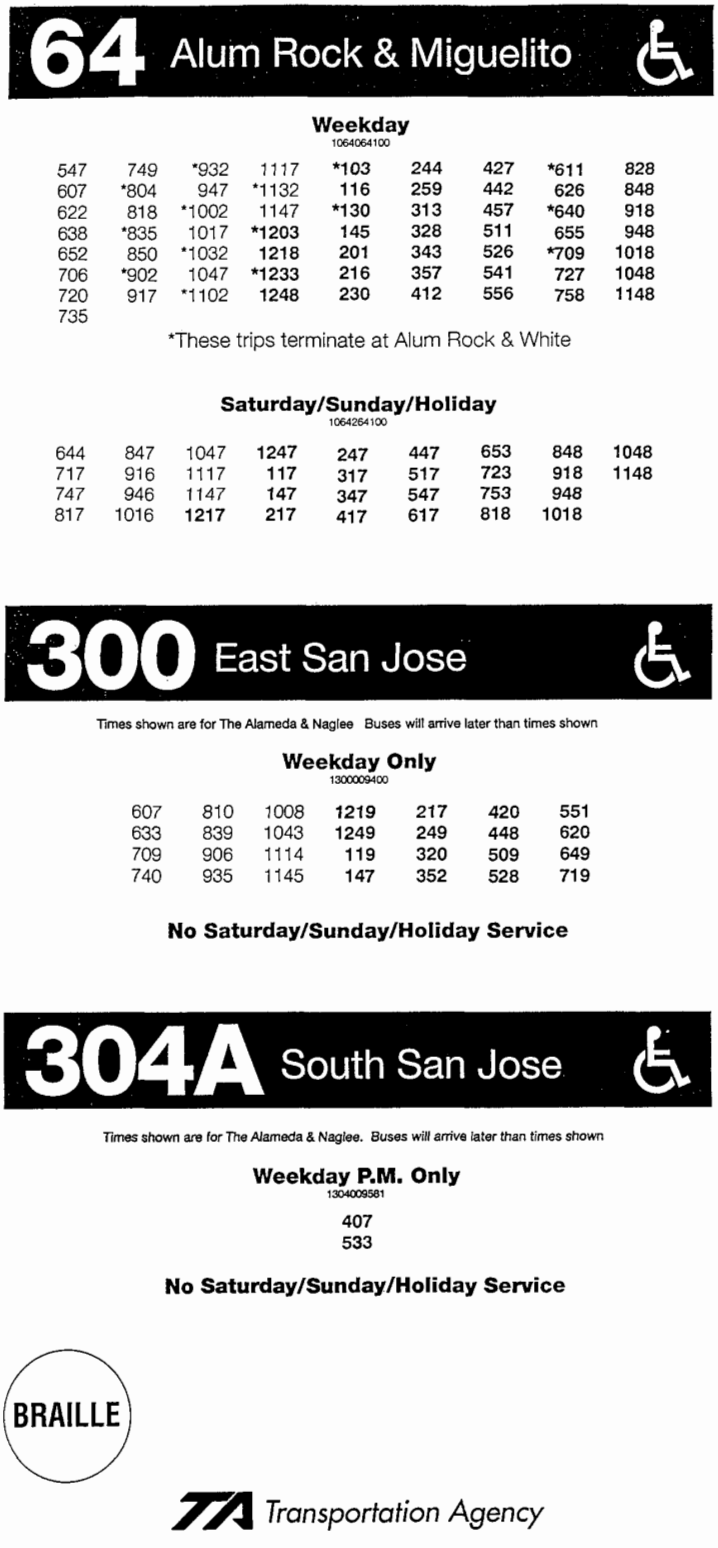
69th & El Cajon → SDSU → Mkt Place At Grove → Spring Valley

