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FINAL REPORT - URBAN CORRIDOR DEMONSTRATION PROGRAM EVALUATION

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## INTRODUCTION

The main purpose of the Urban Corridor Demonstration Program (UCDP) is to test and demonstrate the concerted use of available techniques for relieving traffic congestion in radial corridors serving major urban centers. This program draws on the present programs of the Urban Mass Transportation Administration and the Federal Highway Administration - including UMTA's grants for capital facilities and equipment, research, demonstration, and technical studies; and FHWA's fringe parking, TOPICS, and other construction programs. Limited special funding is also provided for Urban Corridor Demonstration Program.

The Urban Corridor Demonstration Program is, by definition, a demonstration program. It is concerned with identifying transportation innovations and improvements with potential nationwide application. Of vital interest to the program is the development of supportable findings and experience that can be extended to cities other than the demonstration city.

Contracts have been awarded to agencies in eleven metropolitan areas throughout the country for the conduct of UCDP projects. These are: Minneapolis; Dayton; Cincinnati; Washington, D. C.; Los Angeles; New York; Louisville; Philadelphia; Atlanta; Dallas; and New Haven. Demonstration projects in these cities include a variety of transportation improvements, ranging from TOPICS-type improvements on major roadways serving the demonstration corridors to high-speed buses on exclusive rights-of-way. This diversity not only permits demonstration of different techniques, but examination of the impact of different urban conditions on the effectiveness of these techniques.

## PURPOSE AND SCOPE OF THIS STUDY

The evaluation of findings from the Urban Corridor Demonstration Program must be directed at two levels. At the local level, the evaluation is concerned with measuring the effectiveness of the various techniques tested in each corridor. At the national level, the evaluation is aimed at identifying the urban and environmental conditions for which each type of improvement is appropriate, or conversely, determining the types of transportation improvements most effective for different urban conditions.

Overall program evaluation requires measures of effectiveness developed from the local evaluations and other information describing the conditions under which the local demonstrations are conducted. This, in turn, requires that information from the local projects be reported in common terms so they are readily comparable.

As a part of its planning study, each of the eleven metropolitan areas participating in the program is required to prepare a detailed process for the evaluation of its proposed demonstration. It was recognized that a wide variety of evaluation process might result from this approach and that the separate evaluations might not satisfy the requirements for comparability. Therefore, this study was undertaken to coordinate the evaluations of the individual demonstration projects.

This study addresses the evaluation of the demonstrations at both the local and the national levels. For the local level, the objective was to design a process for evaluation to elicit uniform quality information from the eleven individual demonstration projects. This process is documented separately in the Urban Corridor Demonstration Program Evaluation Manual that is intended to give guidance to each UCDP project. The

manual also provides a general framework for the design and evaluation of future demonstrations. It discusses basic concepts of experimental design and evaluation related to transportation demonstration projects, and suggests specific schemes for evaluation of several types of transportation improvements. In addition, the manual recommends data collection techniques and analysis procedures.

For the national level, the objective was to develop an overall strategy for evaluation of the program. This strategy, the subject of this report, indicates different types of social and technical effects that could be examined in the test corridors of the current demonstration program. It also suggests a number of general considerations pertinent to the design of any demonstration project.

The Appendix of this report contains descriptions of the demonstration projects planned for each corridor. These descriptions include the specific techniques and relationships to be tested in each corridor. Factors that may affect the validity of these demonstration projects are also identified and a study approach or evaluation scheme for each project is suggested.

#### QUALIFICATION OF RECOMMENDATIONS

The information in this report is based on a review of project documents (including grant applications, contracts, early implementation proposals, and periodic progress reports), on-site visits, and correspondence with project staffs. Available time and resources limited the ability to become completely familiar with the pertinent details of each UCDP project. Furthermore, implementation plans for the individual projects are not yet finalized. Consequently, this information has some limitations.

Recommendations specific to individual projects, therefore, should be regarded as a model of a general evaluation framework. Where these recommendations are at variance with actual conditions, they should be updated as the details of each project become available. Details of project implementation will be available from the implementation proposals; pertinent characteristics describing the corridors will be specified in the project evaluation reports.

*This report should not be construed as the final representation of what the individual UCDP projects can or hope to accomplish. It is intended only to suggest the general framework appropriate for the conduct and evaluation of a transportation demonstration program.*

## EXPERIMENTAL DESIGN CONSIDERATIONS

For the Urban Corridor Demonstration Program, several common factors can jeopardize the ability of individual projects to demonstrate intended hypotheses, techniques, or relationships. Other factors may limit the application of these findings to other metropolitan areas and corridors. Campbell and Stanley<sup>(1)</sup> have identified these factors as "threats to internal validity" and "threats to external validity."

An understanding of these threats, together with a clear recognition of the program goals, is essential for selecting improvements and priorities for their implementation which will provide the types of demonstrations intended.

The descriptions for the individual demonstration projects, included in the Appendix of this report, identify many of these "threats." Several of these are included in the following discussion.

### THREATS TO INTERNAL VALIDITY

To be internally valid, an experiment must be designed so the technique being tested produces an identifiable response. In transportation demonstrations, the following potential "threats to internal validity" are common. These potential problems should be carefully considered in planning both the implementation and the evaluation of the demonstration.

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1. Campbell, Donald T., and Stanley, Julian C., Experimental and Quasi-Experimental Designs for Research, Rand McNally and Co., Chicago, 1966.

1. *Confounding of effects.*

Confounding refers to mixing two or more techniques, test conditions, or other factors so the effects of each cannot be measured separately.

For several of the present UCDP projects, two or more techniques (such as parking price changes and transit system improvements) intended to encourage transit patronage will be implemented concurrently. If a net change in patronage is observed, it may be impossible to identify the influence of each improvement. In other cases, the effects of the UCDP improvements may be confounded with effects of other external factors (such as subway construction in the CBD or roadway construction in other corridors).

2. *Selection of measures of effectiveness.*

The characteristic (i.e., cost, travel time, accident rates, etc.) chosen for measuring the effectiveness of an improvement must be sensitive or responsive to that improvement. Similar types of improvements in different corridors may not produce measurable responses in the same characteristic; or the scale of these responses may differ (i.e., changes in travel time through a bottleneck versus changes in total trip time through the corridor).

The measure of effectiveness for a particular improvement must also be selected in accordance with the project objectives.

3. *Stability of effects and length of time required for monitoring such effects.*

Staged implementation of projects must permit enough time between stages to monitor the effects of different combinations of improvements. Many of the UCDP projects will not last long enough to identify the long term effects, however, where significant long term changes are anticipated and it is desired to monitor these changes, the evaluation must be continued.



Long term response to the demonstration project (in terms of land speculation or other actions requiring commitment of large sums of money) may be less significant than if the same project were implemented with a more permanent commitment to continued operation. Interpretation of the results should recognize this possibility.

## THREATS TO EXTERNAL VALIDITY

Threats to external validity are those factors that restrict the application of demonstrated findings to other corridors and urban areas. In the context of a transportation demonstration program, potential threats to external validity include the following:

1. *Suitability of techniques being tested for other corridors and urban areas.*

Many of the demonstration corridors have conditions or problems that are unique. These include topographical constraints, combinations of transportation modes and their terminals, and unusual characteristics of transportation demands. Results of improvements aimed at these local problems may have little value in helping other urban areas solve their transportation problems.

2. *Identification of factors that influence the effectiveness of the techniques being tested.*

Factors that influence the success of the demonstration techniques must be thoroughly documented in terms of characteristics that can be readily measured in other corridors.

3. *Range of test conditions.*

To develop comprehensive information relating the effectiveness of various improvements to corridor characteristics such as

population density, income levels, or initial congestion levels, the overall demonstration program should provide for tests of each major technique or improvement for a broad range of urban and corridor conditions.

Numerous types of experimental designs have been proposed to counteract or negate these various threats. While formalized in an extensive body of literature, (1,2,3,4) these designs generally apply to specialized sets of conditions.

The Urban Corridor Demonstration Program includes a wide variety of conditions that affect the validity of the experiments; the evaluation of similar improvements in different corridors may require different techniques. Attempts to meaningfully categorize the experimental designs applicable to these individual demonstration projects are further discouraged by the unfamiliar and somewhat awkward terminology. Instead, the "Suggested Items for Evaluation" included for each project in the Appendix suggest general evaluation schemes that appear, on the basis of available information, appropriate for the individual demonstration projects.

*The design of a demonstration project must consider not only the scheme for evaluation, but also the selection and phasing of the improvements to be implemented in each corridor.*

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1. Campbell, Donald T. and Stanley, Julian C., Experimental and Quasi-Experimental Designs for Research, Rand McNally and Company, Chicago, 1966.
  2. Fisher, R. A., The Design of Experiments, Oliver & Boyd, Edinburgh, 1935-1951.
  3. Snedecor, George W., Statistical Methods, The Iowa State University Press, Ames, Iowa, 1937.
  4. "Research Project Design and Program Development," Highway Research Record, Number 338, Highway Research Board, Washington, D. C. 1970.

*No amount of sophistication, competence, or detail in measuring the results of the demonstration can compensate for failure to design the total demonstration to yield meaningful and useful results.*

## SUMMARY DESCRIPTIONS OF INDIVIDUAL CORRIDOR PROJECTS

To determine how urban conditions influence the applicability of different techniques, these techniques must be tested for a variety of urban conditions. The eleven metropolitan areas included in the Urban Corridor Demonstration Program provide these varied test bases.

Most of the demonstration corridors test the net effectiveness of a combination of several techniques or transportation system improvements for relief of congestion. Most projects also provide the opportunity to examine, at least partially, the effectiveness of certain individual improvements that comprise the total project.

Table 1 indicates the types of improvements proposed for each of the demonstration corridors. Table 2 provides a subjective description of the characteristics of each corridor that are likely to influence the outcome of the demonstration. Taken together, this information indicates very generally the inferences that can be drawn from the program regarding the influence of local urban conditions on the effectiveness of each technique.

There are many limitations on the type of information that can be developed from each of the demonstration projects, particularly with regard to evaluation of the individual improvements. These are discussed in the subsequent sections and in the Appendix.

TABLE 1

SUMMARY OF IMPROVEMENTS PROPOSED BY UCDP PROJECTS

TYPE OF IMPROVEMENT	ATLANTA	CINCINNATI	DALLAS	DAYTON	LOS ANGELES	LOUISVILLE	MINNEAPOLIS	NEW HAVEN	NEW YORK	PHILADELPHIA	WASHINGTON
CORRIDOR-WIDE SYSTEM OF IMPROVEMENTS	X	X	X	X	X	X	X	X		X	
LINE-HAUL SYSTEM IMPROVEMENTS											
LINE-HAUL FACILITY IMPROVEMENTS											
RAIL FACILITIES									X		
EXCLUSIVE ROADWAYS OR RESERVED LANES				X	X		X	X		X	
PRIORITY BUS TREATMENT IN MIXED TRAFFIC		X		X		X		X		X	
ROADWAY IMPROVEMENTS WITHOUT PRIORITY BUS TREATMENT	X								X		
LINE-HAUL TRANSIT SERVICE IMPROVEMENTS	X	X	X	X	X	X	X			X	
LOW DENSITY COLLECTION DISTRIBUTION SYSTEM IMPROVEMENTS											
PARK-RIDE LOTS AND TERMINALS	X	X	X	X	X	X	X	X	X	X	X
SCHEDULED LOCAL BUS		X				X	X				
DEMAND RESPONSIVE BUS	X			X							
PASSENGER SHELTERS		X				X	0		X	X	
CBD COLLECTION-DISTRIBUTION SYSTEM IMPROVEMENTS											
SHUTTLE BUS	0			X				X			
TRANSIT TERMINAL		X		0							
OTHER TYPES OF IMPROVEMENTS											
PRIORITY SYSTEMS FOR BUSES IN MIXED TRAFFIC											
PRIORITY ENTRY TO FREEWAY				X		X		X			
AUTOMATIC BUS IDENTIFIER OR LOCATOR		X						X			
SIGNAL PREEMPTION		X	X		X					X	
STAGGERED WORK HOURS	X										
PARKING PRICE POLICY									X		
CAR POOLS	X			X							
COMMUTER INFORMATION SERVICES AND MARKETING PROGRAMS		X	X	X	X	X		X	X	X	

X - Proposed under Urban Corridor Demonstration Program.

0 - Proposed or implemented under other projects.

TABLE 2

## CHARACTERISTICS OF DEMONSTRATION CORRIDORS

DEMONSTRATION CORRIDOR	SOCIO-ECONOMIC CHARACTERISTICS OF CORRIDOR	RELATIVE ORIENTATION OF TRAVEL TO CBD	PRESENT CONGESTION LEVELS IN CORRIDOR	PRESENT TRANSIT SERVICE IN CORRIDOR	COMPARISON BETWEEN AUTO AND TRANSIT UNDER PROPOSED IMPROVEMENTS
LOUISVILLE	<ul style="list-style-type: none"> <li>- MEDIUM INCOME IN OUTER AREA (WHITE).</li> <li>- LOW INCOME IN INNER AREA (APPALACHIA WHITE).</li> </ul>	<ul style="list-style-type: none"> <li>- SEVERAL MAJOR GENERATORS WITHIN CORRIDOR.</li> <li>- CONSIDERABLE CROSS-CORRIDOR MOVEMENTS.</li> <li>- CORRIDOR BOUNDARIES LOOSELY DEFINED.</li> </ul>	<ul style="list-style-type: none"> <li>- CONGESTION IS SEVERE DURING PEAK PERIODS.</li> <li>- ROAD FACILITIES AND ALTERNATIVES ARE EXTREMELY LIMITED.</li> </ul>	<ul style="list-style-type: none"> <li>- GOOD COVERAGE - ESPECIALLY IN LOWER INCOME AREAS.</li> <li>- TRANSIT COMPANY PRESENTLY OPERATES AT PROFIT, ALTHOUGH PATRONAGE IS DECLINING.</li> </ul>	<ul style="list-style-type: none"> <li>- PREFERENTIAL BUS TREATMENT TO PROVIDE TIME ADVANTAGE FOR BUS.</li> <li>- RELATIVE TIME SAVINGS IS NOT CLEAR NOW, BUT WILL VARY THROUGHOUT THE CORRIDOR.</li> </ul>
MINNEAPOLIS	<ul style="list-style-type: none"> <li>- HIGH INCOME THROUGHOUT MOST OF CORRIDOR (WHITE).</li> <li>- RAPID GROWTH RATE.</li> <li>- POTENTIAL FOR CONTINUED DEVELOPMENT.</li> </ul>	<ul style="list-style-type: none"> <li>- STRONG ORIENTATION TO CBD.</li> <li>- SEVERAL MAJOR GENERATORS WITHIN CORRIDOR.</li> </ul>	<ul style="list-style-type: none"> <li>- FREEWAY IS PRESENTLY CONGESTED DURING THE PEAK PERIOD.</li> <li>- ALTERNATIVE SURFACE STREETS HAVE SIGNIFICANT EXCESS CAPACITY AND AFFORD GOOD TRAVEL TIMES.</li> </ul>	<ul style="list-style-type: none"> <li>- EXTENSIVE SERVICE THROUGHOUT PART OF CORRIDOR.</li> <li>- TRANSIT SYSTEM PRESENTLY HAS A HIGH TRANSIT PATRONAGE RATE.</li> </ul>	<ul style="list-style-type: none"> <li>- TIME DIFFERENTIAL MAY VARY CONSIDERABLY DEPENDING ON LOCATION WITHIN CORRIDOR.</li> </ul>
NEW HAVEN	<ul style="list-style-type: none"> <li>- HIGH INCOME IN GRESHAM AND HANDEY - OUTER AREAS (WHITE).</li> <li>- LOW INCOME IN NEHALLVILLE NEIGHBORHOOD - INNER AREA (BLACK).</li> <li>- LOW DENSITY, SCATTERED DEVELOPMENT IN MOST OF THE CORRIDOR.</li> <li>- POTENTIAL FOR FUTURE GROWTH.</li> </ul>	<ul style="list-style-type: none"> <li>- RELATIVELY FEW WORK TRIPS FROM CORRIDOR TO CBD AT PRESENT.</li> </ul>	<ul style="list-style-type: none"> <li>- CONSIDERABLE CONGESTION ON EXISTING FACILITIES.</li> <li>- LITTLE LIKELIHOOD OF CONSTRUCTION OF NEW FACILITIES.</li> <li>- LIMITED ALTERNATIVE ROUTES.</li> </ul>	<ul style="list-style-type: none"> <li>- LIMITED SERVICE TO OUTER AREAS.</li> <li>- LOCAL BUS PATRONIZED BY LOW-INCOME GROUPS IN INNER AREA.</li> </ul>	<ul style="list-style-type: none"> <li>- TIME EXPECTED TO BE SIGNIFICANTLY LESS FOR TRANSIT THAN FOR PRIVATE AUTO.</li> </ul>
NEW YORK	<ul style="list-style-type: none"> <li>- HIGH INCOME THROUGHOUT CORRIDOR.</li> <li>- EXTREMELY LARGE POPULATION.</li> </ul>	<ul style="list-style-type: none"> <li>- STRONG ORIENTATION TO CBD.</li> <li>- LARGE CBD AND LIMITED RIVER CROSSINGS INFLUENCE TRAVEL PATTERNS WITHIN CORRIDOR.</li> </ul>	<ul style="list-style-type: none"> <li>- EXTREME CONGESTION OF ALL FACILITIES.</li> <li>- PARKING IS SCARCE AND EXPENSIVE.</li> </ul>	<ul style="list-style-type: none"> <li>- AREA-WIDE COVERAGE.</li> <li>- HIGH TRANSIT RIDERSHIP.</li> <li>- CBD DISTRIBUTION IS POOR.</li> </ul>	<ul style="list-style-type: none"> <li>- DIFFERENTIAL BETWEEN AUTO AND BUS WILL DEPEND ON LOCATION WITHIN CORRIDOR.</li> <li>- FUTURE OF AUTOMOBILES IN THE CBD IS LIMITED.</li> </ul>
PHILADELPHIA	<ul style="list-style-type: none"> <li>- HIGH INCOME IN OUTER AREA (WHITE).</li> <li>- LOW INCOME IN INNER AREA (BLACK).</li> </ul>	<ul style="list-style-type: none"> <li>- STRONG ORIENTATION TO CBD.</li> </ul>	<ul style="list-style-type: none"> <li>- EXTREME CONGESTION OF ALL FACILITIES.</li> <li>- PARKING IS SCARCE AND EXPENSIVE.</li> <li>- PARKING POLICY CURRENTLY FAVORS ALL-DAY PARKING.</li> </ul>	<ul style="list-style-type: none"> <li>- AREA-WIDE COVERAGE.</li> <li>- HIGH TRANSIT RIDERSHIP.</li> <li>- GREAT VARIETY IN FORMS OF PUBLIC TRANSIT.</li> </ul>	<ul style="list-style-type: none"> <li>- AUTO TRAVEL PRESENTLY MORE RESTRICTIVE THAN TRANSIT FROM MANY POINTS WITHIN CORRIDOR.</li> <li>- IT IS DOUBTFUL THAT UOOP IMPROVEMENTS WILL SIGNIFICANTLY CHANGE THE RELATIVE TRAVEL TIMES ON A CORRIDOR-WIDE BASIS.</li> </ul>
WASHINGTON	<ul style="list-style-type: none"> <li>- HIGH INCOME IN OUTER AREA (WHITE).</li> <li>- LOW INCOME IN INNER AREA (BLACK).</li> <li>- SOCIO-ECONOMIC CHARACTERISTICS CHANGE SHARPLY AT MARYLAND-D.C. BOUNDARY.</li> <li>- POTENTIAL GROWTH AREA FOR GOVERNMENTAL FACILITIES, POPULATION AND OTHER DEVELOPMENTS.</li> </ul>	<ul style="list-style-type: none"> <li>- ALL AREAS STRONGLY ORIENTED TO CBD.</li> <li>- RELATIVELY LARGE CBD AREA AFFECTS THE TRAVEL PATTERNS AND MODE REQUIREMENTS.</li> <li>- TRAFFIC DIVERTED FROM THE SHIRLEY HIGHWAY AFFECTS TRAVEL IN THIS CORRIDOR.</li> </ul>	<ul style="list-style-type: none"> <li>- EXTREME CONGESTION OF ALL FACILITIES.</li> <li>- PARKING IS SCARCE AND EXPENSIVE.</li> <li>- RIVER CROSSINGS PROVIDE EFFECTIVE TRAFFIC BARRIERS.</li> </ul>	<ul style="list-style-type: none"> <li>- MODERATE COVERAGE WITHIN THE CORRIDOR.</li> <li>- SERVES MAINLY THE LOW-INCOME AREA.</li> <li>- SUBWAY SYSTEM UNDER CONSTRUCTION BUT NO ROUTE PLANNED IN CORRIDOR.</li> </ul>	<ul style="list-style-type: none"> <li>- PREFERENTIAL TREATMENT FOR BUSES MAY PROVIDE SOME TIME ADVANTAGE.</li> <li>- DIFFERENTIAL IS LIKELY TO DEPEND ON AREA OF ORIGIN WITHIN THE CORRIDOR.</li> </ul>