69th St. & El Cajon Blvd Depart	SDSU Transit Center	College Ave. & El Cajon Blvd.	Marketplace At The Grove	Broadway Trolley Station (Lemon Grove)	Carlisle Dr. & Cardiff St	Gillespie Dr. & Jamacha Blvd Arrive
6:49am	6:58am	7:03am	7:12am	7:22am	7:29am	7:35am
7:49	7:58	8:03	8:12	8:22	8:29	8:35
8:46	8:56	9:02	9:11	9:22	9:29	9:35
9:46	9:56	10:02	10:11	10:22	10:29	10:35
10:46	10:56	11:02	11:11	11:22	11:29	11:35
11:46	11:56	12:02pm	12:11pm	12:22pm	12:29pm	12:35
12:46	12:56pm	1:02	1:11	1:22	1:29	1:35
1:46	1:56	2:02	2:11	2:22	2:29	2:35
2:46	2:56	3:02	3:11	3:22	3:29	3:35
3:46	3:56	4:02	4:11	4:22	4:29	4:35
4:46	4:56	5:02	5:11	5:25	5:30	5:35
5:46	5:56	6:02	6:11	6:25	6:30	6:35
6:50	6:59	7:04	7:13	7:27	7:32	7:37
7:50	7:59	8:04	8:13	8:27	8:32	8:37

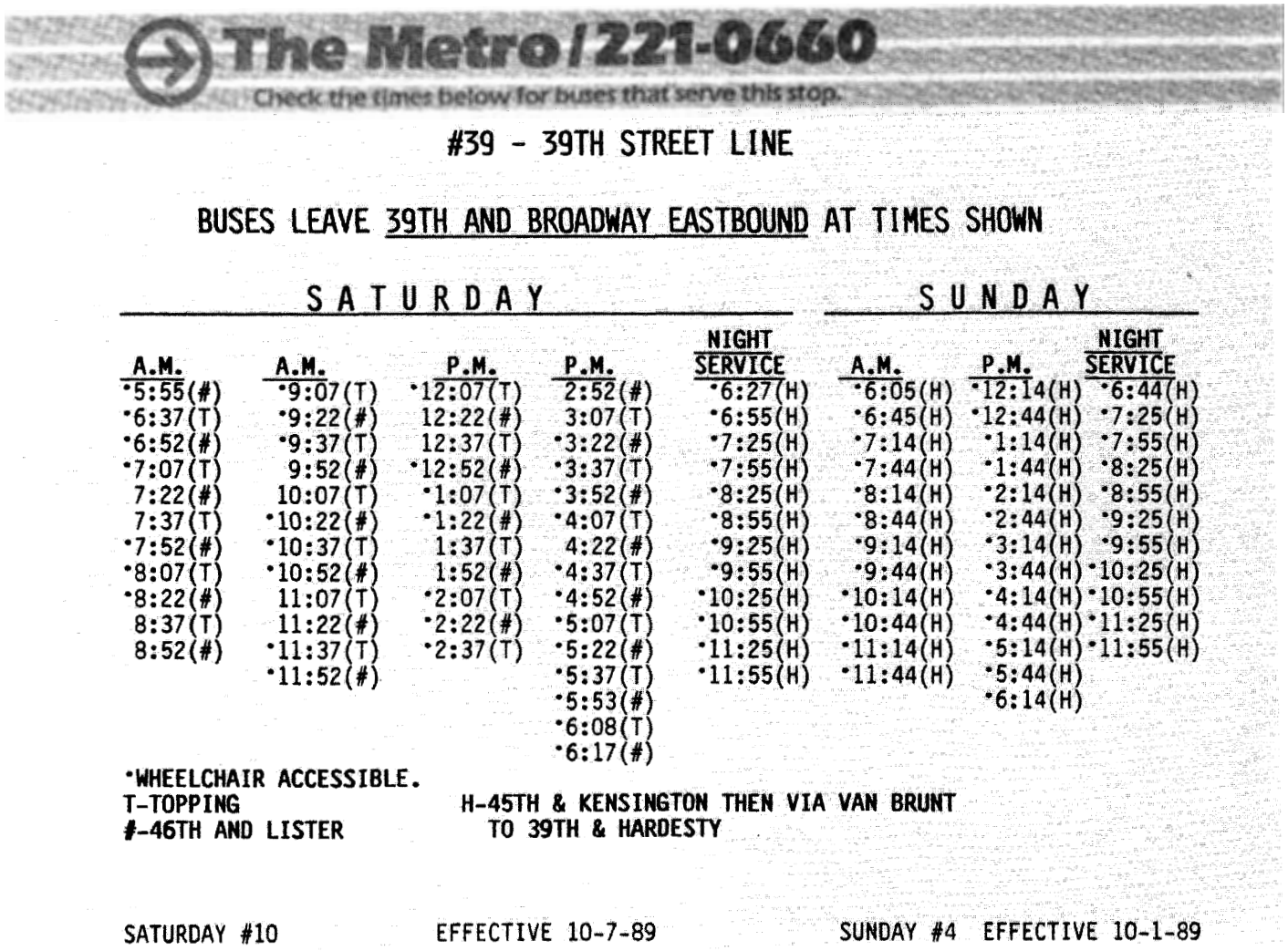
All buses provide wheelchair lift service.