TABLE 2 (CONTINUED)

DEMONSTRATION CORRIDOR	SOCIO-ECONOMIC CHARACTERISTICS OF CORRIDOR	RELATIVE ORIENTATION OF TRAVEL TO CBD	PRESENT CONGESTION LEVELS IN CORRIDOR	PRESENT TRANSIT SERVICE IN CORRIDOR	COMPARISON BETWEEN AUTO AND TRANSIT UNDER PROPOSED IMPROVEMENTS
ATLANTA	<ul style="list-style-type: none"> <li>- HIGH INCOME IN OUTER AREA (WHITE).</li> <li>- LOW INCOME IN INNER AREA (BLACK).</li> <li>- RAPID GROWTH RATE.</li> <li>- POTENTIAL FOR FUTURE DEVELOPMENT.</li> </ul>	<ul style="list-style-type: none"> <li>- MODERATE CONCENTRATION OF TRAVEL FROM CORRIDOR TO CBD.</li> <li>- CORRIDOR FACILITIES ALSO SERVE OTHER MAJOR GENERATORS.</li> <li>- CONSIDERABLE "REVERSE" COMMUTING FOR DOMESTICS AND EMPLOYEES OF INDUSTRY IN THE CORRIDOR.</li> </ul>	<ul style="list-style-type: none"> <li>- EXTREMELY SEVERE ON ALL FACILITIES SERVING THE CORRIDOR.</li> <li>- PARKING IN CBD DOES NOT APPEAR A SERIOUS DETERRANT TO AUTO TRAVEL.</li> </ul>	<ul style="list-style-type: none"> <li>- EXTENSIVE COVERAGE.</li> <li>- LONG TRAVEL TIMES DURING PEAK HOURS.</li> <li>- LITTLE EXPRESS SERVICE.</li> <li>- LARGE PATRONAGE BY "REVERSE" COMMUTERS.</li> </ul>	<ul style="list-style-type: none"> <li>- BUS AND/OR CAR POOLS TO BE GIVEN NO PREFERENTIAL TREATMENT AND CAN BE EXPECTED TO REQUIRE LONGER DOOR-TO-DOOR TRAVEL TIMES THAN PRIVATE AUTO.</li> </ul>
CINCINNATI	<ul style="list-style-type: none"> <li>- HIGH INCOME IN OUTER AREA (WHITE).</li> <li>- LOW INCOME IN INNER AREA (APPALACHIA WHITE).</li> <li>- LOW INCOME IN MODEL CITIES AREA (BLACK), ADJACENT TO CORRIDOR NEAR CBD.</li> </ul>	<ul style="list-style-type: none"> <li>- WHITE-COLLAR WORKERS FROM OUTER AREAS ARE ORIENTED TO CBD.</li> <li>- BLUE-COLLAR WORKERS FROM INNER AREA ARE ORIENTED TO OTHER GENERATORS (NOT PRIME CANDIDATES FOR UCLP IMPROVEMENTS).</li> </ul>	<ul style="list-style-type: none"> <li>- PRESENT FACILITIES USUALLY FLOW FREELY BUT ARE SUBJECT TO FREQUENT AND SEVERE BREAKDOWN.</li> <li>- GEOGRAPHICAL CONSTRAINTS PREVENT EXPANSION TO ACCOMMODATE TRAVEL GROWTH.</li> <li>- PARKING IN CBD IS ATTRACTIVE TO AUTO COMMUTERS.</li> </ul>	<ul style="list-style-type: none"> <li>- CONSIDERABLE COVERAGE BUT RESTRICTED IN CERTAIN AREAS BY TOPOGRAPHY.</li> <li>- RELATIVELY LONG TRAVEL TIMES WITH POOR RELIABILITY.</li> <li>- LITTLE EXPRESS SERVICE.</li> <li>- LITTLE PATRONAGE BY "REVERSE" COMMUTERS.</li> </ul>	<ul style="list-style-type: none"> <li>- EXPRESS SERVICE TO BE PROVIDED WITH BUSES AND CARS IN SAME TRAFFIC STREAM.</li> <li>- DOOR-TO-DOOR TIMES LIKELY TO BE LONGER FOR BUS THAN FOR PRIVATE AUTO.</li> <li>- PRINCIPAL EMPHASIS FOR BUS IS ON SCHEDULE RELIABILITY.</li> </ul>
DALLAS	<ul style="list-style-type: none"> <li>- HIGH TO MEDIUM INCOME AREA (WHITE).</li> <li>- RAPID GROWTH RATE WITH POTENTIAL TO CONTINUE.</li> </ul>	<ul style="list-style-type: none"> <li>- STRONG ORIENTATION TO CBD.</li> <li>- SEVERAL MAJOR GENERATORS WITHIN THE CORRIDOR.</li> </ul>	<ul style="list-style-type: none"> <li>- FREEWAY IS HEAVILY CONGESTED DURING THE PEAK HOURS.</li> <li>- ALTERNATE ROUTES ARE AVAILABLE.</li> <li>- STRONG DEPENDENCE ON PRIVATE AUTOMOBILES.</li> </ul>	<ul style="list-style-type: none"> <li>- BUS SERVICE IS PROVIDED THROUGHOUT THE CORRIDOR.</li> </ul>	<ul style="list-style-type: none"> <li>- BUS TIMES CAN BE BETTER THAN AUTO WITH THE AID OF PREFERENTIAL TREATMENT ON FREEWAY AND SIGNAL PREEMPTION ON ARTERIALS.</li> </ul>
DAYTON	<ul style="list-style-type: none"> <li>- HIGH INCOME AREA THROUGHOUT CORRIDOR (WHITE).</li> <li>- GROWTH AREA.</li> </ul>	<ul style="list-style-type: none"> <li>- CORRIDOR FACILITIES SERVE TRAVEL TO CBD AND OTHER GENERATORS NORTH OF CBD.</li> <li>- SEVERAL MAJOR GENERATORS WITHIN THE CORRIDOR.</li> </ul>	<ul style="list-style-type: none"> <li>- ARTERIALS ARE USUALLY CONGESTED FOR ONLY A RELATIVELY SHORT TIME DURING PEAK PERIODS.</li> <li>- INCREASE IN CONGESTION EXPECTED.</li> <li>- PARKING IN CBD IS ATTRACTIVE TO AUTO COMMUTERS.</li> </ul>	<ul style="list-style-type: none"> <li>- VERY LIMITED COVERAGE.</li> <li>- FINANCIAL STATUS IS VERY WEAK.</li> </ul>	<ul style="list-style-type: none"> <li>- BUS TRAVEL TIME ADVANTAGE WILL BE LESS THAN 15 MINUTES.</li> <li>- CAR POOL ON BUSWAY WILL OPERATE AT SAME SPEED AS BUS.</li> </ul>
LOS ANGELES	<ul style="list-style-type: none"> <li>- CORRIDOR IS EXTREMELY LARGE.</li> <li>- CONTAINS VARIETY OF POPULATION CHARACTERISTICS AND LAND USES.</li> <li>- HAS HAD RAPID POPULATION GROWTH AND CONTINUES TO HAVE GROWTH POTENTIAL.</li> </ul>	<ul style="list-style-type: none"> <li>- STRONG ORIENTATION TO CBD.</li> <li>- SHORTAGE OF PARALLEL ARTERIALS.</li> </ul>	<ul style="list-style-type: none"> <li>- SEVERE CONGESTION DURING PEAK PERIODS.</li> <li>- BOTTLENECK AREAS AFFECT SYSTEM PERFORMANCE.</li> <li>- STRONG DEPENDENCE ON PRIVATE AUTOMOBILES.</li> </ul>	<ul style="list-style-type: none"> <li>- COVERAGE VARIES THROUGHOUT CORRIDOR.</li> </ul>	<ul style="list-style-type: none"> <li>- BUS WILL MOVE ON FREEWAY WITH MIXED AUTO TRAFFIC.</li> <li>- LITTLE PREFERENTIAL TREATMENT WILL BE PROVIDED. BUS TIMES WILL BE MORE THAN AUTO IN MOST CASES.</li> </ul>

## HYPOTHESES, RELATIONSHIPS, AND TECHNIQUES TO BE TESTED BY THE URBAN CORRIDOR DEMONSTRATION PROGRAM

The objective of the Urban Corridor Demonstration Program is to "test and demonstrate the concerted use of available tools" for relieving "traffic congestion during peak hours in corridors leading to and from central business districts."<sup>(1)</sup> This requires the evaluation of the aggregate effects of the total "package" of improvements in terms of corridor-wide changes in travel patterns, congestion levels, travel costs, etc.

In addition to testing the aggregate effects of the main experiment (i.e., the total "package" of improvements), most corridor-wide demonstrations also have an opportunity to conduct several sub-experiments to measure separately the effectiveness of individual improvements. The scope of the information which can be derived from these sub-experiments depends on the characteristics of the corridor and the design of the demonstration, ranging from limited subjective evaluations to comprehensive detailed evaluations.

Although major emphasis is on the main experiment, these sub-experiments provide complementary information that can significantly increase the value of the findings, frequently with little additional cost. For example, while the main experiment measures the effectiveness of the total set of improvements, more detailed evaluations of individual improvements may suggest how the overall project should be modified to suit prevailing conditions in other cities.

The following discussion identifies the types of information of nationwide interest that the Urban Corridor

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1. Urban Corridor Demonstration Program - Information for Applicants, U. S. Department of Transportation, January 1970.



Demonstration Program might provide. It suggests specific hypotheses and, on the basis of information presently available, indicates which of the demonstration projects might be designed to test such hypotheses. This information is outlined in the Appendix in greater detail for each demonstration project.

## MAIN EXPERIMENT

The main experiment refers to the aggregate set of improvements proposed for each demonstration project. In general, the main experiment will be evaluated on a corridor-wide basis. Specific hypotheses that may be tested by the main experiments of the individual demonstration projects are indicated in Table 3.

*Atlanta.* The Atlanta demonstration proposes a series of improvements that includes staggered work hours in the CBD, continuation of an existing bus shuttle system, subscription bus service for low density collection and distribution, computerized techniques for promoting car pooling, and limited roadway improvements for improving line-haul traffic flow. Although the original proposals included consideration of freeway surveillance and control, this does not appear feasible under the current Program. Without major freeway improvements as the nucleus of a corridor-wide approach to relieving congestion, the Atlanta demonstration project seems a somewhat disjoint collection of individual improvements.

Selection of specific improvements to implement in Atlanta and their phasing, will require very careful consideration, since many are very closely interrelated. For example, the staggered work hours program may have very significant effects on the portion of the demonstration involving computerized car pooling or subscription bus service.

*Cincinnati.* The Cincinnati project emphasizes outlying terminals, in conjunction with line-haul bus service, for promoting greater utilization of transit for travel to the central area; and, traffic engineering and operational control techniques for providing good service for line-haul transit vehicles operating in mixed traffic on arterial roadways. A CBD transit terminal is also proposed, but implementation is contingent on the success of the transit improvements in the corridor. Except for the proposed CBD terminal, these improvements are combined such that the emphasis of the evaluation should be placed on the *Main Experiment* rather than on the individual improvements.

To the extent that the diversion of patronage from auto to bus reduces the vehicular demand for arterial streets, this project will test the effectiveness of improved bus service for relieving congestion. In this corridor, however, the diversion from auto to bus will not apparently affect the level of congestion in the immediate future.

*Dallas.* In Dallas, the UCDP project is combined with a current research project involving the implementation of traffic surveillance and control system (including ramp metering and centralized control of selected arterial intersections) is concerned with relieving congestion by improving vehicular flow. The UCDP project includes priority bus treatment in this system along with increased bus service (frequency and coverage) and park-ride facilities.

This project tests the effectiveness of such service improvements in generating additional transit patronage. However, it does not appear to offer a significant test of the ability of transit to attract enough people to substantially reduce congestion, except possibly at certain localized areas.

TABLE 3

HYPOTHESES TO BE TESTED BY MAIN EXPERIMENTS

HYPOTHESES	ATLANTA	CINCINNATI	DALLAS	DAYTON	LOS ANGELES	LOUISVILLE	MINNEAPOLIS	NEW HAVEN	NEW YORK	PHILADELPHIA	WASHINGTON
- EFFECTIVENESS OF TOTAL SET OF IMPROVEMENTS IN RELIEVING CONGESTION ON A CORRIDOR-WIDE BASIS	L	●	●	●	●	●	●	●	●	L	●
- EFFECTIVENESS IN INCREASING USE OF PUBLIC TRANSIT	S	●	S	●	U	●	●	●	●	S	●
- RELATIONSHIP BETWEEN BENEFITS AND COSTS OF CORRIDOR-WIDE TRANSPORTATION IMPROVEMENTS	L	●	●	●	L	●	●	●	●	L	●
- EFFECTIVENESS OF CORRIDOR APPROACH IN DEALING WITH MULTI-JURISDICTIONAL TRANSPORTATION PROBLEMS	●	●	●	●	●	●	●	●	●	●	●
- IMPACT OF CORRIDOR TRANSPORTATION SYSTEM IMPROVEMENTS ON LAND DEVELOPMENT, EMPLOYMENT AND RECREATIONAL OPPORTUNITIES, AND OTHER MAJOR CHANGES IN SOCIO-ECONOMIC ACTIVITY WITHIN THE CORRIDOR,	U	L	L	●	D	U	●	●	D	L	●
- EFFECTIVENESS OF MAJOR TRANSPORTATION IMPROVEMENTS IN REDUCING VEHICLE EXHAUST EMISSIONS AND NOISE LEVELS ON A CORRIDOR-WIDE BASIS	D	L	L	●	●	L	●	●	D	D	L

- Stated hypothesis can be tested (subject to limitations cited in Appendix).
- L Limited information can be developed.
- S Hypothesis tested by sub-experiments.
- U Insufficient information presently available to indicate whether a valid test can be made.
- D Doubtful that hypothesis can be meaningfully tested.

*Dayton.* The key element of the Dayton system is an exclusive roadway (serving buses and car pools) on a little used railroad right-of-way. The total system includes facility construction, new express transit service, and new collection-distribution systems in the corridor and the CBD. This total set of improvements tests the effectiveness of a high-quality public transit system in attracting patronage from a strongly auto-oriented suburban area. These improvements generally must be evaluated as a total system, although it is also possible and desirable to examine certain of these improvements on an individual basis.

With the comprehensive data bank available for the Dayton area and with the considerable commitment of resources to the operation of a fixed facility, evaluation of this demonstration project should also provide significant information on the impact of such a system on land development and other socio-economic changes in the corridor.

*Los Angeles.* Improvements proposed for Los Angeles focus on the roadway (ramp controls, additional lanes, etc.). Bus service improvements (including park-and-ride lots, express buses, and expanded coverage) are also proposed, but substantial transit improvements will be implemented only after significantly improved travel times in the corridor are demonstrated. Pending completion of the freeway improvements, little change or improvement will be made in the bus service.

With this type of phasing, it will be possible to first measure the effectiveness of the roadway improvements in relieving congestion. The transit improvements, if implemented, then provide the means for testing separately the effectiveness of improved service in generating additional patronage. It is doubtful that this project will provide a significant test of the ability of transit service improvements to divert enough auto commuters to transit to provide measurable relief from congestion.

*Louisville.* This demonstration project tests two categories of improvements aimed at relief of peak-hour congestion. These are: roadway improvements to relieve bottlenecks, improve traffic flow, and provide for priority treatment of buses at certain locations; and bus improvements aimed at attracting auto commuters to buses, thereby reducing the number of vehicles using the corridor roadways. Measurement of the effects of these improvements on congestion and transit patronage will require evaluation of the combined set of improvements on a corridor-wide level, but certain additional information may also be developed for individual improvements included in the project.

The bus system in the Louisville corridor will operate along existing arterial streets; however, through a portion of the corridor this operation will include exclusive bus lanes on a pair of one-way arterials. Signal preemption will provide additional priority treatment for buses.

*Minneapolis.* The Minneapolis project tests the concept of an express bus on a metered freeway. This is a complete system that includes both line-haul and low density collection-distribution services and facilities. Major demonstration objectives of this project are:

To test the feasibility of freeway metering with preferential bus treatment as a means of providing high-quality line-haul transit service.

To test the impact of the system on level of service and travel patterns of private vehicles.

To test the effectiveness of a high-quality bus service in diverting commuters from autos to buses.

Evaluation of the main experiment will measure the aggregate effectiveness of the total system. The project will

be phased, however, so the transit system improvements are implemented before the freeway control system is functional. A carefully designed evaluation will therefore provide a valuable comparison of transit operations "with" and "without" preferential bus treatment on a metered freeway.

*New Haven.* The Canal Line Transit System proposed for New Haven is a single corridor-wide improvement rather than a system of individual improvements. It is a bus transit system operating on an exclusive right-of-way (shared by a currently operating railroad). This demonstration should provide an opportunity to measure the effects of such a system on the socio-economic characteristics of the area, particularly: improved accessibility to employment opportunities, improved recreational opportunities, and land development. Since the paralleling arterial roadways are presently heavily congested, this project will demonstrate the ability of a new transit system to relieve congestion of such facilities. A detailed analysis of the benefits and costs for this particular project is an important element of the evaluation.

*New York.* This demonstration includes an exclusive bus lane, freeway surveillance and control with preferential bus treatment, park-ride facilities, improved CBD bus service, an automatic bus identification system, and a transit information system. These improvements are aimed at relieving congestion by both improving the efficiency of the roadway system and by making transit more attractive to commuters who presently use automobiles.

The demonstration improvements are interrelated and should be evaluated as a "package" with respect to their effectiveness in satisfying these objectives. However, the effectiveness of several of these individual improvements with respect to other objectives can be evaluated in detail.

*Philadelphia.* The Philadelphia project includes a variety of separate improvements for several modes. While the aggregate effects of the proposed individual improvements, if they are all implemented, may have a significant impact on travel throughout the entire corridor, few of these individual improvements are closely interrelated. Furthermore, extensive evaluation of the corridor-wide impact of these improvements seems to have limited usefulness for other metropolitan areas, since the combination of modes and the transportation problems in Philadelphia are relatively unique. Therefore, an improvement-by-improvement approach to the evaluation of the Philadelphia demonstration project should receive greater emphasis than a corridor-wide evaluation of the aggregate effects. Specific suggestions are discussed subsequently.

*Washington, D. C.* The Washington demonstration project employs both roadway and transit improvements. This demonstration includes an exclusive bus lane to serve line-haul buses. Since the area presently experiences very heavy congestion, this project provides an excellent opportunity to demonstrate the combined effectiveness of improved bus service, roadway improvements, and car pools for relieving congestion.

#### LINE HAUL SYSTEM IMPROVEMENTS

Line-haul system improvements include both improvements to roadways or other fixed facilities serving the line-haul portions of the trip (by any mode) and changes in the line-haul transit service offered (i.e., frequency of service, new express routes, increased coverage, etc.). The nature of the individual demonstration project determines whether these improvements must be evaluated separately, in combination with each other, or in combination with the total set of improvements included in the demonstration project.

## LINE-HAUL FACILITY IMPROVEMENTS

Line-haul facility improvements include separate busways or exclusive lanes, roadway improvements that provide priority treatment for buses in mixed flow (including freeways and arterial streets), and other roadway improvements. Table 4 indicates the specific types of hypotheses relating to the line-haul facility improvements which might be tested by each demonstration project.

Projects in New Haven, Dayton, Louisville, New York, and Washington are similar in that they all propose buses operating on exclusive lanes or roadways. While detailed comparisons between projects may not be very meaningful, this set of projects covers a broad spectrum of urban conditions. Careful analysis of the findings from this set of projects should provide useful indicators of what urban conditions (i.e., congestion levels, travel patterns, orientation of commuters to transit, other changes in the transportation system, etc.) warrant the dedication of an exclusive lane or facility for buses. Similar comparisons for Minneapolis, Dallas, and the Route 3 improvements in New York will indicate how the effectiveness of preferential treatment for buses in mixed flow is influenced by different urban conditions.