There will be no service on Sundays and the following Holidays:
(New Years Day, Memorial Day, Independence Day, Labor Day,

San Diego MTDB bus stop schedule display, with timetable information.



Santa Clara County Transportation Agency bus stop schedule display.



The Metro/221-0660

Check the times below for buses that serve this stop.

#39 - 39TH STREET LINE

BUSES LEAVE 39TH AND BROADWAY EASTBOUND AT TIMES SHOWN

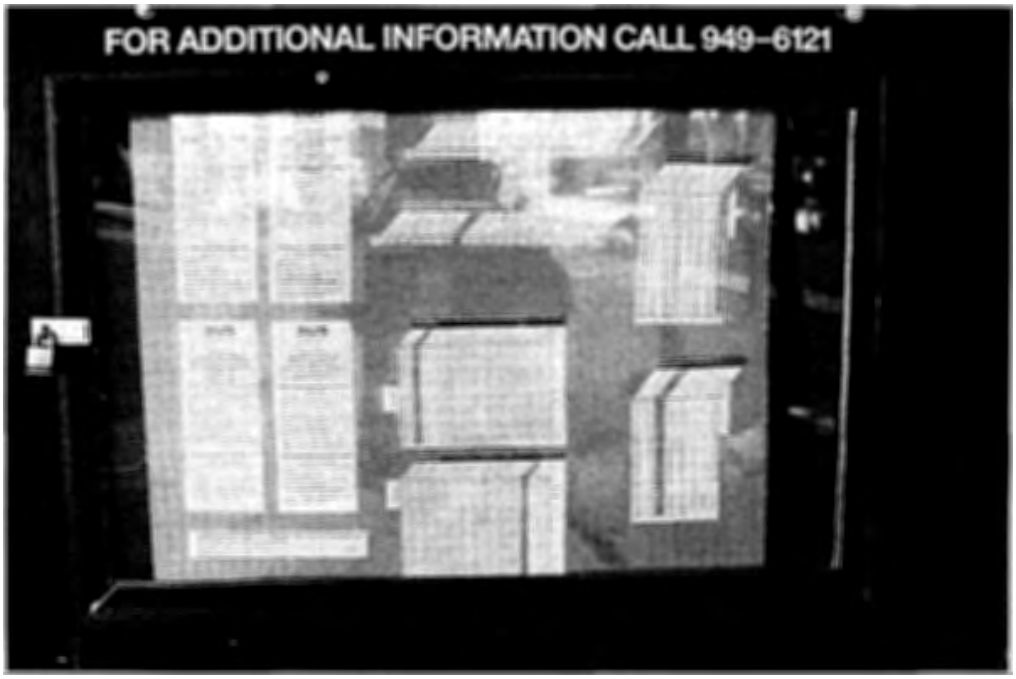
SATURDAY					SUNDAY		
A.M.	A.M.	P.M.	P.M.	NIGHT SERVICE	A.M.	P.M.	NIGHT SERVICE
•5:55(#)	•9:07(T)	•12:07(T)	2:52(#)	•6:27(H)	•6:05(H)	•12:14(H)	•6:44(H)
•6:37(T)	•9:22(#)	12:22(#)	3:07(T)	•6:55(H)	•6:45(H)	•12:44(H)	•7:25(H)
•6:52(#)	•9:37(T)	12:37(T)	•3:22(#)	•7:25(H)	•7:14(H)	•1:14(H)	•7:55(H)
•7:07(T)	9:52(#)	•12:52(#)	•3:37(T)	•7:55(H)	•7:44(H)	•1:44(H)	•8:25(H)
7:22(#)	10:07(T)	•1:07(T)	•3:52(#)	•8:25(H)	•8:14(H)	•2:14(H)	•8:55(H)
7:37(T)	•10:22(#)	•1:22(#)	•4:07(T)	•8:55(H)	•8:44(H)	•2:44(H)	•9:25(H)
•7:52(#)	•10:37(T)	1:37(T)	4:22(#)	•9:25(H)	•9:14(H)	•3:14(H)	•9:55(H)
•8:07(T)	•10:52(#)	1:52(#)	•4:37(T)	•9:55(H)	•9:44(H)	•3:44(H)	•10:25(H)
•8:22(#)	11:07(T)	•2:07(T)	•4:52(#)	•10:25(H)	•10:14(H)	•4:14(H)	•10:55(H)
8:37(T)	11:22(#)	•2:22(#)	•5:07(T)	•10:55(H)	•10:44(H)	•4:44(H)	•11:25(H)
8:52(#)	•11:37(T)	•2:37(T)	•5:22(#)	•11:25(H)	•11:14(H)	•5:14(H)	•11:55(H)
	•11:52(#)		•5:37(T)	•11:55(H)	•11:44(H)	•5:44(H)	
			•5:53(#)			•6:14(H)	
			•6:08(T)				
			•6:17(#)				