### Exclusive Bus Roadways

*New Haven and Dayton.* These projects both test total new transit systems on exclusive rights-of-way. The effectiveness of the facility improvements alone cannot be identified in terms of changes in congestion levels, transit patronage, or transportation costs. Therefore, the evaluation must consider the combined effects of the new facilities, new transit services, and the collection-distribution systems.



TABLE 4

HYPOTHESES TO BE TESTED BY LINE-HAUL FACILITY IMPROVEMENTS

HYPOTHESES	ATLANTA	CINCINNATI	DALLAS	DAYTON	LOS ANGELES	LOUISVILLE	MINNEAPOLIS	NEW HAVEN	NEW YORK	PHILADELPHIA	WASHINGTON
<b>IMPLEMENTATION OF EXCLUSIVE TRANSIT FACILITIES OR RESERVED LANES</b>											
- FEASIBILITY OF JOINT USE OF RIGHT-OF-WAY BY BUS AND TRAIN OR CAR POOL				●				●			
- DEVELOPMENT OF DESIGN STANDARDS FOR BUSWAYS				●				●			
- EFFECTIVENESS IN REDUCING VEHICULAR CONGESTION OF ALTERNATE FACILITIES			M		M		M	D	D	U	
- EFFECTIVENESS IN IMPROVING TRANSIT SERVICE			M(1)		●		M(1)	●	●	●	
- EFFECTIVENESS IN REDUCING RATE OF VEHICLE EXHAUST EMISSIONS			M		M		M	●	D	U	
- EFFECTIVENESS IN REDUCING PRIVATE AND PUBLIC COSTS OF TRAVEL AND SYSTEM OPERATION			M		M		M	●	●	U	
<b>IMPROVEMENTS TO FREEWAYS OR ARTERIALS WITH PRIORITY BUS TREATMENT IN MIXED FLOW</b>		(3)		(2)	(2)						(2)
- EFFECTIVENESS IN REDUCING OVERALL VEHICULAR CONGESTION			●	●		M		●			
- EFFECTIVENESS IN IMPROVING TRANSIT TRAVEL TIMES, RELIABILITY, ETC.			●	●		●		●			
- EFFECTIVENESS IN REDUCING RATE OF VEHICLE EXHAUST EMISSIONS			●	●		●		L			
- EFFECTIVENESS IN REDUCING PRIVATE AND PUBLIC COSTS OF TRAVEL AND SYSTEM OPERATION			●	●		M		M			
<b>IMPROVEMENTS TO MAJOR CORRIDOR ROADWAYS THAT DO NOT PROVIDE PRIORITY BUS TREATMENT</b>				(4)							
- EFFECTIVENESS IN REDUCING OVERALL VEHICULAR CONGESTION	●	●		●						●	
- EFFECTIVENESS IN IMPROVING TRANSIT TRAVEL TIMES, RELIABILITY, ETC.	●	●		●						●	
- EFFECTIVENESS IN REDUCING RATE OF VEHICLE EXHAUST EMISSIONS	●	●		●						●	
- EFFECTIVENESS IN REDUCING PRIVATE AND PUBLIC COSTS OF TRAVEL AND SYSTEM OPERATION	●	M		●						●	

● Stated hypothesis can be tested (subject to limitations cited in Appendix).

L Limited information can be developed.

M Hypothesis can be tested only with reference to the combined effects of several improvements.

U Insufficient information presently available to indicate whether a valid test can be made.

D Doubtful that hypothesis can be meaningfully tested by this project.

(1) PRESENT TRANSIT SERVICE IN THESE AREAS IS VERY LIMITED.

(2) SIGNAL PREEMPTION PLANNED FOR LOUISVILLE, DAYTON, AND WASHINGTON, D. C. IS INCIDENTAL TO THE OVERALL OPERATION OF THE EXCLUSIVE LANES AND BUSWAYS AND IS DISCUSSED UNDER *Transit Priority Systems*.

(3) TRANSIT PRIORITY DISCUSSED IN THE CINCINNATI PROPOSAL REFERS TO GIVING EXPRESS BUSES PRIORITY OVER LOCAL BUSES AND TRUCKS, BUT NOT OVER PRIVATE AUTOMOBILES. IN THE CONTEXT OF THIS DISCUSSION, THIS IS NOT CONSIDERED AS PRIORITY BUS TREATMENT.

(4) AVAILABLE INFORMATION SUGGESTS THAT LOS ANGELES WILL IMPLEMENT ROADWAY IMPROVEMENTS BEFORE CONSIDERING PREFERENTIAL TREATMENT FOR BUSES.

## Exclusive Bus Lanes

*Louisville.* Exclusive bus lanes in Louisville operate in the reverse direction to normal flow on a pair of one-way arterial streets. Since present bus service has good coverage in this area, this project will test the effectiveness of such roadway improvements in improving bus service (i.e., travel times, travel time costs, reliability, etc.). The effects on overall congestion levels, bus patronage, and travel costs should be evaluated for the total project.

These "wrong-way" lanes will be operated through a predominantly residential area, with numerous pedestrian crossings. Past experience with similar operations suggests a high potential for bus-pedestrian accidents. Therefore, this demonstration project should provide an informative test of the feasibility and public acceptability of "wrong way" bus lanes on arterial streets, especially with respect to this potential hazard.

*New York.* The exclusive bus lane on the approach to the Lincoln Tunnel improves existing bus service. It tests the ability of such facilities to relieve localized congestion and improve transit travel times through a major bottleneck area. Except to the extent that other UCDP improvements influence modal choice on a corridor-wide basis, this improvement can be evaluated independent of other corridor improvements.

*Washington.* The test of exclusive bus lanes in Washington is confined mainly to the bridge across the Anacostia River. This area is already strongly oriented to transit.

This project should permit the separate evaluation of the effectiveness of the *facility* in improving transit travel times and reliability, reducing travel costs, and reducing overall congestion levels. An independent test of the bus lane, however, requires that other improvements which will significantly

affect patronage and travel patterns be implemented before the exclusive bus lane.

#### Priority Bus Treatment in Mixed Traffic

*Dallas.* Facility improvements for Dallas involve freeway ramp metering and coordinated control of arterial street intersections near the freeway. The surveillance and control system is being implemented under a separate project. Although priority treatment will be given to buses at freeway ramps and at certain nearby intersections, these improvements are aimed mainly at improving overall vehicular flow in the corridor.

The benefits of the facility improvements can be estimated in terms of reduced congestion levels and travel costs (vehicle operation, travel time, etc.). Travel time savings and reliability for bus riders can also be separately identified and associated with the facility improvements; however, complete evaluation of the benefits to bus riders must consider the total set of bus improvements in the corridor (i.e., park-ride facilities, increased frequency and coverage, etc.).

*Minneapolis.* In contrast to Dallas, where the principal thrust is on improving total vehicular flow, the UCDP project in Minneapolis will use freeway surveillance and control to operate the freeway much as a rapid transit facility, with the additional capacity allocated to private vehicles. If bus service improvements, (i.e., increased coverage, frequency, etc.) are implemented before the freeway control system is operational, this demonstration project will permit measurement of the incremental benefits of the freeway control system for improving bus service, reducing transportation costs, and increasing bus patronage.

*New York.* Improvements involving buses in mixed flow in New York include metering a limited number of ramps to Route 3 in the New Jersey corridor. The objective of metering in this area is to smooth the total traffic flow through particular bottleneck areas. Commuter benefits (in terms of reduced travel time costs, vehicle operating costs, etc.) can be evaluated on a localized basis (i.e., bottleneck-by-bottleneck), but not be significant on a corridor-wide basis.

*Los Angeles.* The Los Angeles demonstration project is aimed at improving total traffic flow and reducing congestion with freeway surveillance and control. The discussion of the *Main Experiment* suggests an approach to the evaluation of these improvements.

#### Roadway Improvements Without Priority Bus Treatment

*Cincinnati.* The Cincinnati UCDP project incorporates a number of roadway improvements intended to serve both automobiles and buses. These include the provision of additional lanes, bus turnouts, etc. These improvements are expected to provide bus travel times equal to but no better than travel times for automobiles for the line-haul portion of the trip.

The major changes in congestion in this corridor will probably result from improvement of traffic flow through bottlenecks, reduction of the disruptive effects of bus stops, and redistribution of traffic between major arterials. Cost savings associated with these facility improvements may not be separately identifiable and will require corridor-wide evaluation.

*Philadelphia.* Roadway improvements in Philadelphia are expected to provide better service for automobile traffic. Since buses use the same facilities, these improvements should also benefit certain bus routes; however, no preferential bus

treatment is intended. This portion of the demonstration principally tests the effectiveness of roadway improvements in relieving vehicular congestion on a localized, rather than a corridor-wide basis. Cost savings associated with reduced travel times, vehicle operating costs, etc. may be identified for specific improvements.

The specific line-haul facility improvements proposed for the fixed rail systems in this corridor appear to have limited value as demonstration projects; however, their implications toward improving quality of transit service may be applicable to other cities.

#### LINE-HAUL TRANSIT SERVICE IMPROVEMENTS

Line-haul transit service improvements refer to the direct changes in the transit system such as frequency of service, express service, and quality of equipment. Facility improvements are also reflected in the quality of transit service (in the form of travel times, reliability, etc.). Therefore, evaluation of line-haul transit service improvements for some corridors may include certain characteristics of the facility improvements. Table 5 indicates the hypotheses to be tested by the line-haul transit service improvements for each demonstration project.

*Cincinnati.* Transit improvements in Cincinnati include a total package of improvements (i.e., more frequent and faster line-haul service, improved collection-distribution systems, and marketing program). These improvements will be implemented concurrently, therefore, the evaluation must consider the combined effects of all improvements.

The principal market for the improved transit service in Cincinnati is the medium to high income areas in the outer portions of the corridor. The Cincinnati project will test

whether an improved transit service, which provides no time advantage over the private automobile, can successfully attract patronage from a relatively high-income area that is strongly automobile-oriented.

*Dallas.* Line-haul transit service improvements include more frequent service to certain areas and preferential treatment for buses on the freeway and surface streets. Collection-distribution system improvements consist of park-ride facilities. All improvements will be implemented at about the same time, making it difficult to associate changes in patronage, travel costs, or congestion levels with any specific improvement.

*Dayton.* Bus transit improvements in Dayton include both the line-haul and the collection-distribution systems. Because of the implementation phasing, the fraction of total patronage generated by each of these improvements cannot be identified. The aggregate effects should be evaluated as discussed for the *Main Experiment*.

*Los Angeles.* Transit improvements contemplated for Los Angeles focus on improved line-haul service, using express buses on a metered freeway. More detailed definitions of the transit service improvements are required to determine the specific tests that will be provided by this project.

*Louisville.* Bus system improvements in Louisville affect the line-haul and residential collection-distribution systems. These improvements will be implemented as a package, and their effectiveness generally must be evaluated in aggregate.

The Louisville demonstration project provides an opportunity to measure the difference in response to improved transportation services for groups with significantly different socio-economic characteristics. Variations in income levels within the corridor, however, pose a problem in applying a

TABLE 5

HYPOTHESES TO BE TESTED BY LINE-HAUL TRANSIT SERVICE IMPROVEMENTS

HYPOTHESES	ATLANTA	CINCINNATI	DALLAS	DAYTON	LOS ANGELES	LOUISVILLE	MINNEAPOLIS	NEW HAVEN	NEW YORK	PHILADELPHIA	WASHINGTON
- EFFECTIVENESS IN ATTRACTING COMMUTERS FROM PRIVATE AUTOMOBILES TO TRANSIT.	M	M	M	U	M	●	●	M	L	M	
- EFFECTIVENESS OF INCREASED PATRONAGE IN REDUCING CONGESTION OF CORRIDOR TRANSPORTATION FACILITIES.	M	M	M	U	M	●	●	●	L	M	
- EFFECTIVENESS OF TRANSIT SERVICE IMPROVEMENTS IN REDUCING TRANSPORTATION COSTS, ESPECIALLY FOR COMMUTERS WHO SWITCH FROM AUTO TO TRANSIT.	●	●	●	U	●	●	●	●	●	M	
- FINANCIAL FEASIBILITY OF TRANSIT SERVICE IMPROVEMENTS.	●	●	●	U	●	●	●	(1)	(1)	M	

- Stated hypothesis can be tested (subject to limitations cited in Appendix).
- L Limited information can be developed.
- M Hypothesis can be tested only with reference to the combined effects of several improvements.
- U Insufficient information presently available to indicate whether a valid test can be made.

(1) MAJOR CHANGES IN THE QUALITY OF LINE-HAUL TRANSIT-SERVICE IN NEW YORK AND PHILADELPHIA WILL RESULT FROM FACILITY IMPROVEMENTS RATHER THAN THE OFFERING OF SUBSTANTIALLY NEW SERVICES.

uniform measure of effectiveness for the bus improvements. In the low-income areas, where a much higher percentage of the commuters are captive riders, patronage will not be as sensitive to changes in transit service as in the higher-income area.

The Louisville corridor presently experiences considerable congestion on certain facilities. This demonstration is expected to provide a valid test of whether enough commuters can be switched from automobile to bus to significantly alleviate congestion in these areas.

*Minneapolis.* The bus transit system planned for Minneapolis includes freeway metering to maintain a high quality of traffic flow, and priority entry for buses. As indicated under the discussion of the *Main Experiment*, the phasing of project implementation will permit evaluation of the effectiveness of different levels of line-haul bus service, in terms of the patronage generated and the impact on congestion and private and public costs.

*New Haven.* The Canal Line System proposed for New Haven is a single package of improvements, and detailed evaluations of the individual components are not appropriate. The main emphasis of this project, however, is on the line-haul service.

*New York.* Changes in the line-haul transit service in New York will result mainly from the roadway improvements, not from the offering of substantial new service.

*Philadelphia.* Line-haul transit service improvements for Philadelphia will also result mainly from facility improvements. Benefits from these improvements will be very localized and are not likely to be significant if considered only in a corridor-wide evaluation.

*Washington.* Line-haul transit service improvements and fringe parking facilities will be implemented together and



cannot be readily separated for evaluation purposes. The evaluation must consider their joint effectiveness in attracting new transit patronage, in reducing congestion of the corridor transportation facilities, and in reducing transportation costs.

#### LOW DENSITY COLLECTION-DISTRIBUTION SYSTEM IMPROVEMENTS

Low density collection-distribution systems include park-ride facilities, transit terminals, scheduled local bus service, demand responsive local bus service, and passenger shelters. Tests of these systems in each of the demonstration projects are indicated in Table 6.

The ability to develop meaningful indicators of the costs, benefits, and financial feasibility of collection-distribution systems is influenced by methods of cost allocation, pricing, and fare or fee collection used by the operating agencies. The ability to separately measure the effectiveness of the collection-distribution system also depends on the design of each individual project.

*Atlanta.* Atlanta's proposed park-ride facilities would test the ability of such facilities to encourage increased transit patronage without complementary improvements of the line-haul service. Details of the subscription bus service proposed for low density collection-distribution are not currently available.

*Cincinnati.* Low density collection-distribution improvements in Cincinnati include major park-ride facilities and scheduled collection-distribution bus service. Because these improvements are included together with other major changes in the transit system, their effects on transit patronage and on transportation costs (public and private) cannot be identified separately. Refer to *Main Experiment* and *Line-Haul Transit Service Improvements*.

TABLE 6

HYPOTHESES TO BE TESTED BY PROPOSED LOW DENSITY COLLECTION-DISTRIBUTION SYSTEM IMPROVEMENTS

HYPOTHESES	ATLANTA	CINCINNATI	DALLAS	DAYTON	LOS ANGELES	LOUISVILLE	MINNEAPOLIS	NEW HAVEN	NEW YORK	PHILADELPHIA	WASHINGTON
<b>LOCAL BUS SERVICE</b>											
- EFFECTIVENESS IN INCREASING TRANSIT PATRONAGE	●	M		M	U	M	●				
- IMPACT ON AND COMPATIBILITY WITH NEIGHBORHOOD ENVIRONMENT (INCLUDING LOCAL STREETS)	●	●		●	U	●	●				
- IMPACT ON DEMAND FOR AND ECONOMIC VIABILITY OF OTHER COLLECTION-DISTRIBUTION SYSTEMS SERVING THE SAME AREA	U	D		L	U	●	●				
- FINANCIAL FEASIBILITY OF THE SERVICE	U	●		●	U	●	●				
<b>PARK-RIDE LOTS AND OTHER SUBURBAN TERMINALS</b>											
- EFFECTIVENESS IN INCREASING TRANSIT PATRONAGE	U	M	M	M	U	M	●	M	M	M	M
- IMPACT ON AND COMPATIBILITY WITH NEIGHBORHOOD ENVIRONMENT (INCLUDING LOCAL STREETS)	U	●	●	●	U	●	●	●	●	●	●
- IMPACT ON DEMAND FOR AND ECONOMIC VIABILITY OF OTHER COLLECTION-DISTRIBUTION SYSTEMS SERVING THE SAME AREA	U	D	D	L	U	●	●	M	●	D	M
- FINANCIAL FEASIBILITY OF THE SERVICE	U	●	●	●	U	●	●	M	●	●	M
<b>PASSENGER SHELTERS</b>											
- EFFECTIVENESS IN INCREASING TRANSIT PATRONAGE		L				M	U		●		M
- PUBLIC ACCEPTABILITY		●				●	U		●		M

- Stated hypothesis can be tested (subject to limitations cited in Appendix).
- L Limited information can be developed.
- M Hypothesis can be tested only with reference to the combined effects of several improvements.
- U Insufficient information presently available to indicate whether a valid test can be made.

Curbside passenger shelters will also be provided in the Cincinnati corridor. However, because of the limited number and the proposed location of these shelters, they are not expected to provide a comprehensive demonstration of the effectiveness of such facilities to encourage transit patronage.

*Dallas.* Park-ride facilities that serve the collection-distribution function for Dallas will be implemented at the same time as other transit improvements. This demonstration, therefore, does not provide for separate evaluation of the collection-distribution system.

*Dayton.* The Dayton project compares several types of low-density collection-distribution systems, including park-ride facilities, scheduled local bus, and demand responsive bus collection-distribution systems. If these systems are properly distributed throughout the corridor so that different systems operate under similar conditions, useful comparisons can be derived in terms of relative usage, public acceptance, and financial feasibility.

*Los Angeles.* Proposals for Los Angeles indicate that park-ride facilities will be included in the set of transit improvements. However, more definite plans are needed to indicate the types of demonstration results to expect from this project.

*Louisville.* The Louisville demonstration project includes park-ride lots, scheduled local bus, and passenger shelters as components of the low density collection-distribution system. All of these improvements will be implemented together with line-haul service improvements. Therefore, measurement of additional patronage generated or cost savings attributable to any one of these improvements may not be possible.

Bus passenger shelters for Louisville include several different designs. It may be possible, therefore, to obtain

information for developing design standards for passenger shelters. Designs appropriate for Louisville, however, may not be suitable for other cities. The acceptability of shelter design characteristics will be influenced by climatic conditions, crime rate, and many other local factors.

*Minneapolis.* Incremental implementation of the Minneapolis demonstration project should permit separate evaluation of the park-ride facilities and the scheduled local bus service as low density collection-distribution systems. Passenger shelters are being implemented in conjunction with other projects.

*New Haven.* Transit terminals in the low density areas of the corridor are an integral part of the total transit system and do not lend themselves to separate evaluation.

*New York.* The park-ride facilities planned for New York are intended to intercept commuters at greater distances from the CBD. This is expected to effect an earlier change of mode and to reduce the number of vehicles using the corridor arterials. Measurement of the usage of these facilities should provide an indication of their effectiveness in reducing vehicular traffic downstream from the park-ride lots; however, the extent to which commuters switch from auto to transit in this corridor is also influenced by other demonstration improvements.

*Philadelphia.* Parking facilities and terminals in Philadelphia are planned in conjunction with changes in rail service. It will not be possible, therefore, to isolate changes in the service from the availability of the parking facilities in identifying the impact on transit patronage.

Present proposals also call for improvement of the passenger waiting shelters along the tramway. These passenger shelter improvements will not be accompanied by substantial changes in quality of service along this line. Therefore, there is an opportunity to measure increased patronage attributable

to the improvement of these shelters. It must be recognized, however, that even if such increases do not occur, there will be some positive benefit from these transit passenger shelter improvements. Such benefits may require evaluation through passenger attitude surveys or similar techniques.

*Washington.* The low density collection-distribution system for the Washington demonstration is an integral part of the transit system improvements and does not warrant detailed separate evaluation.

### CBD COLLECTION-DISTRIBUTION SYSTEM IMPROVEMENTS

This discussion is concerned with demonstration projects having separate CBD collection-distribution transit systems. Projects in which this function is served by a CBD "loop" of the line-haul system are not included.

*Atlanta.* The CBD collection-distribution system proposed for the Atlanta demonstration project is a continuation of the existing Town Flyer shuttle service that operates between two parking lots near the CBD. This service has been operated under another UMTA demonstration project and reference should be made to that specific contract for details concerning the potential demonstration value of this improvement.

*Cincinnati.* The proposal for Cincinnati includes long-range plans for a transportation terminal and a bus shuttle service in the CBD. Implementation of these improvements is contingent on the success of the other transit improvements in developing significant patronage from the corridor. Delayed implementation of this component of the demonstration project will permit a separate evaluation - particularly with respect to its financial feasibility and its ability to generate additional transit patronage.

TABLE 7

HYPOTHESES TO BE TESTED BY CBD COLLECTION-DISTRIBUTION SYSTEM IMPROVEMENTS

HYPOTHESES	ATLANTA	CINCINNATI	DALLAS	DAYTON	LOS ANGELES	LOUISVILLE	MINNEAPOLIS	NEW HAVEN	NEW YORK	PHILADELPHIA	WASHINGTON
- EFFECTIVENESS IN IMPROVING SERVICE TO COMMUTERS AT THE CBD END OF THE TRIP,	U	●		●				●			
- EFFECTIVENESS IN RELIEVING CONGESTION IN THE CBD,	D	●		M				D			
- EFFECTIVENESS IN ATTRACTING COMMUTERS FROM AUTO TO TRANSIT,	D	●		M				D			
- FINANCIAL FEASIBILITY,	U	●		●				●			
- PUBLIC ACCEPTABILITY	U	●		●				●			

● Stated hypothesis can be tested (subject to limitations cited in Appendix).

M Hypothesis can be tested only with reference to the combined effects of several improvements.

U Insufficient information presently available to indicate whether a valid test can be made.

D Doubtful that hypothesis can be meaningfully tested.



TABLE 8  
 HYPOTHESES TO BE TESTED BY TRANSIT PRIORITY SYSTEMS

HYPOTHESES	ATLANTA	CINCINNATI	DALLAS	DAYTON	LOS ANGELES	LOUISVILLE	MINNEAPOLIS	NEW HAVEN	NEW YORK	PHILADELPHIA	WASHINGTON
- EFFECTIVENESS IN IMPROVING TRANSIT TRAVEL TIMES AND SERVICE RELIABILITY.	●	●	●	●	●	●	●	●	●	●	●
- EFFECTIVENESS AS PART OF TRANSIT MANAGEMENT INFORMATION.	U	U	U	U	U	U	U	U	U	U	U
- EFFECTS ON OTHER TRAFFIC.	●	●	●	●	●	●	●	●	●	●	●
- OPERATIONAL RELIABILITY.	●	●	●	●	●	●	●	●	●	●	●
- PUBLIC ACCEPTABILITY	●	●	●	●	●	●	●	●	●	●	●

● Stated hypothesis can be tested (subject to limitations cited in Appendix).

U Insufficient information presently available to indicate whether a valid test can be made.



bus locators, and traffic signal preemption devices. Priority entry on metered freeways is discussed under line-haul facility improvements. New Haven's exclusive right-of-way is not regarded as a priority system. Cincinnati's priority treatment will provide bus travel times equal to, but not better than, autos. In this discussion this is not regarded as a transit priority system.

#### Automatic Bus Identifier or Locator

*New York.* The automatic bus identifier system proposed for the New York demonstration will be used for automatic toll collection and will be a part of the management information system used to improve operation of the transit system. It can be evaluated in terms of benefits to commuters (i.e., reduced travel times and time costs and better reliability), benefits to transit operators, and reduction in toll collection costs.

*Dallas.* Early proposals for Dallas suggest that an automatic identification device for transit vehicles might be integrated into the total corridor system. This would permit signal preemption with the centralized control system and also coordination of these priority movements with traffic movements at nearby intersections. The corridor-wide surveillance system will allow detailed evaluation of the effects of such a system on the overall traffic flow in the corridor.

#### Signal Preemption

*Dayton, Louisville, and Washington.* Signal preemption devices to be tested in these corridors operate on a localized basis. These projects test the feasibility in terms of operational characteristics and public acceptability. The range

in levels of congestion for these urban areas should give an indication of the influence of urban conditions on the applicability and effectiveness of such systems. Benefits of these systems cannot generally be isolated and evaluated separately.

#### STAGGERED WORK HOURS

The following tests will be made by the UCDP staggered work hours project:

1. Feasibility of implementing staggered work hours
2. Effectiveness in relieving congestion
3. Public acceptability

*Atlanta.* The early implementation proposal for Atlanta includes a test of staggered work hours in the CBD. To truly measure the effectiveness of this improvement, the test should be conducted in relative isolation from other improvements that could affect the peak-hour demand for transportation services. Essentially, this requires that the staggered hours program be tested well in advance of other major transportation improvements, included either in the corridor demonstration program or other programs. It should also be recognized that prior implementation of staggered work hours may affect the ability to meaningfully measure the effectiveness of other improvements in the same corridor.

#### CAR POOLS

Tests of car pools should include:

1. Effectiveness of various techniques to encourage car pooling

2. Effectiveness of car pools to reduce vehicular congestion
3. Potential impact of car pools on transit patronage in the corridor
4. Public acceptability

*Atlanta.* The Atlanta project proposes testing a computerized matching technique, analogous to the computer dating game, for encouraging and facilitating car pooling. This technique relies on the willingness and desire of individuals to participate. If this test is conducted, it will provide an indication of whether such techniques, which do not otherwise improve the quality of the trip, can be effectively used to increase vehicle occupancies.

Several potential problems may threaten the validity of such a demonstration in Atlanta. The implementation of the staggered work hours program may disrupt existing car pools. This might make it impossible to separate the effects of the computerized technique from the effects of the staggered work hours on car pooling.

The application of the same technique is also proposed for scheduling buses in this corridor. By treating both buses and car pools within the same demonstration project, the potential effectiveness of each, in isolation from the other, cannot be determined. It is possible for areas where travel is strongly oriented to the private automobile, that attempts to apply too many competitive techniques at the same time may dilute the market so that no technique can be effectively implemented, continued, or demonstrated.

*Dayton.* The Dayton project attempts to encourage car pooling by allowing high-occupancy vehicles to use the exclusive busway. This technique will give a time advantage

to car pools for the line-haul portion of the trip. Costs and benefits to commuters using car pools can be evaluated.

As indicated in the earlier discussion of line-haul transit improvements; however, car pools in Dayton will compete with the transit system. Assuming that the bus service is implemented either before or at the same time as the car pools, this demonstration does not measure the potential effectiveness of car pooling in relieving congestion in corridors without public transportation alternatives.

#### TRANSIT INFORMATION SERVICES AND MARKETING PROGRAMS

The criteria by which marketing techniques and commuter information services should be evaluated depend on the objectives of the service or program and the market it serves. Marketing of a new system will have somewhat different objectives from systems that provide additional conveniences to existing transit riders. Similarly, the characteristics and criteria for information services that serve the daily commuter will differ from systems or services aimed at non-commuters (i.e., shopping trips, pleasure trips, medical trips, etc.).

Typical tests that may be included in the demonstration projects are:

1. Effectiveness of techniques in encouraging commuters to use transit
2. Effectiveness of techniques in providing higher quality service to riders of the transit system
3. Comparison of effectiveness of alternative techniques and media for providing information to commuters

*Cincinnati, Minneapolis, and Philadelphia.* Programs in these cities are aimed at marketing new transit systems or

service improvements. The nature of these programs limits the ability to separately identify the changes in transit patronage due to the advertising campaign from the changes due to the improvements being advertised. Detailed examination of the specific program planned for implementation in each corridor is necessary to assess the potential demonstration value of each.

*Dallas, Louisville, New York, and Washington.* The objective of the commuter information services proposed for these cities is to improve the overall quality of transit service. For these types of services, the specific media used, methods of disseminating information, and other factors peculiar to the individual projects will influence the hypotheses that can be tested and the demonstration value of each. A recent study was conducted under UMTA sponsorship dealing with various types of transit information services in the Washington Metropolitan Area.<sup>(1)</sup>

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1. "Transit Information Aids," Final Report, Mass Transportation Demonstration Project INT-MTD-10, prepared by Washington Metropolitan Area Transit Commission in conjunction with Sidney Hollader and Associates.

## RECOMMENDATIONS

The previous section has indicated the general types of information and tests that might be developed from each of the projects included in the Urban Corridor Demonstration Program. To accomplish these objectives in the most efficient manner possible requires further efforts. The following steps are necessary at the overall program level to develop findings with the maximum value that can be applied nationwide.

1. *Delineate the specific demonstration objectives or hypotheses to be tested by the program and assign priorities for testing each.*

Priorities for testing these various hypotheses or relationships should be established from the national - not the local - point of view. However, these priorities must recognize the local constraints and other factors that affect the ability of the local projects to successfully carry out the desired demonstration.

This discussion has attempted to identify the hypotheses that can be meaningfully tested for each demonstration project, together with constraints that affect the ability to develop satisfactory results. These possibilities should be carefully examined, in light of the state-of-the-art and the need for new information.

2. *Select improvements and phasing for each demonstration project.*

This selection must be made in accordance with the objectives and priorities, and with a recognition of the ability of each project to provide valid and useful demonstration of these techniques.

3. *Maintain close surveillance, from a demonstration viewpoint, of project execution and evaluation throughout its duration.*

The Urban Corridor Demonstration Program Evaluation Manual suggests a general framework for evaluation of transportation demonstrations. This manual, however, does not treat all objectives and problems which will be encountered in the execution of the program. These must be handled on an individual basis.

4. *Assemble, interpret, and disseminate findings from the individual demonstration projects.*

This stage is absolutely essential to fulfilling one objective of the program - applying the findings to other cities. In addition to addressing the present program, however, this should also include a survey of the state-of-the-art with special emphasis on relating the findings of this demonstration to the findings of other demonstration projects.

Maximum benefit will be derived if this is a continuing process, serving not only the present program, but other projects and programs as well. This will also provide direction needed in establishing objectives and selecting test conditions for future transportation demonstrations.

APPENDIX



# ATLANTA

## SUMMARY

The UCDP project in Atlanta proposes testing the following types of improvements:

1. Using freeway control and other roadway improvements for improving line-haul traffic flow;
2. Encouraging car pooling and bus patronage as a means for reducing the number of automobiles using the corridor;
3. Using a "staggered hours" plan and continuing the existing bus shuttle system to reduce congestion in the CBD.

Major reconstruction of the freeway is imminent. While ramp controls could be implemented on isolated ramps not programmed for immediate reconstruction, implementation of surveillance and control on a system-wide basis does not appear feasible in the near future. This also has very strong implications regarding the kinds of inferences that can be drawn from the Atlanta demonstration project.

A reduction in the number of automobiles using the corridor depends upon the success of the computerized "car pool" program and increased transit usage due to the computerized "bus subscription" program and express bus service. Plans for improved public transit include express bus service combined with park-and-ride facilities at existing suburban shopping centers. The existing "Town Flyer" program forms the basis for an improved CBD distribution system and will be coordinated with other bus improvements. The "staggered hours" program is intended to mitigate congestion in the CBD by reducing the peak hour demand and extending the peak demand period.

### *Suggested Scheme for Evaluation*

Since the improvements proposed for Atlanta interact with each other (i.e., staggered work hours may have an impact on the effectiveness of car pools, car pools compete with public transit, etc.),

an improvement by improvement approach to evaluation will not give a complete picture of the combined effects of the total project on travel conditions within the corridor. Therefore, evaluation of the total "package" of improvements is necessary. Nevertheless, detailed examination of the effectiveness of the individual improvements or combination of improvements is also valuable and should be included in the evaluation.

Specific data required for the analysis of total project effectiveness are suggested below. Many of these data items are also required for evaluation of specific improvements as discussed subsequently. The total project evaluation should be planned so that the affected characteristics are measured each time a significant improvement or change in the transportation system is made. This may require a series of "after" studies.

A major factor which must be considered in the evaluation of the Atlanta UCDP project is the potential impact of the rapid-transit referendum. The passage of this referendum would lead to significant short-term changes in the existing transit service and the travel patterns in the area. Such changes would complicate the evaluation of the UCDP project.

## TOTAL PROJECT

### *Suggested Items for Evaluation*

1. Costs of improvements
2. Description of improvements
3. Corridor travel and congestion
  - a. Changes in the number of persons and vehicles entering (and leaving) the CBD from routes in the demonstration corridor and from adjacent corridors
    - (1) Volume measurements should be taken every 15 minutes.
    - (2) Volume counts should be cross-classified to give the number of persons entering the CBD by mode for each major route.

- b. Changes in travel times along major routes in the corridor and the CBD

4. Corridor travel costs

- a. Changes in the costs of travel should be identified for the following groups:

- (1) Commuters who use auto before and after transit improvements
- (2) Commuters who switch mode as a result of the improvements

- b. Cost items to be used in the evaluation should include:

- (1) Automobile operating cost (including capital costs) and/or bus fares
- (2) Value of passenger travel time (including time waiting for bus, transfer, etc.)
- (3) Accident costs
- (4) Parking costs (where applicable), whether or not paid for by user

[Cost factors and recommendations for their application are described in greater detail in the Evaluation Manual].

5. Community effects

- a. Significant changes in land use are not anticipated in the corridor or CBD because of the limited amount of time and type of improvements being made.
- b. Some improvements such as park-and-ride facilities may have localized effects and should be evaluated at that level.

ROADWAY AND OPERATIONAL IMPROVEMENTS

*Objectives*

Although detailed plans for roadway and operational improvements have not yet been spelled out, it is presumed that the indicated improvements are aimed primarily at relieving vehicular congestion at

bottleneck locations along the arterials and freeway serving the corridor. With the exception of freeway control, which does not appear implementable at this time, these improvements do not provide significant priority treatment for buses.

*Factors Affecting the Outcome of the Demonstration and Its Applicability to Other Cities*

1. Freeway controls cannot be effectively implemented until after reconstruction of the freeway is completed.
2. Reconstruction of the freeway will seriously affect traffic patterns throughout the corridor.
3. Many improvements will be applied concurrently and it will not always be possible to identify the effects of each type of improvement. A thorough evaluation of the staggered hours program may require postponing the implementation of certain roadway improvements.
4. Where certain types of improvements are used to improve flow through bottleneck areas, the opportunity may exist to provide evaluations of these types of improvements at critical locations.
5. Preferential treatment for buses will be impossible until freeway controls are implemented.
6. Time lag caused by construction may extend project beyond any useful evaluation possibilities under the present Urban Corridor Demonstration Program.
7. Arterial route changes may be distorted by freeway construction problems.
8. Roadway pattern forces arterials to serve both radial and circumferential movements.
9. Implementation period will be long.
10. Staggered hours program may distort measures of effectiveness.

*Suggested Items for Evaluation*

1. Overall corridor travel conditions

- a. Distribution of traffic within the corridor and entering the CBD before and after any improvements or experiments have taken place. This is necessary to identify any diversionary effects the improvements may have and to identify new problem locations.
  - b. Most of these effects will be evaluated by the total project evaluation discussed in the preceding section.
  - c. Since it appears that freeway control will not be implemented in this corridor under the present program, no evaluation is suggested for this special type of improvement.
2. Traffic flow conditions at critical locations
- a. Changes in quality of flow through bottleneck areas. Alternate methods of measuring may include:
    - (1) Travel times
    - (2) Frequency and severity of stoppages or "input-output" study
    - (3) Acceleration noise
  - b. Changes in accident experience at the critical areas.
  - c. Changes in vehicular exhaust emissions and noise through the areas where traffic flow is improved.
  - d. Where the effects of such improvements can be translated into time saved, reduced vehicle operating costs, and/or reduced accident rates, these benefits should be evaluated in a cost-effectiveness analysis.

## BUS SERVICE IMPROVEMENTS

### *Objectives*

Improvements to the existing bus service are designed to reduce automobile traffic within the corridor by intercepting auto traffic at the perimeter of the CBD with the "Town Flyer" bus shuttle and by diverting auto traffic in the suburbs to park-and-ride facilities and express bus service. These improvements applied to collection/distribution, line-haul, and CBD distribution services.

*Factors Affecting the Outcome of the Demonstration and Its Applicability to Other Cities*

1. No preferential treatment for buses will be available in the critical early phases before freeway controls and reconstruction are completed.
2. Bus travel times will not equal private automobile travel times.
3. Multiple demonstration improvements will be implemented within the corridor at the same time. Care must be exercised in the design and implementation of the demonstration to insure that changes attributable to individual projects can be separately identified where appropriate.
4. CBD shuttle service is already operational and has been operated under an earlier UMTA grant. It is assumed that its evaluation will be continued under the existing program.
5. Transit service in Atlanta serves significant reverse commuting patterns.

*Suggested Items for Evaluation*

To adequately evaluate the effectiveness of the bus improvements in attracting patronage, the documentation should include descriptions of both the changes in service and the measures of effectiveness.

1. Descriptions of changes in bus service
  - a. Travel times by bus to the CBD from selected points within the corridor
  - b. Differential travel time between bus and auto (before and after the improved service) from selected points within the corridor
  - c. Transit coverage (i.e., number of potential patrons with convenient access to park-and-ride or kiss-and-ride facilities)
  - d. Schedule reliability
  - e. Frequency of service and time required for transfers along principal routes

- f. Perceived change in commutation cost associated with switching from auto to bus (i.e., fare and time cost for bus vs. vehicle operation, parking, and time costs for auto)
2. Measures of effectiveness of improved bus service
- a. Total patronage and the percentage of the candidate commuters (those who work in the CBD or other major generator and live within the area covered by bus service) who switch to bus. Data required would include:
    - (1) Total corridor travel patterns (Urban Transportation Study data may be enough)
    - (2) Bus patronage counts (this may require boarding and alighting surveys for major routes and boarding points)
    - (3) Bus origin/destination survey (may be obtained in conjunction with on-board survey)
  - b. Characteristics of bus patrons. In applying these results to other cities and corridors, a profile of the characteristics of the bus riders together with similar information for all residents of the corridor, will indicate more clearly the segment of the total market that improved transit service is likely to attract. On-board or similar direct surveys of bus passengers appear to be the most desirable method of collecting such information. The exact type of information which can be obtained depends very much upon local conditions; however, the following items are suggested for inclusion in such a survey where possible:
    - (1) Trip purpose
    - (2) Origin/Destination
    - (3) Mode and travel time to/from bus at each end of trip
    - (4) Was this trip regularly made before improved bus service was initiated
    - (5) Mode previously used for this trip
    - (6) Number of autos in family
    - (7) Availability of auto for this trip

(8) Age group

(9) Income class

[These items are not intended to represent a complete survey questionnaire. Additional items may be necessary to evaluate other portions of the demonstration project.]

c. Revenue/cost characteristics associated with the bus service

(1) This may require monitoring over an extended time period and should be re-examined after any significant changes in service or marketing program.

(2) Routes with different characteristics should be monitored individually.

d. Public acceptance of improvements

(1) Attitude survey regarding desirability of park-and-ride facilities

(2) Attitude and patronage of bus terminals

(3) Evaluation of the functional operation of park-and-ride designs

(4) Audit, or depth of public awareness of bus improvements and marketing program

## COMPUTERIZED CAR POOL AND SUBSCRIPTION BUS SERVICE

### *Objectives*

1. To develop and test the feasibility of a computerized method for establishing car pools and matching transit service to demands.
2. To test the effectiveness of this technique as a means for reducing congestion by encouraging higher auto occupancy and transit patronage.

In the absence of freeway control, the Atlanta project also tests whether increased car pooling and transit patronage can be obtained without incentives such as preferential treatment.



## COMPUTERIZED CAR POOL PROGRAM

### *Factors Affecting the Outcome of the Demonstration*

1. The car pool service and subscription bus service will be implemented simultaneously. Since both will compete for approximately the same market, this project will provide an indication only of the relative preference for the different types of services. This will not indicate how effective one system would be in the absence of the other.
2. Public response to the computer matching program may be visualized as an "invasion of privacy."
3. The staggered hours project could disrupt existing car pools.