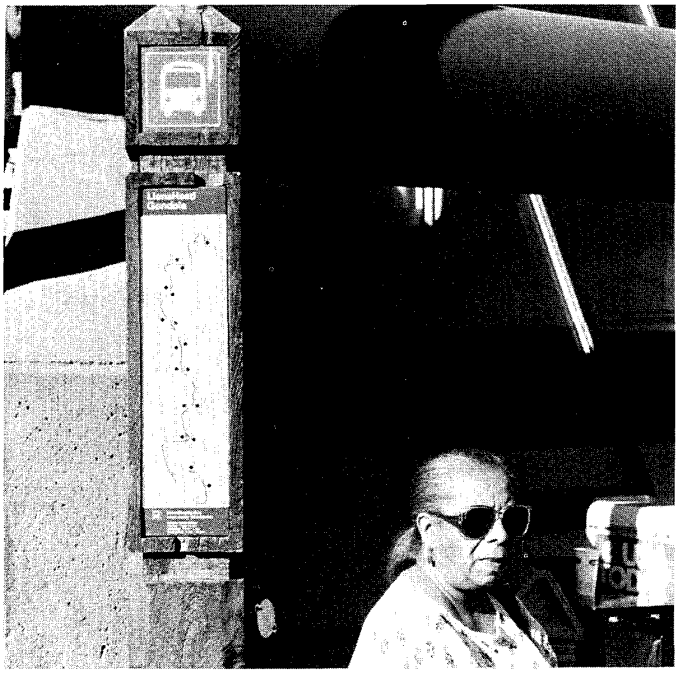
•WHEELCHAIR ACCESSIBLE.
T-TOPPING
#-46TH AND LISTER

H-45TH & KENSINGTON THEN VIA VAN BRUNT TO 39TH & HARDESTY

SATURDAY #10 EFFECTIVE 10-7-89 SUNDAY #4 EFFECTIVE 10-1-89

Kansas City ATA corner schedule insert.