### *Factors Affecting the Applicability of Demonstration Results to Other Cities*

1. Population and income characteristics may affect the success of the program and will differ from other cities.
2. The tradition and/or acceptability of car pools may differ between cities.
3. The market for car pools may not be within the same employment groups.

### *Suggested Items for Evaluation*

To adequately evaluate the effectiveness of the car pool program, it will be necessary to document and describe each stage of the project in great detail because of the unique nature of the research and implementation procedures. The primary evaluation should be concerned with how many car pools were created or aided by the project and the resultant change in vehicle occupancy and the number of vehicles.

#### Description of project technique:

1. Strategy
2. Forms and sampling techniques required for processing the car pool requests
3. Assignment techniques and modeling programs

4. Public information and marketing program
5. Data problems

Achievements of the project:

1. Number of car pools formed
2. Number of participating riders
3. Reduction in automobile usage
4. Changes in vehicle occupancy
5. Cost of the actual project and of continuing the matching program

Characteristics and evaluation of the service:

1. Population profile of participating riders
2. Relation of current riders to previous work trip mode
3. Analysis of home location and employment area usage of car pools
4. Types of employment centers where car pools are most successful
5. Cost and feasibility using this matching program in another city
6. Changes needed in data sources and information
7. Attitude survey of service users
8. Life expectancy of car pools
9. Will any public agency be willing to accept responsibility for continuing the service?

SUBSCRIPTION BUS SERVICE

*Factors Affecting the Outcome of the Demonstration and Its Applicability to Other Cities*

1. Buses will have to run on the same congested streets with everyone else and without preferential treatment.
2. Growth potential of the corridor is very high.

3. This project will be competing directly with the car pool program and regular bus service.
4. Reverse commuting occurs regularly in the Atlanta transit system and may confound subscription service.

*Suggested Items for Evaluation*

The effectiveness of the subscription bus service will ultimately depend upon the patronage it attracts and the revenue/cost factors associated with providing the service. The unique nature of the project will require a detailed description and documentation of the technique and strategy utilized in planning and implementation.

Description of project techniques:

1. Strategy
2. Methods and format of data collection
3. Assignment techniques
4. Public information and marketing program
5. Changes and/or improvements in data requirements

Project results:

1. Patronage, by location and destination
2. Number and location of bus routes
3. Costs of providing the service
4. Attitude survey of riders
5. Changes in mode and submodes for trips
6. Reduction in automobile usage
7. Changes in vehicle occupancy
8. Evaluation of vehicles used to provide the service

Characteristics and evaluation of the service:

1. Population profile of riders
2. How were previous trips made
3. Operating characteristics of the services (speed, time, distance, delays, etc.)
4. Application to other cities
5. Should service be continued and by what means
6. Characteristics of trip destination and origins

STAGGERED HOURS PLAN

*Objectives*

1. To demonstrate the feasibility and acceptance of a staggered work hours program.
2. To demonstrate the effectiveness of this program in reducing peak hour congestion.

*Factors Affecting the Outcome of the Demonstration*

1. Several other improvements will be implemented at the same time.
2. Shuttle bus service may be eliminated or modified.
3. Proportion of employment in the CBD participating in the demonstration.
4. If significant changes are made to the street or signal system within the CBD during the demonstration period, these will influence the ability to evaluate the effects of staggered hours on CBD traffic flow.

*Factors Affecting the Applicability of Demonstration Results to Other Cities*

1. Concentration, classification, composition, and magnitude of employment within the affected area may influence the acceptability of this technique.
2. Climate and recreation opportunities may be a critical factor in public acceptance.

*Suggested Items for Evaluation*

1. Description of program should include:
  - a. Number of employees and firms affected
  - b. Geographical limits of affected area
  - c. Work schedule indicating the breakdown by type of business, number of employees, and geographical distribution for each shift
2. Measures of effectiveness
  - a. Changes in peak hour flows into and out of CBD by transit and by automobile
    - (1) Should include vehicle counts and occupancies by time period for each route entering CBD (as discussed in CBD cordon count in Evaluation Manual).
    - (2) Time interval necessary for reporting counts depends on staggered hours schedule but should be as small as possible (15 minutes-absolute minimum).
  - b. Effects on traffic flows of arterials and freeways leading into CBD
    - (1) Travel time measurements before and after.
    - (2) This improvement should improve flow in all corridors, but observation of changes in the demonstration corridor may be sufficiently indicative of changes throughout the urban area.
    - (3) Travel times should be measured for several points in time (i.e., 7:30, 7:45, 8:00, etc.).
    - (4) Travel times may be limited only to the portions of these routes near the CBD which presently experience heavy congestion.
  - c. Effects on traffic flow in CBD
    - (1) Changes in travel times for major streets within CBD
    - (2) Intersection delay at critical intersections within CBD

- (3) Changes in time required to park automobile
  - (a) Can be measured as the time from CBD cordon to the parking garage
  - (b) Repeat for several points throughout the CBD
- d. Because this improvement influences travel conditions throughout the urban area, it may not be feasible to identify the cost and benefits of this improvement.
- e. Changes in exhaust emissions and noise levels in the CBD.
  - (1) Noise may be reduced by lowering the concentration of vehicles in the CBD.
  - (2) Exhaust emissions may be reduced by reduction of delay (i.e., idling vehicles).
  - (3) In the CBD, these factors can be evaluated by actual before-after measurement; it is doubtful that they can be meaningfully calculated in this situation.

### 3. Subjective evaluation

- a. Employee and business reaction to the staggered hours program
- b. Problems in implementation and supervision
- c. Impact on CBD parking
- d. Disruption to existing car pools
- e. Firms and/or employees who elect to adopt the program on a continuing basis
- f. Suggested improvements to strategy for application to other cities

# CINCINNATI

## SUMMARY

The UCDP project in Cincinnati has two major demonstration objectives:

1. To test the effectiveness of outlying terminals in conjunction with line-haul (express) bus service to the central area, for promoting greater utilization of transit for travel oriented to the central area.
2. To test the effectiveness of various traffic engineering and operational control techniques, for providing preferential treatment for line-haul vehicles operating in mixed traffic on arterial roadways.

To the extent that the diversion of patronage from auto to bus reduces the vehicular demand for the arterial streets, this project will test the effectiveness of improved bus service as a means for relieving congestion. However, in this corridor it does not appear that the diversion from auto to bus will significantly affect the level of congestion in the corridor in the immediate future.

Traffic engineering and operational control techniques included in this project refer to such items as lane usage restrictions, intersection improvements, bus turnouts, traffic signal and signing changes, etc. Except where these improvements are intended to alleviate bottlenecks, it will not generally be possible to isolate the effects of the individual improvements on the level of congestion.

Bus improvements consist of adding express service through the corridor (on existing arterials), providing suburban collection-distribution systems in the form of park-ride facilities and local bus service, and providing a limited number of bus shelters. The roadway improvements will facilitate improved bus service so that bus travel times may be approximately equivalent to auto travel times. A marketing program will also be included in conjunction with these improvements.

In addition to the main experiment, the project lends itself to several sub-experiments which may provide useful, although not comprehensive, information about certain components of the project. These include: a marketing program, bus passenger shelters, and a comparison of park-ride and local bus service as low-density collection-distribution systems. Long-range plans also include providing for a downtown bus terminal and an improved collection-distribution system in the CBD.

Evaluation of the UCDP project should measure the effectiveness, costs, and benefits of the individual techniques or improvements being tested for relieving congestion or improving travel conditions. However, the overall effectiveness of the combined set of improvements should also be measured.

Specific data required for the analysis of total project effectiveness are suggested below. Many of these data items (in the same or greater level of detail) are also required for evaluation of specific improvements as discussed subsequently.

## TOTAL PROJECT

### *Suggested Items for Evaluation*

1. Costs of the improvements
2. Corridor travel and congestion
  - a. Changes in the number of persons and vehicles entering (and leaving) the CBD from routes in the demonstration corridor and from routes in adjacent corridors to/from which corridor traffic might be diverted
  - b. Changes in accident rates associated with the improvement
  - c. Changes in the travel times along major routes serving the corridor
3. Corridor travel costs



- a. Changes in the costs of travel should be identified for the following groups:
  - (1) Commuters who use auto before and after the improvement
  - (2) Commuters who use bus before and after the improvement
  - (3) Commuters who switch mode as a result of the improvement
- b. Cost items to be used in the evaluation should include:
  - (1) Automobile operating cost and/or bus fares (including capital costs)
  - (2) Value of passenger travel time (including time waiting for bus, transfers, etc.)
  - (3) Accident costs
  - (4) Parking costs (where applicable), whether or not paid for by user
- c. In estimating changes in travel costs, emphasis should be given to those routes which are affected by the improvements, either by physical changes or by diversion to/from other routes.
- d. Unit costs for this analysis are given in the Evaluation Manual.

#### 4. Community effects

- a. It is doubtful that the transportation improvements within the corridor will have significant corridor-wide impact on land use or other socioeconomic characteristics because of the limited time period of the program and nature of the improvements.
- b. Individual improvements are likely to have some localized impact, but these effects should be considered during the evaluation of the individual improvement.
- c. Changes in vehicle exhaust emissions and noise can also be localized and associated directly with specific improvements.

## ROADWAY IMPROVEMENTS

### *Objectives*

Roadway improvements are intended to provide for preferential treatment of line-haul vehicles along arterial roadways within the corridor and to relieve congestion through the alleviation of bottlenecks along these routes.

### *Factors Affecting Outcome of the Demonstration*

1. Many of these improvements will be applied concurrently and it will not always be possible to identify the effects of each type of improvement on overall travel conditions within the corridor.
2. Where certain types of improvements are used to improve flow through bottleneck areas, the opportunity may exist to provide evaluations of these types of improvements at critical locations.

### *Factors Affecting Applicability of Demonstration Results to Other Cities*

1. Most of the techniques being applied to improve traffic flow along the corridor routes are not unique and their results are generally predictable.
2. The particular set of improvements being applied, together with the characteristics of the transportation facilities and the topographic constraints which restrict the types of improvements which can be made, are not common in other cities.
3. Changes in overall vehicular travel conditions in the corridor will provide a measure of effectiveness of the concerted application of roadway improvements.

### *Suggested Items for Evaluation*

Overall corridor travel conditions:

1. Redistribution of traffic entering the CBD from Columbia Parkway and Eastern Avenue and any diversion to or from Madison Road and other alternate routes.

2. Most of these effects will be evaluated by the total project evaluation discussed in the preceding section.

Traffic Flow Conditions at Critical Locations:

1. Changes in quality of flow through bottleneck areas.

Alternative methods of measuring may include:

- (a) Travel times;
  - (b) Frequency and severity of stoppages or "input-output" study;
  - (c) Acceleration noise.
2. Changes in accident experience at the critical areas.
  3. Changes in vehicular exhaust emissions and noise through the areas where the traffic flow is improved.
  4. Where the effects of such improvements can be translated into time saved, reduced vehicle operating costs, and/or reduced accident rates, these benefits can be evaluated in a cost-effectiveness analysis.

## IMPROVED BUS SERVICE

### *Objectives*

Bus service improvements are intended to increase transit patronage by improving bus schedule reliability, coverage, marketing, travel time, comfort, and convenience. These improvements will test the effectiveness of improved transit service in relieving congestion by the diversion of auto passengers to bus.

### *Factors Affecting Outcome of the Demonstration*

1. Since most of the bus service improvements (including both the collection/distribution system and the line-haul service) and the marketing program will be tested concurrently, the fraction of the total patronage attributable to each component of the total system cannot be readily identified. The improved bus service must be regarded as a package and its aggregate characteristics identified accordingly.

2. In addition to diverted traffic, improved bus service may also generate new trips. This component of the patronage should be identified.

*Factors Affecting Applicability of Demonstration Results to Other Cities*

1. Bus preferential treatment for the express service is principally restricted to utilizing the center lane in the major direction of flow on Eastern Avenue for private autos and line-haul vehicles, requiring trucks and local buses to use the curb lane.
2. Upgraded bus service will provide travel times comparable to, but no better than, private auto.
3. The principal market at which the bus service is directed is a relatively high income, suburban area. However, there is an opportunity to develop limited reverse commuting from areas near the CBD.
4. The ability of the bus improvements to attract patronage from this corridor is likely to be adversely affected by the relatively attractive parking conditions (supply and price) presently existing in the CBD.

*Suggested Items for Evaluation*

To adequately evaluate the effectiveness of the bus improvements in attracting patronage, the documentation should include descriptions of both the changes in service (as perceived by the patron) and the measures of effectiveness. Much of this data will also be required for the total project evaluation.

Descriptions of changes in bus service:

1. Travel times by bus from selected points within the corridor
2. Differential travel time between bus and auto (before and after the improved service) from selected points within the corridor
3. Transit coverage
  - number of candidate patrons within walking distance of a bus stop

- number of candidate patrons with convenient access to a "park-ride" or "kiss-ride" facility
- 4. Schedule reliability
- 5. Frequency and time required for transfers along the principal routes
- 6. Perceived commutation cost associated with switching from auto to bus (i.e., fare and time cost for bus vs. vehicle operation, parking, and time costs for auto)

Measures of effectiveness of improved bus service:

1. Total patronage and the percentage of the candidate commuters (those who work in the CBD or other major generator and live within the area covered by bus service) who switch from auto to bus.

Data required include:

- a. Total corridor travel patterns (Urban transportation study may be adequate)
  - b. Bus patronage counts (this may require boarding and alighting surveys for the major routes and boarding points)
  - c. Bus origin-destination survey (May be obtained in conjunction with an on-board survey)
2. Characteristics of bus patrons. In applying these results to other cities and corridors, a profile of the characteristics of the bus riders together with similar information for all residents of the corridor, will indicate more clearly the segment of the total market that improved transit service is likely to attract. On-board or similar direct surveys of bus passengers appear to be the most desirable method of collecting such information. The exact type of information which can be obtained depends very much on local conditions; however, the following items are suggested for inclusion in such a survey where possible:
    - a. Trip purpose
    - b. Origin/Destination
    - c. Mode and travel time to/from bus at each end of trip

- d. Was this trip regularly made before improved bus service
- e. Mode previously used for this trip
- f. Availability of automobile for this trip
- g. Age group
- h. Income class

[ These items are not intended to represent a complete survey questionnaire. Additional items may be necessary to evaluate other portions of the demonstration project. ]

- 3. Revenue/cost characteristics associated with the bus service.
  - a. This may require monitoring over an extended time period and should be re-examined after any significant changes in service or marketing program. Routes with different characteristics should be monitored individually.
  - b. This provides a means for assessing the cost-effectiveness of the bus service improvements.
- 4. Changes in work/residence location resulting from improved bus service. Although very significant changes of this nature are not likely during a relatively short time period, this should be monitored if feasible.
  - a. Volumes of reverse commuters should indicate whether many central city residents find employment in the suburbs.
  - b. Information relating to employees who might move into the corridor to take advantage of the bus service can be obtained as a part of an on-board survey.

#### LOW DENSITY COLLECTION-DISTRIBUTION SYSTEM

The low-density collection-distribution system, including local bus service, bus terminals, and park-ride facilities, is an integral part of the total bus improvement. Much of the information required for this portion of the evaluation will also be required for

evaluation of the total transit system, but since it may be possible to develop information specifically about the low density collection-distribution portion of the system, it is treated separately.

*Factors Affecting the Outcome of the Demonstration and Its Applicability to Other Cities*

1. Regardless of the effectiveness of the local collection-distribution system, its usage is directly dependent on the attractiveness of the line-haul service so that any comparisons which are made are strictly valid only where similar line-haul conditions exist.
2. Because of topographic constraints, the local bus serving the collection-distribution function will not be able to operate in all areas.

*Suggested Items for Evaluation*

1. Where the collection-distribution function is served by both bus and park-ride facilities, comparison of volumes using each type of service may suggest the ordering of preferences for each.

Specific data may include:

- a. Attitude surveys may be used to obtain such information as type of collection-distribution system preferred or whether the availability of a particular type of system significantly affects transit ridership.
  - b. Patronage classified by arrival mode (should be coordinated with on-board surveys).
  - c. Subjective evaluation of interface between modes and vehicles.
2. Community Effects associated with the collection-distribution systems (especially terminals) should also be monitored. These effects may include:
    - a. Noise and air pollution
    - b. Land development adjacent to parking areas
    - c. Effects on commercial activity, especially in the case of joint use of parking facilities

An evaluation based on interviews with businessmen or similar techniques may provide the best indicator of these effects.

3. The effectiveness of this component of the system is highly interrelated with the line-haul service and other improvements. A benefit vs. cost type of analysis for the suburban collection-distribution system does not appear feasible.

## CBD BUS TERMINAL

### *Objectives*

The proposed CBD bus terminal and shuttle service is intended to improve access to points within the CBD and to facilitate interchange between bus routes within the corridor and other routes. It will test the financial feasibility of such a system.

### *Factors Affecting Outcome of the Demonstration and Its Applicability to Other Cities*

1. Institution of this terminal is contingent upon the development of substantial patronage on the line-haul system.
2. This terminal will provide an interface and be coordinated with the area-wide transit system.
3. Implementation of this facility must be coordinated with other developments in the CBD (i.e., second level walkway system, etc.).
4. Since this terminal will not be developed until the conditions in the corridor have stabilized after the initial improvements, it may provide a measure of the incremental effects of such an improvement on transit patronage.

### *Suggested Items for Evaluation*

1. Changes in accessibility of various points within the CBD for bus commuters from the corridor.
2. Changes in volume of passenger traffic on all bus routes resulting from improved interchange facility.



3. Subjective evaluation of the effects of the terminal on congestion in the CBD.
  - a. Does it change the apparent level of congestion around the terminal?
  - b. How far does this effect extend?
4. Changes in noise levels and vehicle exhaust emissions in the vicinity of the terminal.
5. Analysis of financial feasibility of such systems (including costs, benefits, and revenues).

## MARKETING PROGRAM

### *Objectives*

The marketing program is a part of the total package of bus service improvements being implemented in the corridor. The demonstration goal is to test the effectiveness of this technique as a means for providing public awareness of the service and stimulating bus patronage.

### *Factors Affecting Outcome of the Demonstration and Its Applicability to Other Cities*

1. Since the marketing campaign will be conducted in conjunction with the improved bus service, it will not be possible to accurately measure the additional patronage generated by the marketing program.
2. Interpretation of any findings relating patronage generated to the marketing effort must recognize that changes in patronage are very closely associated with the transportation alternatives available. With a different set of transportation alternatives, the marketing program may achieve very different results.

### *Suggested Items for Evaluation*

1. Degree of public awareness of the transit service achieved by marketing program.

2. If marketing campaigns are repeated, it may be possible to obtain some indication of the influence of the program on patronage by monitoring ridership over the affected portions of the system before and after each such effort.
3. Other methods of evaluation may be suggested by the agencies responsible for conducting the demonstration.

## CURBSIDE SHELTERS

### *Objectives*

The principal objective of the passenger shelters is to improve the comfort and convenience of service to bus riders. This project does not provide a good basis for testing the effectiveness of shelters on patronage or for evaluating different types of shelter designs.

The passenger shelter program is limited, but will include bus stops in a low-income area of the corridor. Although travel to and from this area of the corridor is not significant or strongly oriented to the CBD, the cooperation and support of these residents are essential to the overall success of the demonstration project.

### *Suggested Items for Evaluation*

1. It is not likely that passenger shelters will stimulate a significant increase in bus patronage; however, at locations where such improvements are made, the patronage should be monitored. To be able to associate any increases with the improvements, similar locations without such improvements should also be monitored.
2. It would appear that the most meaningful evaluation of such shelters is a subjective evaluation by bus patrons who use the facilities. This could be conducted in conjunction with an on-board survey.
3. A cost-effectiveness analysis of passenger shelters does not appear feasible for this project.

## MISCELLANEOUS

In addition to the improvements discussed in the previous sections, the evaluation should also consider other items which may provide useful guidelines to other cities contemplating the use of similar techniques. A limited subjective evaluation will be adequate in most cases. Such items may include:

- Bus loading characteristics at new types of bus stations
- The effects of bus stations on traffic patterns of surrounding streets
- Enforcement problems associated with preferential bus treatment
- Design characteristics of bus turnouts, terminals, parking facilities, etc.
- Additional law enforcement requirements

# DALLAS

## SUMMARY

The principal emphasis of the improvements in the Dallas corridor is on the use of freeway surveillance and control for relief of vehicular congestion. The UCDP improvements in Dallas focus on the bus system. Improved bus service includes: preferential treatment for buses on both the freeway and surface streets, more frequent service on certain branches, and the implementation of park-ride facilities. No improvements for the CBD are contemplated under the UCDP project.

In addition to the main experiment, however, the Dallas UCDP project provides the opportunity to examine certain other relationships and techniques more closely. These include:

1. The effectiveness of park-ride as a collection-distribution system
2. The effectiveness of a bus locator system

### *Factors Affecting the Outcome of the Demonstration and Its Application to Other Cities*

1. By providing different levels of bus service to similar areas within the same corridor, this project provides the opportunity to examine the effects of quality of service on patronage.
2. The demonstration project must coordinate with the ongoing freeway surveillance and control project and the transit study.
3. With an extensive surveillance system throughout the corridor, the Dallas project provides an opportunity to measure changes in traffic operations and flow characteristics with greater precision than is economically feasible in other cities.

## *Corridor Surveillance and Control System*

Since the surveillance and control system is being implemented and evaluated under another project, suggestions concerning the measurement of traffic flow characteristics are not included here.

## *Transit Service Improvements*

### 1. Descriptions of Service

- a. Comparison of travel times by alternate modes available. (To CBD from several selected points within the corridor)
- b. Transit coverage
  - (1) Number and percentage of corridor residents within walking distance of bus service
  - (2) Number and percentage of corridor residents with convenient access to a transit terminal
  - (3) Separate measures should be provided for different regions within the corridor
- c. Schedule reliability
- d. Frequency and time required for transfers along principal routes
- e. Perceived changes in commutation cost associated with switching from auto to bus (i.e., fare and time cost for bus vs. vehicle operation, parking, and time costs for auto)

### 2. Measures of Effectiveness

- a. Total patronage and the percentage of the candidate commuters (those who work in the CBD or other major generator and live within the area covered by bus service) who switch from auto to bus

Data required include:

- (1) Total corridor travel patterns
- (2) Bus patronage counts

[The possibility that some commuters may switch from bus to auto should also be considered where there is existing bus service.]

b. Characteristics of bus patrons

In applying these results to other cities and corridors, a profile of the characteristics of the bus riders, together with similar information for all residents of the corridor, will indicate more clearly the segment of the total market that improved transit service is likely to attract. On-board or similar direct surveys of bus passengers appear to be the most desirable method of collecting such information. The exact type of information which can be obtained depends very much on local conditions; however, the following items are suggested for inclusion in such a survey where possible:

- (1) Trip purpose
- (2) Origin/Destination
- (3) Mode and travel time to/from bus at each end of trip
- (4) Was this trip regularly made before improved bus service
- (5) Mode previously used for this trip
- (6) Availability of automobile for this trip
- (7) Age group
- (8) Income class

[These items are not intended to represent a complete survey questionnaire. Additional information from such a survey may be necessary to evaluate other portions of the demonstration project.]

c. Revenue/cost characteristics associated with the bus service

This may require monitoring over an extended time period and should be re-examined after any significant changes in service. Routes with different characteristics should be monitored individually.

## PARK-RIDE LOTS

### *Objectives*

To test the effectiveness of park-ride facilities as the collection-distribution system.

### *Factors Affecting the Outcome of the Experiment and Application to Other Cities*

1. The ability to test the effectiveness of the park-ride facility in increasing patronage depends on the phasing of the project. If the park-ride facility is implemented at the same time as the other improvements, the patronage cannot be separated.
2. The ability to compare the park-ride facility with other types of collection-distribution systems in this corridor would require comparison with similar areas within the corridor served by other types of collection-distribution systems.

### *Suggested Items for Evaluation*

1. Usage
  - a. Counts of persons boarding the line-haul vehicle at each terminal (should be classified to give mode of arrival at the terminal)
  - b. User characteristics (should be coordinated with on-board surveys, where applicable, to reduce data costs and to permit cross classification of data from the two surveys)
    - (1) Travel patterns of users
      - (a) Previous mode(s) and/or route used for trip
      - (b) Origin-Destination
      - (3) Frequency of trip (by mode)
    - (2) User profile in comparison to profile of corridor residents in general
      - (a) To determine which segment of the corridor uses the service

(b) Typical data items

(i) Income/occupation

(ii) Car ownership and availability

2. Community effects associated with the various collection-distribution systems should be monitored. Where significant changes are not expected, a subjective evaluation or simply the monitoring of complaints may be adequate. However, the evaluation design should provide the mechanism for such measurements. Effects which should be considered include:

a. Commercial activity, land development, etc. in the surrounding area (i.e., retail sales at shopping centers used for park-ride facilities)

b. Noise and air pollution

c. Traffic flow on nearby streets

3. Analysis of benefits and costs

a. Detailed costs associated with the construction and operation of these facilities should be documented

b. The ability to analyze the revenue/cost characteristics will depend on the pricing policy adopted

c. It is doubtful that the benefits from such facilities can be quantified with sufficient accuracy for analysis



# DAYTON

## SUMMARY

The proposal for Dayton centers around the provision of transit service along a fixed facility for rubber-tired vehicles (i.e., a busway). This demonstration project tests two principal techniques:

1. The effectiveness of a high-quality public transit system in attracting patronage from a relatively high-income suburban area that is strongly auto-oriented.
2. The effectiveness of preferential treatment (reduced travel times on exclusive roadways) for automobiles with high occupancies in encouraging car pooling.

In addition to the main experiment, this project provides an opportunity to test other relationships of nationwide interest. These include comparisons of effectiveness between several types of suburban collection-distribution systems, regularly scheduled local bus service, demand responsive bus service, and park-ride or kiss-ride operations at transit stations. This project also provides the opportunity to monitor community reaction to, or acceptance, of a public transit system in close proximity to residential developments and the impact of a major transportation system (which involves a separate, fixed facility) on land development and economic activity within the corridor.

## TOTAL PROJECT

### *Objectives*

1. To test ability of new or significantly improved public transit service to generate patronage and to measure its economic viability.
2. To test preferential treatment for high-occupancy automobiles as a means for encouraging car pooling.
3. To test the effectiveness of this combination of techniques in reducing congestion levels on roadways serving the corridor.

4. To test the interaction between car pools and public transit service.
5. To demonstrate the impact of such an improved system on land development and other socio-economic activity within the corridor (Evaluation of this impact may be contingent on degree of public acceptance and performance of the transportation system).
6. To test the effectiveness of the total system as a means for reducing vehicle exhaust emissions. (It may be necessary to restrict this portion of the evaluation to the line-haul portion of the system).

*Factors Affecting the Outcome of the Demonstration*

1. Although the demonstration corridor is experiencing rapid growth and increased congestion of the transportation facilities is expected, present congestion levels are less acute than in many other urban areas.
2. The supply and price of parking in the CBD area appear attractive to auto commuters and may influence the extent to which increased occupancies and transit patronage are achieved.
3. The extent to which commuters divert to bus and/or car pools is dependent on the quality of service presently available by automobile. Evaluation of this project must recognize that even if the anticipated diversion does not occur, this type of system, in general, may still be successful in corridors with more severe congestion and where travel by auto is relatively less attractive.
4. There is a potential for considerable land development and other socio-economic impacts within the corridor as a consequence of the transportation improvements. Such changes are likely to be long term, however, and are contingent on public acceptance of the system. Such changes may also require a more firm commitment to the system than a demonstration project provides.
5. Inferences which can be drawn relative to the effectiveness of public transit versus car pools depend on the sequencing of their implementation. If public transit is provided first, the patronage generated or diverted from auto may be somewhat higher than if both alternatives are made available at the same time. Sequential implementation also requires sequential evaluation to first identify bus patronage and to later determine the effectiveness of car pools and their impact on bus patronage.

6. Serving car pools on the busway conflicts with the goal of increasing transit patronage. It is expected that some potential bus patrons would be diverted to the car pools. A reasonable test of this impact would be provided, however, by opening the facility to car pools only after the bus service has been in operation for several months.

*Factors Affecting Applicability of Findings to Other Cities*

1. Since this project tests the system under a fairly limited set of conditions, similar improvements may have significantly different results in other corridors. Corridor characteristics influencing the extensibility of these findings should be documented in detail in the evaluation report. These generally include:
  - a. Relatively high income and low residential density
  - b. Strong orientation to automobile at present
  - c. High level of congestion only during peak period
2. The physical characteristics of the transportation system are somewhat unique to this corridor; however, in applying these results to other corridors, the demonstration project can be most appropriately described in terms of service characteristics rather than physical characteristics.

*Suggested Items for Evaluation*

The following evaluation items require "before" and "after" measurements. Assuming that bus service is instituted before car pools are permitted to use the facility, at least two "after" measurements will be required. If the bus improvements are implemented sequentially, additional "after" measurements and evaluations will be required for each significant change in quality of service.

1. Corridor travel and congestion
  - a. Changes in the number of persons and vehicles entering (and leaving) the CBD from routes in the demonstration corridor and from routes in adjacent corridors to/from which corridor traffic might be diverted.

- (1) To maintain comparability between projects, and to measure changes in peaking characteristics, these volume measurements should be obtained for intervals no greater than 15 minutes.
  - (2) Volume counts should be cross classified to give the number of persons entering the CBD by mode for each major route.
  - (3) Where possible, the portions of the traffic volume change attributable to normal growth, generated traffic, and diverted traffic should be identified.
- b. To the extent that the diversion of traffic to the busway improves the traffic flow characteristics on other major facilities serving the corridor, an improvement in accident rate might result and should be monitored. Accident experience on the busway would be of interest to other areas considering similar facilities.
  - c. Changes in travel times along major routes serving the corridor.
2. Analysis of project costs and commuter benefits (See Evaluation Manual for details)
    - a. Costs of the improvements
    - b. Corridor travel costs
      - (1) Changes in the costs of travel should be identified for the following groups:
        - (a) Commuters who use auto before and after the improvement;
        - (b) Commuters who use bus before and after the improvement;
        - (c) Commuters who switch mode as a result of the improvement.
          - (i) Private auto to car pool on busway
          - (ii) Private auto to bus
          - (iii) Transit to auto and/or car pool
      - (2) Cost items to be used in the evaluation should include (See Evaluation Manual for cost factors to be used):
        - (a) Automobile operating costs and/or bus fares;

- (b) Value of passenger travel time (including time waiting for bus, transfers, etc.);
  - (c) Accident costs;
  - (d) Parking costs (where applicable), whether or not paid for by user.
- (3) In estimating changes in travel costs, emphasis should be given to those routes which are affected by the improvements either directly or by diversion to/from other routes.

### 3. Community effects

- a. Enthusiastic public acceptance of the system accompanied by relatively high patronage may lead to increased socio-economic activity within the corridor, particularly in terms of land value and type and extent of development in the presently undeveloped areas of the corridor. If the service is continued beyond the demonstration period, development of the property in close proximity to the facility and terminals should be carefully monitored. This, together with information on development in similar "control" areas in the region, will provide an indication of the impact of the transportation system.
- b. Other effects such as noise, air pollution, etc. can be associated more directly with specific improvements and are discussed subsequently.

## BUS SERVICE

Although the bus system is an integral part of the total project, detailed attention should be given to its evaluation. This evaluation requires descriptions of the services offered (as perceived by the patron) as well as measures of effectiveness such as patronage, revenue/cost characteristics, etc.

Certain elements of data required for evaluation of the bus service may also be required for evaluation of other improvements.

### 1. Descriptions of service

- a. Comparison of travel time by alternate modes available.  
(To CBD from several selected points within the corridor)

(1) Bus on surface streets - "before"

- (2) Auto on surface streets - "before"
- (3) Bus on busway - "after"
- (4) Car pool on busway - "after"
- (5) Auto on surface streets - "after"

b. Transit coverage

- (1) Fraction of corridor residents within walking distance of bus service (stratified by type of service)
- (2) Fraction of corridor residents with convenient access to transit terminals

c. Schedule reliability

d. Frequency and time required for transfers along principal routes.

e. Perceived changes in commutation cost associated with switching from auto to bus (i.e., fare and time cost for bus vs. vehicle operation, parking, and time costs for auto)

2. Measure of Effectiveness

a. Total patronage and the percentage of the candidate commuters (those who work in the CBD or other major generator and live within the areas covered by bus service) who switch from auto to bus

Data required include:

- (1) Total corridor travel patterns (Urban transportation study may be adequate);
- (2) Bus patronage counts (this may require boarding and alighting surveys for the major routes and boarding points);
- (3) Bus origin/destination survey (may be obtained in conjunction with an on-board survey).

b. Characteristics of bus patrons

In applying these results to other cities and corridors, a profile of the characteristics of the bus riders, together with similar information for all residents of the corridor, will indicate more clearly

the segment of the total market that improved transit service is likely to attract. On-board for similar direct surveys of bus passengers appear to be the most desirable method of collecting such information. The exact type of information which can be obtained depends very much on local conditions; however, the following items are suggested for inclusion in such a survey where possible:

- (1) Trip purpose
- (2) Origin/Destination
- (3) Mode and travel time to/from bus at each end of trip
- (4) Was this trip regularly made before improved bus service?
- (5) Mode previously used for this trip
- (6) Availability of automobile for this trip
- (7) Occupation
- (8) Age group
- (9) Income class

[These items are not intended to represent a complete survey questionnaire. Additional items may be necessary to evaluate other portions of the demonstration project.]

c. Revenue/Cost characteristics associated with the bus service

This may require monitoring over an extended time period and should be re-examined after any significant changes in service or marketing program. Routes with different characteristics should be monitored individually.

d. Changes in work/residence location resulting from improved bus service

Although very significant changes of this nature are not likely during a relatively short time period, this should be monitored if feasible.

- (1) Volumes of reverse commuters should indicate the extent to which central city residents find employment in the suburbs.

- (2) Information relating to employees who might move into the corridor to take advantage of the bus service can be obtained as a part of an on-board survey.

## LOW DENSITY COLLECTION-DISTRIBUTION SYSTEMS

### *Objectives*

1. To compare the effectiveness in terms of relative usage, public acceptance, and cost characteristics of various types of collection-distribution systems, including:
  - a. Park-ride
  - b. Scheduled local bus (existing CTC service where there is significant overlap)
  - c. Demand responsive bus collection system
  - d. Kiss-ride
2. To test the operational characteristics of demand-responsive bus collection-distribution.
3. To test the ability of these various types of local systems to adequately interface with tightly scheduled line-haul service.
4. To test the community effects of various types of collection-distribution systems.

### *Factors Affecting Outcome of the Experiment and Its Applicability to Other Cities*

1. Line-haul and collection-distribution improvements will be implemented concurrently so that it will not be possible to separate the incremental effects of the collection-distribution system on patronage.
2. Comparison between patronage of different types of collection-distribution systems serving the same area of the corridor (i.e., demand-responsive vs. kiss-ride) should provide an indication of the preferences for each.
3. Phasing of implementation will affect the types of information that can be derived from the experiment.



4. The value of each type of system in terms of additional patronage generated is a function of the characteristics of the total system and its public acceptance. Inasmuch as Dayton provides the test for only a limited set of line-haul conditions, complete evaluation of these various types of systems require projects in other cities.

*Suggested Items for Evaluation*

1. Schedule reliability and delays at transit terminals
2. Public acceptance
  - a. Questions concerning the public's awareness of the services may be desirable. This would best be conducted for a sample of the corridor population and this should be coordinated with the evaluation of any marketing survey which may be conducted.
  - b. Attitude or preference survey to obtain subjective indication of the type of system preferred.
3. Revenue-cost characteristics
  - a. Revenue-cost records for each route or service area should be maintained.
  - b. Records should be stratified by type of service, time of day (peak vs. off-peak), and route or service area.
4. Patronage
  - a. Counts of persons boarding the line-haul vehicle at each terminal should be classified to give mode of arrival at the terminal.
  - b. Such counts should also be coordinated with on-board surveys to permit cross-classification of data from the two surveys.
5. Community effects associated with the various collection-distribution systems should be monitored. Where very significant changes are not expected, a subjective evaluation or simply the monitoring of complaints may be adequate. However, the evaluation design should provide the mechanism for such measurements. Effects which should be considered include:

- a. For terminals and/or park-ride facilities:
  - (1) Commercial activity, land development, etc. in the immediately surrounding area (i.e., retail sales at shopping centers used for park-ride facilities)
  - (2) Noise and air pollution
  - (3) Traffic flow on nearby streets
- b. For bus systems
  - (1) Noise
  - (2) Accident experience on local streets
  - (3) Traffic flow on local streets

## CBD SHUTTLE

### *Objective*

The implementation objective of this improvement is to provide better transit coverage of the CBD to the public and to, therefore, encourage higher patronage rates. The demonstration value of examining this component of the system apart from the total transit system improvement is limited.

### *Factors Affecting the Outcome of the Demonstration*

1. A cost effectiveness analysis (i.e., examination of revenue/cost characteristics) is desirable, but may not be sufficiently indicative of the benefits to be derived from the system if, indeed, the CBD shuttle is responsible for increased patronage on the line-haul system.
2. If the shuttle service is implemented after other components of the corridor system are in operation and patronage has stabilized, the incremental patronage (which would also include some growth) would place an upper limit on the effectiveness of the shuttle in improving corridor patronage. (Assuming that patronage is increasing, not decreasing).
3. Benefits to other users of the system are difficult to identify and quantify.

4. Because the shuttle serves passengers from all corridors, its effectiveness may be influenced by other developments within the urban areas.

*Suggested Items for Evaluation*

1. Service improvements
  - a. Change in the number of potential destinations of CBD trips that are within a specified walking distance (such as one block) of a bus stop (This may be estimated on the basis of land use in the CBD rather than from detailed analysis of travel patterns)
  - b. Change in travel time to selected points within the CBD (measured from the CBD cordon line)
2. Patronage
  - a. Identify shuttle patronage by corridor of origin
  - b. Stratify patronage by time period (this should indicate whether the improvement serves commuters, shoppers, etc.)
  - c. Patronage counts should include CTC trolley riders within the CBD - "before" and "after" - and the riders on the Demonstration shuttle circulation system "after" (this will help identify the portion of the observed patronage that has been generated by the new system and the portion that has been diverted from the existing service)
3. Revenue/cost characteristics
  - a. The importance of this evaluation, in part, depends upon the philosophy used in establishing the fare for the shuttle.
  - b. The impact of this service on the viability of existing transit routes in the CBD should be measured.

**BUSWAY (PHYSICAL FACILITIES)**

*Objectives*

1. To test the feasibility of an exclusive roadway for public transit service and high occupancy vehicles.

2. To evaluate the environmental problems associated with placing a public transit facility through a residential area.
3. To test the effectiveness of an exclusive transit right-of-way for providing service to emergency vehicles.

*Factors Affecting Outcome of the Demonstration and Its Application to Other Cities*

1. Cross section of the busway and volume and mix of vehicles will vary along the facility. The evaluation should reflect the impact of these varying conditions.
2. The usefulness of the busway for service to emergency vehicles will depend partly on the access to cross streets and operational characteristics of the facility.

*Suggested Items for Evaluation*

1. Noise levels
  - a. Varying cross sections may have a significant impact on the noise levels perceived by the surrounding neighbors.
  - b. Sequential implementation of bus service followed by car pools will suggest sequential evaluation.
2. Air pollution

Measurement and/or calculation of the reduction in vehicle emissions may be significant for this project.
3. Residents' attitudes
4. Effectiveness for service to emergency vehicles
  - a. Frequency of usage and approximate time saved for various types of emergencies and locations within the corridor.
  - b. Problems associated with this type of operation.
5. Accident record
6. Enforcement and policing problems concerned with car pool occupancy requirements
7. Development of design standards for busways

## SIGNAL PREEMPTION DEVICES

### *Objectives*

1. To test the effectiveness of this system in reducing travel times and improving flow for buses.
2. To test the effect of signal preemption on traffic flow on opposing roadways.
3. To test the reliability of the system in terms of operational characteristics and susceptibility to violation.

### *Factors Affecting the Outcome of the Experiment and Its Applicability to Other Cities*

1. Signal preemption will be implemented at the same time as the other improvements. Measurement of reduction in bus travel time would require peak hour operation without use of this device in order to obtain "before" data.
2. Since similar types of devices are under consideration in other urban areas, this type of device has considerable nationwide interest.
3. Measurement of effectiveness of the device suggests balancing the physical costs of signal preemption plus the increased costs to other vehicular traffic against the savings to the bus riders.