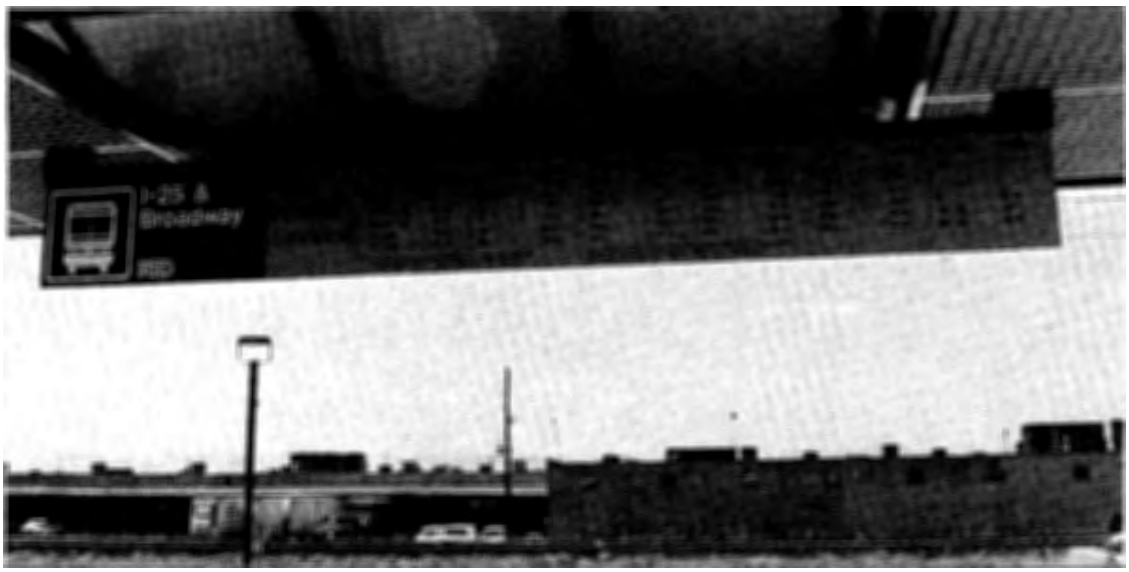




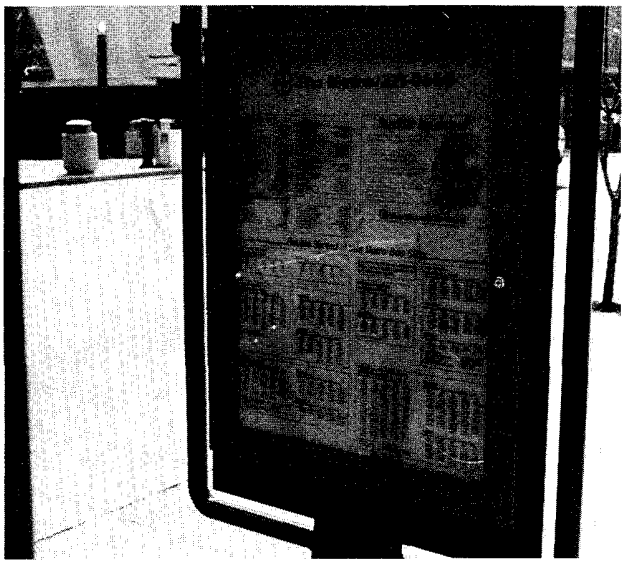
Bus information displays, Vail, Colorado.

Denver RTD information display, 16th Street Mall.

Denver RTD bus schedule display at Transit Center.



Denver RTD bus route location sign at Transit Center.



Kansas City ATA information kiosk at downtown stop.

Kansas City ATA corner schedule application.

Kansas City Trolley Corporation on-street information display.