Relative values assigned to time costs for bus commuters and for auto commuters depend on the project objectives and may differ between the demonstration city and other cities considering this type improvement. For purposes of this analysis, the value of time factors given in the Evaluation Manual should be used for both auto and bus commuters.

### *Suggested Items for Evaluation*

1. Improved traffic flow for buses
  - a. Comparisons should be made only along the portions of the route utilizing these devices (should consider only the delay at intersections).

- b. Evaluation may be made by actual measurement (with and without signal preemption, or by calculation using probability theory and the characteristics of the signals). A combination of these two methods would probably be the most efficient.
2. Effects on other vehicular traffic
  - a. Should consider both the car pools with benefit from the bus equipment and the cross traffic which incurs additional delay.
  - b. Critical intersection studies (Input-Output) as specified in the Manual provide a means of measuring this component of delay.
  - c. Effects may not be confined only to the preempted intersections but to other downstream locations as well.
3. Analysis of costs and benefits (including commuter travel time and vehicle operating costs)
4. Reliability and other operational problems

# LOS ANGELES

## SUMMARY

The Santa Ana Freeway Corridor poses unique problems as a demonstration project because of its immense length, size, population characteristics, and growth potential. The demonstration project is primarily concerned with:

1. Improving the traffic flow on the freeway during peak periods through signal and operational improvements, such as ramp controls and additional lanes in conjunction with improved local alternate routes;
2. Improving bus service by taking advantage of the improved freeway operations and by providing "park-and-ride" lots, express buses and expanded coverage.

Substantial transit improvements will be implemented only after significantly improved travel times in the corridor are demonstrated. A fringe parking lot in the Norwalk area is planned, however, past experiences with site acquisition attempts have revealed problems of adverse community reactions. Preferential treatment for buses will be feasible in conjunction with the freeway metering program and the possible construction of exclusive bus ramps. Since surveillance on the Santa Ana Freeway will not be implemented until the results of the Los Angeles Area Freeway Surveillance and Control Project have been analyzed in mid-1973, these are not near-term solutions.

The project includes improved access to the east side of the CBD from the demonstration corridor. This will be accomplished by using one-way couplets, peak hour reverse lanes, street widenings and jog eliminations. Significant improvements to the circulation system in the CBD are intended to relieve some of the pressure on the freeway caused by congested distribution routes.

The major thrust of the demonstration project is the implementation of roadway improvements. The effects of most such improvements will be largely localized and should be evaluated in detail at this level. However, the aggregate effects of these and all other improvements on corridor-wide congestion and travel patterns should also be evaluated. Since the project will be implemented in stages, this may require repeated "after" measurements following implementation of each major stage.

## TOTAL PROJECT

### *Suggested Items for Evaluation*

1. Costs of improvements
2. Description of improvements
3. Corridor travel and congestion.
  - a. Changes in the number of persons and vehicles entering (and leaving) the CBD from routes in the demonstration corridor and from adjacent corridors
    - (1) Volume measurements should be taken every 15 minutes.
    - (2) Volume counts should be cross classified to give the number of persons entering the CBD by mode for each major route.
    - (3) Traffic volume changes attributable to normal growth, generated traffic, and diverted traffic should be identified.
  - b. Changes in accident rates where applicable
  - c. Changes in travel times along major routes in the corridor and the CBD
4. Corridor travel costs
  - a. Changes in the costs of travel should be identified for the following groups:
    - (1) Commuters who use auto before and after roadway and transit improvements
    - (2) Commuters who use bus before and after improvements
    - (3) Commuters who switch mode as a result of the improvements



b. Cost items to be used in the evaluation should include:

- (1) Automobile operating cost and/or bus fares
- (2) Value of passenger travel time (including time waiting for bus, transfer, etc.)
- (3) Accident costs
- (4) Parking costs (where applicable)

[Cost factors and recommendations for their application are described in greater detail in the Evaluation Manual].

5. Community effects

- a. Significant changes in land use are not anticipated in the corridor or CBD because of the limited amount of time and type of improvements being made. However, if the time period for implementation is stretched out beyond 1973-1974, then accurate land use and population changes will require measurement to evaluate growth of area and generated traffic.
- b. Some improvements such as park-and-ride facilities may have localized effects and should be evaluated at that level.
- c. Changes in noise levels and exhaust levels can be anticipated in some areas and should be measured in the evaluation of the specific improvement. Noise levels in the CBD should receive special attention.

## ROADWAY AND OPERATIONAL IMPROVEMENTS

### *Objectives*

Ramp controls and roadway improvements are intended to improve freeway speeds during peak periods. Other roadway and operational improvements are designed to eliminate bottlenecks along arterials and access streets serving the corridor.

*Factors Affecting the Outcome of the Demonstration*

1. Tremendous size and length of the corridor and its population and growth characteristics
2. Limited parallel streets and alternate routes to the freeway
3. Degree of dependence upon the private automobile as a means of transportation
4. Implementation schedule and rate of project completion

*Factors Affecting Applicability of Demonstration Results to Other Cities*

1. Unique size and growth of the corridor
2. High traffic volumes involved in the corridor and freeway
3. Relative dependence upon private automobiles
4. Shortage of parallel roads to accommodate diverted traffic and provide alternate routes

*Suggested Items for Evaluation*

1. Overall corridor travel conditions
  - a. Distribution of traffic within the corridor and entering the CBD before and after any improvements have been implemented. This is necessary to identify any diversionary effects the improvements may have and to identify new problem locations.
  - b. Most of these effects will be evaluated by the total project evaluation discussed in the preceding section.
2. Traffic flow conditions at critical locations
  - a. Changes in quality of flow through bottleneck areas. Alternate methods of measuring may include:
    - (1) Travel times
    - (2) Frequency and severity of stoppages
    - (3) Delay (as measured by the "input-output" or "demand-delay" techniques)

(4) Acceleration noise

- b. Changes in accident experience at the critical areas
  - c. Changes in vehicular exhaust emissions and noise through the areas where traffic flow is improved
  - d. Where the effects of such improvements can be translated into time saved, reduced vehicle operating costs, and/or reduced accident rates, these benefits should be quantified. The Manual provides cost factors for such analyses.
3. Public attitude toward freeway controls and preferential treatment for transit, where applicable

## BUS SERVICE IMPROVEMENTS

### *Objectives*

Improvements to the existing bus system are intended to increase the coverage, convenience and quality of bus transit available in the demonstration corridor. These improvements test the ability of significantly increased coverage and quality of bus service to attract patronage from an area that is presently strongly oriented to the automobile.

### *Factors Affecting the Outcome of the Demonstration and Its Applicability to Other Cities*

1. Express bus service will only be initiated after freeway improvements are completed and guaranteed traffic flow speeds are available. An extended time period may, therefore, be required for evaluation.
2. Alternate and/or parallel facilities to the freeway are not available to serve as alternate routes or to carry diverted traffic.
3. Expansion of service will be focused upon an industrial area with a large employment base.
4. No previous experience with park-and-ride facilities in the corridor.

### *Suggested Items for Evaluation*

To adequately evaluate the effectiveness of the bus improvements in providing better service and attracting patronage, the documentation should include descriptions of both the changes in service and the measures of effectiveness.

1. Descriptions of changes in bus service
  - a. Travel times by bus to the CBD and other points from selected points within the corridor
  - b. Differential travel time between bus and auto (before and after the improved service) from selected points within the corridor
  - c. Transit coverage
    - (1) Number of potential patrons within walking distance of a bus stop
    - (2) Number of potential patrons with convenient access to park-and-ride or kiss-and-ride facilities
  - d. Schedule reliability
  - e. Frequency and time required for transfers along principal routes
  - f. Perceived commutation cost associated with switching from auto to bus (i.e., fare and time cost for bus vs. vehicle operation, parking, and time costs for auto)
2. Measures of effectiveness of improved bus service
  - a. Total patronage and the percentage of the candidate commuters (those who work in the CBD or other major generators and live within the area covered by bus service) who switch to bus. Data required would include:
    - (1) Total corridor travel patterns (Urban Transportation Study data may provide sufficient information)
    - (2) Bus patronage counts (this may require boarding and alighting surveys for major routes and boarding points)
    - (3) Bus origin/destination survey (may be obtained in conjunction with an on-board survey)

b. Characteristics of bus patrons. In applying these results to other cities and corridors, a profile of the characteristics of the bus riders together with similar information for all residents of the corridor, will indicate more clearly the segment of the total market that improved transit service is likely to attract. On-board or similar direct surveys of bus passengers appear to be the most desirable method of collecting such information. The exact type of information which can be obtained depends very much upon local conditions; however, the following items are suggested for inclusion in such a survey where possible:

- (1) Trip purpose
- (2) Origin/Destination
- (3) Mode and travel time to/from bus at each end of trip
- (4) Was this trip regularly made before improved bus service was initiated
- (5) Mode previously used for this trip
- (6) Number of autos in family
- (7) Availability of auto for this trip
- (8) Age group
- (9) Income class

[These items are not intended to represent a complete survey questionnaire. Additional items may be necessary to evaluate other portions of the demonstration project.]

c. Revenue/cost characteristics associated with the bus service

- (1) This may require monitoring over an extended time period and should be re-examined after any significant changes in service.
- (2) Routes with different characteristics should be monitored individually.

d. Changes in work/residence location resulting from improved bus service. It is doubtful that the scale of improvements in the Santa Ana Corridor will be great enough to cause identifiable changes in work/residence locations.

- e. Public acceptance of improvements
  - (1) Attitude survey regarding desirability of park-and-ride facilities
  - (2) Attitude and patronage of bus terminals
  - (3) Evaluation of the functional operation of park-and-ride designs
  - (4) Audit, or depth of public awareness of bus improvements and marketing program
  
- f. Community effects associated with the bus system improvements
  - (1) Noise and air pollution.
  - (2) Land development, especially in areas adjacent to terminal facilities
  - (3) Effects on commercial activity

# LOUISVILLE

## SUMMARY

### TOTAL PROJECT

On a corridor-wide basis, the Louisville UCDP project tests two types of improvements for the relief of peak hour congestion:

1. Bus improvements
  - a. To provide improved service to present patrons
  - b. To attract auto commuters to bus, thus reducing the number of vehicles using the corridor roadways
2. Roadway improvements to relieve bottlenecks, improve traffic flow, and provide for priority treatment of buses at certain locations

Bus improvements, in the following discussion, refer to the entire package of service, operational, and information changes intended to make the service more attractive to commuters. Roadway improvements include a wide range of typical traffic engineering changes in addition to the "wrong way" bus lanes on the one-way streets and other treatments to give priority service to buses.

In addition to total project evaluation, the configuration of the experiment will permit a partial evaluation of the effectiveness of certain individual improvements (i.e., passenger shelters, information systems, signal preemption devices, etc.). These are discussed subsequently.

### *Factors Affecting the Outcome of the Demonstration*

1. In analyzing changes in patronage and public response to the improvements, it must be recognized that these effects are due to the aggregate set of bus system improvements and the alternative automobile commuting conditions.

2. Except to the degree that increases in bus patronage are successful in reducing the number of vehicles entering the CBD, it is doubtful that the project improvements will significantly affect the congestion levels in the CBD.
3. It is unlikely that the improvements planned and proposed for the Louisville project will have significant impact on land use or land development within the corridor except in the immediate vicinity of park-ride facilities or other transit terminals. Extensive corridor-wide surveillance of changes in these factors, therefore, does not appear warranted.

*Factors Affecting Applicability of Findings to Other Cities*

1. Travel patterns are somewhat more diverse than for other corridors, with a significant amount of cross town traffic and an orientation to several other major areas beside the CBD. The evaluation should, therefore, consider the effects on non-CBD traffic.
2. The Louisville project affords the opportunity to test transit service improvements in an area of low to medium income and auto ownership. This is contrasted to other corridors included in the program where the primary market is of relatively high income. By providing similar quality service to two relatively distinct economic groups, the project also tests this relationship locally.

This also has significant implications for evaluation - namely, where patronage increase may be a good measure of effectiveness in areas of high income, other measures may be required in areas where the ridership is largely captive and relatively insensitive to quality of service.

3. Because of the diversity of travel patterns, it is doubtful that reductions in commutation costs associated with these improvements can be evaluated as precisely as for other corridors with well-defined boundaries and highly concentrated travel.

*Suggested Items for Evaluation*

1. Corridor travel and congestion ("before" and "after" project implementation)



- a. Changes in the number of persons and vehicles entering (and leaving) the CBD from routes in adjacent corridors to/from which corridor traffic might be diverted.
    - (1) To maintain comparability between projects, and to measure changes in peaking characteristics, these volume measurements should be obtained for intervals no greater than 15 minutes.
    - (2) Volume counts should be cross classified to give the number of persons entering the CBD by mode for each major route.
    - (3) Where possible, the portions of the traffic volume change attributable to normal growth, generated traffic, and diverted traffic should be identified.
  - b. Changes in accident rates associated with the improvement.
  - c. Changes in travel times along major routes serving the corridor.
2. Analysis of project costs and commuter benefits
- a. Costs of the improvements
  - b. Corridor travel costs
    - (1) Changes in the costs of travel should be identified for the following groups:
      - (a) Commuters who use auto before and after the improvement
      - (b) Commuters who use bus before and after the improvement
      - (c) Commuters who switch mode as a result of the improvement
    - (2) Cost items to be used in the evaluation should include: (see Evaluation Manual for cost factors to be used)
      - (a) Automobile operating cost and/or bus fares
      - (b) Value of passenger travel time (including time waiting for bus, transfers, etc.)
      - (c) Accident costs

- (d) Parking costs (where applicable), whether or not paid for by user
- (3) In estimating changes in travel costs, emphasis should be given to those routes which are affected by the improvements, either by diversion to/from other routes.

3. Community effects

- a. It is doubtful that the improvements proposed for this project will be significant enough to have corridor-wide impact on land development.
- b. Pollution, noise, etc. can best be measured and evaluated on a localized basis.

## ROADWAY IMPROVEMENTS

### *Objectives*

Roadway improvements are typically "topics-type" improvements aimed at relieving localized congestion. However, the project does include two changes whose operational characteristics are of special demonstration value:

- 1. Improvements to New Cut Road include one section with intersection modifications only and another section with intersection modifications and roadway widening. This provides an opportunity to examine the incremental benefits associated with the roadway widening.
- 2. The "wrong way" bus lanes pose interesting questions concerning their operational efficiency, safety, and public acceptance. Findings of this study should provide useful guidelines for the application of similar techniques elsewhere.

### *Factors Affecting the Outcome of the Demonstration*

- 1. Multiple improvements are being made for several sections of roadway so that separating the effectiveness of individual improvements will not always be possible.
- 2. The validity of the comparison between the widened and unwidened section depends on the uniformity of traffic between the two sections.

3. The bus priority system may cause some diversion or realignment of traffic patterns within the corridor. Inferences concerning the effectiveness of individual improvements should recognize the possible confounding between such factors and the actual improvements.

*Factors Affecting Applicability of Findings to Other Cities*

1. Past experience with "wrong way" bus lanes suggests this type of operation may be conducive to a high accident rate. The Louisville demonstration will be most useful in testing the feasibility of such a system in other cities.
2. Many of the traffic engineering improvements being proposed or planned for implementation in the Louisville corridor have predictable results. It appears that detailed evaluation at individual intersections, etc. will provide little useful information that cannot be obtained otherwise by careful analysis. Surveillance of the total set of improvements, however, is important to demonstrate the effectiveness of the overall combination of such improvements.
3. While measurement of the effectiveness of individual roadway improvements is not a primary item for evaluation, measurement of the travel conditions is very critical for evaluation of the bus system improvements.

*Suggested Items for Evaluation*

1. Overall Corridor Travel Conditions (Discussed under evaluations for *Total Project* and *Bus Improvements*)
2. Traffic Flow Conditions at Critical Locations
  - a. Changes in quality of flow through bottleneck areas. Alternative methods of measuring may include
    - (1) Travel times
    - (2) Frequency and severity of stoppages
    - (3) Input-output studies
    - (4) Acceleration noise

- b. Changes in accident experience at the critical areas, (especially "wrong way" bus lanes)
- c. Changes and vehicular exhaust emissions and noise through the areas where the traffic flow is improved.
- d. Where the effects of such improvements can be translated into time saved, reduced vehicle operating costs, and/or reduced accident rates, the analysis should compare these savings with the cost of the individual improvement(s)

## BUS IMPROVEMENTS

### *Objectives*

To test the ability of improved bus service to better serve travel requirements of the corridor and to attract additional patronage.

### *Factors Affecting the Outcome of the Demonstration*

1. Several of the bus system improvements (i.e., new express routes, park-ride facilities, passenger waiting shelters, etc.) are being tested concurrently so that it is not possible to identify the fraction of increased patronage attributable to each. The total set of bus system improvements must be treated and evaluated as a package.
2. Variations in income level and car ownership rates within the corridor pose a problem in applying uniform measures of effectiveness for the bus improvements. In the southern part, where car ownership is comparatively high, it is expected that transit patronage will be relatively sensitive to changes in quality of service. Increased patronage would come from trips diverted from auto to transit.

In the north end of the corridor, the auto ownership rate is lower and a much higher percentage of the commuters are captive bus riders. Patronage in this area is not likely to be as sensitive to changes in transit service as in other areas where more alternatives are available. Transit users in this area may, however, derive as much benefit from improvements in service as those in other areas of the corridor.

3. Assuming that service is initiated under the early implementation program and later upgraded, multiple "after" analyses will be required. If the period between service improvements is long enough to allow the patronage to stabilize, this method of incrementally improving service would provide an indication of the relationship between quality of service and patronage generated.

*Factors Affecting Applicability of Findings to Other Cities*

1. A policy decision has been made to provide additional bus service with the minimum disruption of existing routes and schedules. This may result in unprofitable duplication of service, which could adversely affect the revenue/cost characteristics of certain bus routes. Interpretation of this portion of the evaluation should recognize that under other circumstances, the revenue/cost characteristics of the service could be improved.
2. Contrasted to other UCDP projects which are aimed mainly at providing transit service for the high-income areas of the corridor, the Louisville project tests improved transit service for areas of low and medium income and car ownership.
3. The provision of similar improved bus service to two different economic groups within the same corridor also provides the opportunity to examine the relationship between income and patronage under a relatively well controlled set of test conditions.
4. Primary users of the service can be classified as a low income, Appalachia white resident population, thus, a rather unique transit market.
5. Private bus companies provide the transit service and they are presently operating at a profit.

*Suggested Items for Evaluation*

Evaluation of the bus service improvements requires a description of the services offered (as perceived by the patron) as well as the measures of effectiveness. Much of this data will also be required for evaluation of other parts of the project.

## Descriptions of Service

1. Comparison of travel times by bus and auto
  - a. To CBD from several selected points within the corridor
  - b. "Before" and "after" project implementation
2. Transit coverage - suggested measures
  - a. Fraction and number of corridor residents within walking distance of bus service
  - b. Fraction and number of corridor residents with convenient access by auto to transit terminal
  - c. Separate data should be provided for different areas of the corridor
3. Schedule reliability
4. Frequency and time required for transfers along principal routes
5. Perceived changes in commutation cost associated with switching from auto to bus (i.e., fare and time cost for bus vs. vehicle operation, parking and time costs for auto)

## Measures of Effectiveness

1. Total patronage and the percentage of the candidate commuters (those who work in the CBD or other major generators and live within the area covered by bus service) who switch from auto to bus

Data required include:

- a. Total corridor travel patterns (Urban Transportation Study may be adequate)
- b. Bus patronage counts (this may require boarding and alighting surveys for the major routes and boarding points)
- c. Bus origin/destination survey (may be obtained in conjunction with an on-board survey)
- d. Commuters who switch from bus to auto should also be identified

2. Since changes in patronage in areas with a high percentage of captive riders may not be an adequate measure of the benefits of the improvements, additional measures of effectiveness, such as an attitude survey, may be necessary.
3. Characteristics of bus patrons. In applying results of this demonstration to other cities and corridors, a profile of the characteristics of the bus riders together with similar information for all residents of the corridor, will indicate more clearly the segment of the total market that improved transit service is likely to attract. On-board or similar direct surveys of bus passengers appear to be the most desirable method of collecting such information. The exact type of information which can be obtained depends very much on local conditions; however, the following items are suggested for inclusion in such a survey where possible:
  - a. Trip purpose
  - b. Origin/Destination
  - c. Mode and travel time to/from bus at each end of trip
  - d. Was this trip regularly made before improve bus service?
  - e. Mode previously used for this trip
  - f. Availability of automobile for this trip
  - g. Age group
  - h. Income class

[These items are not intended to represent a complete survey questionnaire. Additional items may be necessary to evaluate other portions of the demonstration project.]