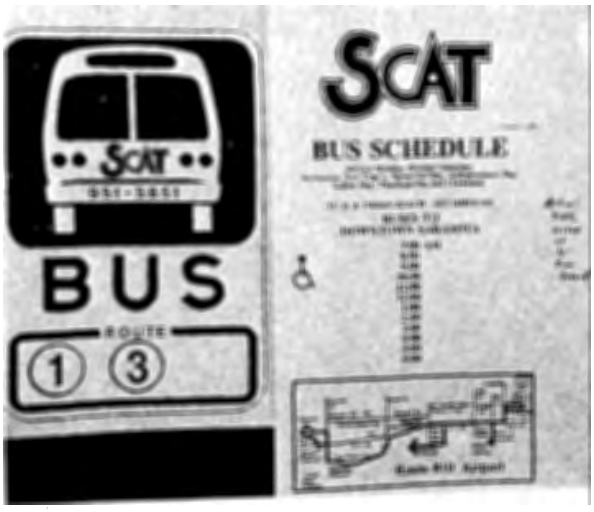
San Diego MTDB information displays at Transit Center.

Milwaukee MTC's information display in downtown passenger shelter.

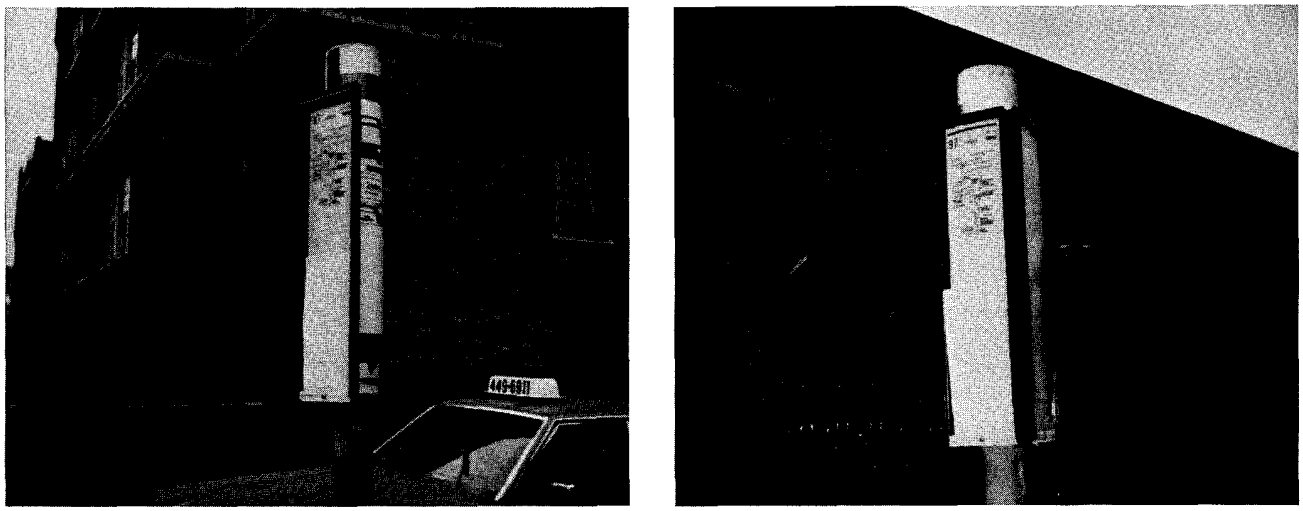
Sheboygan transit information display at Transit Center.

Fond du Lac area transit information display in downtown passenger shelter.

Fond du Lac area transit bus route location markers at Transfer Center.



Sarasota, Florida, SCAT bus stop sign and route/schedule display.



Toronto TTC bus stop schedule display.

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The National Academy of Sciences is a private, nonprofit, self-perpetuating society of distinguished scholars engaged in scientific and engineering research, dedicated to the furtherance of science and technology and to their use for the general welfare. Upon the authority of the charter granted to it by the Congress in 1863, the Academy has a mandate that requires it to advise the federal government on scientific and technical matters. Dr Bruce Alberts is president of the National Academy of Sciences.

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