4. Revenue/cost characteristics associated with the bus service
  - a. This may require monitoring over an extended time period and should be re-examined after any significant changes in service or marketing program. Routes with different characteristics should be monitored individually.

- b. In Louisville, it appears desirable to retain the existing transit route structures and schedules through portions of the area where new service is to be provided. Since the new system may divert traffic from the existing routes, it is important to carefully analyze the impact of the new lines on existing service, in terms of both patronage and cost characteristics.
5. Changes in work/residence location resulting from improved bus service. Although very significant changes of this nature are not likely during a relatively short time period, this should be monitored if feasible.
  - a. Volumes of reverse commuters should indicate whether many central city residents find employment in the suburbs.
  - b. Information relating to employees who might move into the corridor to take advantage of the bus service can be obtained as a part of an on-board survey.

## LOW DENSITY COLLECTION/DISTRIBUTION SYSTEM

### *Objectives*

To test the relative effectiveness and/or commuter preferences for local bus service and park-ride facilities as collection/distribution systems.

### *Factors Affecting the Outcome of the Demonstration and Its Applicability to Other Cities*

1. Although the project includes both park-ride and local bus for collection/distribution, the park-ride system serves the southern portions of the corridor with higher income and car ownership ratios and the local bus serves the low-income area nearer the CBD. Since preferences are expected to vary with auto ownership, this portion of the experiment alone does not provide for a thorough evaluation or comparison between these two types of systems.



2. An attitude survey could be used to provide a subjective evaluation of this preference; however, since the judgements would be made on the basis of hypothetical alternatives, such evaluations may be biased.
3. The effectiveness of the collection/distribution systems is strongly influenced by the quality of service provided by the total transit system and the street system.
4. Benefits of the collection/distribution improvements will be reflected in patronage levels of the total transit system, but the additional patronage attributable to these improvements may not be identifiable.

*Suggested Items for Evaluation*

1. Schedule reliability
  - a. Punctuality of bus arrival at selected points along the route
  - b. Delays at interchanges between line-haul and collection/distribution vehicles
  - c. Breakdowns and accidents
2. Public acceptance
  - a. Knowledge concerning the depth of the public's awareness of the transit services offered may be desirable. This should be conducted for a sample of the corridor population and coordinated with the evaluation of information services.
  - b. Attitude or preference surveys may be used to obtain subjective indications of the type of system preferred.
  - c. Previous work in planning the Louisville project provides a good basis for developing this type of information.
3. Patronage
  - a. Counts of persons boarding the line-haul vehicle at each terminal should be classified to give mode of arrival at the terminal and/or stop.
  - b. Such counts should also be coordinated with on-board survey data so that the on-board data can be cross classified against arrival mode data.

4. Analysis of benefits and costs

a. Bus system

- (1) Revenue and cost records for each route or service area should be maintained.
- (2) Records should be stratified by type of service, time of day (peak vs. off-peak), and route or service area.

b. Parking and terminal facilities

- (1) Detailed costs of construction and operation should be maintained.
- (2) Analysis of revenues depends on pricing policy for parking and/or bus service.

5. Community effects associated with the various collection/distribution systems should be monitored. Where very significant changes are not expected, a subjective evaluation or simply the monitoring of complaints and changes may be adequate. However, the evaluation design should provide the mechanism for such measurements. Effects which should be considered include:

a. For terminals and/or park-ride facilities.

- (1) Commercial activity, land development, etc. in the immediately surrounding area (i.e., retail sales at shopping centers used for park-ride facilities)
- (2) Noise and air pollution
- (3) Traffic flow on nearby streets

b. For bus systems

- (1) Noise
- (2) Accident experience on local streets
- (3) Traffic flow on local streets

## PASSENGER WAITING SHELTERS

### *Objectives*

1. To test the effect of shelters on transit patronage (generated or diverted from other non-sheltered boarding points).
2. To test effectiveness of various shelter designs.

### *Factors Affecting the Outcome of the Demonstration*

1. Shelters are planned mainly for the low-income portion of the corridor. The effectiveness of bus shelters as a means for increasing patronage is influenced by the possibility that all potential patrons may already be riding the bus. While these patrons benefit from the shelter, there may be no additional patronage.
2. With the large number of shelters proposed in this corridor, this project provides an opportunity to investigate preferences for different types of shelter designs (i.e., types of amenities). Such an evaluation; however, requires that the different shelters be located so that the differences are not confounded with the variations in transit service or similar factors.

### *Factors Affecting Applicability of Findings to Other Cities*

Shelter design requirements can be expected to vary considerably between urban areas. Factors affecting these requirements which should be documented include:

- a. Local climatic conditions;
- b. Frequency and reliability of bus service (i.e., typical waiting times);
- c. Crime rate;
- d. Income level.

*Suggested Items for Evaluation*

1. Effects of shelters on patronage
  - a. Change in boardings at each site
  - b. Diversion from non-sheltered stops. Comparison of boarding and alighting (a.m. vs. p.m.) counts for sheltered vs. non-sheltered stops in same area may indicate the extent of diversion.
  - c. Increase in patronage at sheltered stops
2. Subjective evaluation of shelters
  - a. To be obtained from attitude survey
  - b. Population to be sampled
    - (1) Can be included in on-board survey of bus riders - this will expedite data collection and permit cross classification with other data obtained from the survey.
    - (2) Sample may be restricted only to those persons boarding at sheltered stops.
  - c. Cost effectiveness analysis
    - (1) This analysis should report average cost per patron served.
    - (2) Data should be reported separately for shelters with different levels of amenities.

TRANSIT INFORMATION SERVICES

*Objectives*

1. To encourage increased transit patronage through dissemination of information about routes and schedules.
2. To improve convenience to transit patrons.
3. To test the effectiveness of different types of techniques for providing public information.

### *Factors Affecting the Outcome of the Demonstration*

1. Transit information services and bus improvements will be implemented at the same time so that it will not be possible to identify the patronage increase due to this service simply by counting the increase in passengers.
2. In the absence of the public information system, many potential patrons will discover the improvements anyway, but perhaps at a slower rate.
3. Accurate measurement of the increase in patronage attributable to the information services requires comparison to a control area without such a system. Although other UCDP projects may appear to provide such control areas, it is doubtful that they are sufficiently alike in other aspects to serve as the basis for such comparisons.
4. The segment of the market (i.e., work trips vs. shopping trips, etc.) for which the service is intended will influence types of evaluation required.

### *Factors Affecting Application of Findings to Other Cities*

1. The type of information service or marketing program most appropriate for a particular city may vary significantly between cities, depending on such characteristics as the size of the transit system and the commuting patterns of the area.
2. Comparisons between various types of public information systems and marketing programs being tested by different UCDP projects provide a means for assessing the relative effectiveness of each on a nationwide scale.

### *Suggested Items for Evaluation*

1. Degree to which public information system informs potential patrons (may require a sample of the total corridor population).
2. Public attitude toward the information system, including preferences for different media used.

## SIGNAL PREEMPTION

### *Objectives*

This improvement permits testing the following effects:

1. Technical feasibility in terms of improved bus flow, reliability, violations, etc.
2. Impact of signal preemption on flow of other traffic.

### *Factors Affecting the Outcome of the Demonstration and Its Applicability to Other Cities*

Relative values assigned to times costs for bus commuters and for auto commuters depend on the project objectives and may differ between the demonstration city and other cities considering this type of improvement. For purposes of this analysis, the value of time factors given in the Evaluation Manual should be used for both auto and bus commuters.

### *Suggested Items for Evaluation*

1. Improved traffic flow for bus routes
  - a. Comparisons should be made only along the portions of the route utilizing these devices.
  - b. Changes in frequency and duration of delay at intersections may be adequate measures.
  - c. Evaluation may be made by actual measurement, (with and without signal preemption) or by calculation using probability theory and the characteristics of the signals. A combination of these two methods would probably be the most efficient.

2. Effects on other vehicular traffic

- a. Should consider the cross traffic which incurs additional delays.
- b. Critical intersection studies as discussed in the Evaluation Manual provide a means of measuring changes in delay at intersections.
- c. Effects may not be confined only to the preempted intersections but to other downstream locations as well.

3. Analysis of benefits and costs

Measurement of effectiveness of this device suggests balancing the physical costs plus the increased costs to other vehicular traffic against the savings to the bus riders.

4. Reliability of devices

MISCELLANEOUS

In addition to the improvements discussed in the previous sections, the evaluation should also consider certain items that are somewhat incidental to the total project, but which may provide useful information to other cities contemplating the use of similar techniques. A limited subjective evaluation will be adequate in most cases. Such items may include:

- Enforcement problems concerned with controls permitting preferential bus treatment
- Design characteristics of terminals, parking facilities, etc.
- Additional law enforcement requirements

The Louisville UCDP project staff appears to have achieved excellent local cooperation and participation in developing the UCDP project. Documentation of this experience should provide valuable guides for implementation of similar programs in other cities.

# MINNEAPOLIS

## SUMMARY

The Minneapolis UCDP project tests the concept of an express bus on metered freeway as a device for relieving congestion of urban corridor transportation facilities. Major demonstration objectives of this project are:

1. To test the feasibility of freeway metering with preferential bus treatment as a means for providing high-quality line-haul transit service.
2. To test the impact of the system on level of service and travel patterns of private vehicles.
3. To test the effectiveness of a high-quality bus service in diverting commuters from autos to buses.

Overall evaluation of the project must recognize that it is a system of improvements including both line-haul and low density collection-distribution services and facilities. Many characteristics are influenced by the total set of improvements, and cannot be evaluated on an improvement by improvement basis. Certain relationships, however can be examined with respect to individual components of the project.

### *Factors Affecting the Outcome of the Demonstration*

1. Changes in parking fees and bus fares may be confounded with each other or with other components of the program if such changes are not carefully coordinated.
2. Seasonal variations in commuting patterns may require relatively long periods between changes in transit service in order for patronage to stabilize.



3. Sequencing for implementation of improvements will be important to the design of the evaluation. It is assumed that express bus service will be implemented under the UCDP project prior to implementation of the freeway metering system. This will permit a subsequent evaluation of the effects of the freeway metering system on the transit patronage within the corridor. This type of sequencing should provide valuable information on the effectiveness of the freeway metering system as a device for improving transit service and thereby attracting additional patronage.
4. Because of the possibility of other changes in the transportation system which may affect traffic conditions in the CBD, it is doubtful that the impact of the UCDP project on congestion in the CBD can be identified, except by monitoring changes in the volume of traffic entering the CBD from the demonstration corridor. No major changes in the CBD are planned under the UCDP project.
5. Significant changes in the mix, volume, and speed of vehicles using the freeway may affect the noise and air pollution levels. Noise level measurements may be influenced by resurfacing required to repair damage to the pavement surface caused by studded tires.

*Factors Affecting the Applicability of Results to Other Cities*

1. This project focuses directly on the freeway. During the peak traffic periods, several alternate facilities are available and are relatively congestion-free. The operational success of the freeway metering system and the applicability of these findings to other corridors may be dependent on the availability of such facilities.
2. The demonstration corridor is a relatively high income area.
3. Bus routes operating within the corridor presently have a patronage large enough to support good bus transit service.

*Suggested Items for Evaluation*

Evaluation on a corridor-wide basis should consider at least three types of effects:

1. Changes in traffic operations characteristics attributable to the freeway control system.
2. Effectiveness of improved transit service in terms of increased patronage, changes in commuting costs, etc.
3. The aggregate effect of all improvements on congestion levels and travel patterns within the corridor.

In some cases, the same data may be required for evaluating several types of effects.

#### FREEWAY CONTROL SYSTEM

##### *Suggested Items for Evaluation*

1. Overall corridor travel conditions
  - a. Redistribution of traffic between major roadways entering the CBD
  - b. Changes in quality of traffic flow, etc. along major corridor routes (Most of these effects are discussed under total project evaluation.)
2. Traffic flow conditions at critical locations
  - a. Changes in quality of flow through bottleneck areas  
Alternative methods of measuring may include:
    - (1) Travel times
    - (2) Frequency and severity of stoppages
    - (3) Acceleration noise
    - (4) Delay as measured by "input-output" or similar studies
3. Changes in accident experience at the critical areas
4. Changes in vehicular exhaust emissions and noise through the areas where the traffic flow is improved
5. Where the effects of such improvements can be translated into time saved, reduced vehicle operating costs, and reduced accident rates, these benefits can be evaluated in a cost-effectiveness analysis

## BUS SERVICE IMPROVEMENTS

### *Suggested Items for Evaluation*

To adequately evaluate the effectiveness of the bus improvements in attracting patronage, the documentation should include descriptions of both the changes in service (as perceived by the patron) and the measures of effectiveness.

1. Descriptions of changes in bus service
  - a. Travel times by bus from selected points within the corridor before and after initiation of service
  - b. Differential travel time between bus and auto (before and after the improved service) from selected points within the corridor
  - c. Transit coverage
    - number of candidate patrons within walking distance of a bus stop
    - number of candidate patrons with convenient access to a "park-ride" or "kiss-ride" facility
  - d. Schedule reliability
  - e. Frequency and time required for transfers along the principal routes
  - f. Perceived changes in commutation costs associated with switching from auto to bus (i.e., fare and time cost for bus vs. vehicle operation, parking, and time costs for auto)
2. Measures of effectiveness of improved bus service
  - a. Total patronage and the percentage of the candidate commuters (those who work in the CBD or other major generator and live within the area covered by bus service) who switch from auto to bus

Data required include:

  - (1) Total corridor travel patterns (urban transportation study may be adequate)

- (2) Bus patronage counts (this may require boarding and alighting surveys for the major routes and boarding points)
3. Characteristics of bus patrons. In applying these results to other cities and corridors, a profile of the characteristics of the bus riders together with similar information for all residents of the corridor, will indicate more clearly the segment of the total market that improved transit service is likely to attract. On-board or similar direct surveys of bus passengers appear to be the most desirable method of collecting such information. The exact type of information which can be obtained depends very much on local conditions; however, the following items are suggested for inclusion in such a survey where possible:
  - a. Trip purpose
  - b. Origin/Destination
  - c. Mode and travel time to/from bus at each end of trip
  - d. Was this trip regularly made before improved bus service
  - e. Mode previously used for this trip
  - f. Availability of automobile for this trip
  - g. Age group
  - h. Income class

[These items are not intended to represent a complete survey questionnaire. Additional items may be necessary to evaluate other portions of the demonstration project.]
4. Revenue/cost characteristics associated with the bus service
  - a. This may require monitoring over an extended time period and should be re-examined after any significant changes in service or marketing program. Routes, especially those with different characteristics, should be monitored individually.
  - b. This provides a means for assessing the cost-effectiveness of the bus service improvements.
5. Changes in work/residence location resulting from improved bus service. Although significant changes of this nature are not likely during a relatively short time period, this should be monitored if a long term (4 to 5 years) evaluation is possible.

- a. volumes of reverse commuters should indicate whether many central city residents find employment in the suburbs.
- b. Information relating to employees who might move into the corridor to take advantage of the bus service can be obtained as a part of an on-board survey.

TOTAL PROJECT

*Suggested Items for Evaluation*

- 1. Corridor travel and congestion
  - a. Changes in the number of persons and vehicles entering (and leaving) the CBD from routes in the demonstration corridor and from routes in adjacent corridors to/from which corridor traffic might be diverted.
    - (1) To maintain comparability between projects, and to measure changes in peaking characteristics, these volume measurements should be obtained for intervals no greater than 15 minutes.
    - (2) Volume counts should be obtained so as to give the number of persons entering the CBD by mode for each major route.
    - (3) Where possible, the portions of the traffic volume change attributable to normal growth, generated traffic, and diverted traffic should be identified.
  - b. Changes in accident rates associated with the improvements.
  - c. Changes in travel times along major routes serving the corridor.
- 2. Analysis of project costs and commuter benefits (see Evaluation Manual for details)
  - a. Costs of the improvements
  - b. Corridor travel costs
    - (1) Changes in the costs of travel should be identified for the following groups:

- (a) Commuters who use auto before and after the improvement
  - (b) Commuters who use bus before and after the improvement
  - (c) Commuters who switch mode as a result of the improvement
- (2) Cost items to be used in the evaluation should include: (see Evaluation Manual for cost factors to be used)
- (a) Automobile operating costs and/or bus fares
  - (b) Value of passenger travel time (including time waiting for bus, transfers, etc.)
  - (c) Accident costs
  - (d) Parking costs (where applicable), whether or not paid for by user
- (3) In estimating changes in travel costs, emphasis should be given to those routes which are affected by the improvements, by diversion to/from other routes

### 3. Community effects

- a. Enthusiastic public acceptance of the system accompanied by relatively high patronage may lead to increased socio-economic activity within the corridor, particularly in terms of land value and type and extent of development in the presently undeveloped areas of the corridor. If the service is continued over a demonstration period of several years, development of the property in close proximity to the facility and terminals should be carefully monitored. This, together with information on development in similar "control" areas in the region, might provide an indication of the impact of the transportation system.
- b. Some improvements such as park-and-ride facilities may have some localized effect and should be evaluated at that level.

## LOW DENSITY COLLECTION-DISTRIBUTION SYSTEM

### *Objectives*

1. To compare the effectiveness (in terms of usage) of local bus routes, park-ride lots, and suburban terminals as collection-distribution facilities.
2. To test whether the addition of a park-ride facility in an area also served by local bus significantly increases transit patronage.
3. To test the impact of a park-ride facility on the local bus service.

### *Factors Affecting the Outcome of the Demonstration and the Applicability of Results to Other Cities*

1. The ability to measure the incremental patronage associated with addition of a park-ride facility in an area already served by local bus depends on the sequencing of project implementation.
2. Climatic conditions may influence the preference between park-ride and local bus differently in Minneapolis than in other cities with a more moderate climate.
3. The effect of the collection-distribution system on transit patronage depends on the quality of line-haul service and other features of the total system. Under different corridor conditions, the effectiveness of the collection-distribution system may differ.
4. The type of analysis appropriate for evaluating the cost-effectiveness of park-ride facilities will depend on the pricing scheme used.

### *Suggested Items for Evaluation*

1. Schedule reliability.  
Delays at interchanges between line-haul and collection-distribution vehicles.
2. Public acceptance
  - a. Answers to questions concerning the public's awareness of the service may be desirable. This would best be conducted for a sample of the corridor population. This should be coordinated with the evaluation of any marketing survey which may be conducted.

- b. Attitude or preference survey to obtain subjective indication of type system preferred.
- 3. Revenue-cost characteristics
  - a. Revenue-cost records for each route or service area should be maintained.
  - b. Records should be stratified by type of service, time of day (peak vs. off-peak), and route or service area.
  - c. Special attention should be given to monitoring the effects of the park-ride facilities on the local bus operations.
- 4. Patronage
  - a. Counts of persons boarding the line-haul vehicle at each terminal should be classified to give mode of arrival at the terminal.
  - b. User characteristics (should also be coordinated with on-board surveys, where applicable, to reduce data costs and to permit cross-classification of data from the two surveys).
    - (1) Travel patterns of users
      - (a) Previous mode(s) and/or route used for trip
      - (b) Origin/destination
      - (c) Frequency of trip (by mode)
    - (2) User profile in comparison to profile of corridor residents in general
      - (a) To determine which segment of the corridor uses the service
      - (b) Typical data items
        - (i) Income/occupation
        - (ii) Car ownership and availability
- 5. Community effects associated with the various collection-distribution systems should be monitored. Where very significant changes are not expected, a subjective evaluation or simply the monitoring of complaints may be adequate. However, the evaluation design should provide the mechanism for such measurements. Effects which should be considered include:



- a. For terminals and/or park-ride facilities
  - (1) Commercial activity, land development, etc. in the immediately surrounding area.
  - (2) Noise and air pollution
  - (3) Traffic flow on nearby streets
- b. For bus systems
  - (1) Noise
  - (2) Accident experience on local streets
  - (3) Traffic flow on local streets

## MARKETING PROGRAM

### *Objective*

To test the effectiveness of a marketing technique for introducing an improved type of public transit service.

### *Factors Affecting the Outcome of the Demonstration*

1. The marketing program and bus improvements will be implemented at the same time so that it will not be possible to identify the patronage increase due to this service simply by counting the increase in passengers.
2. In the absence of the marketing program, many potential patrons will discover the improvements anyway, but perhaps at a slower rate.
3. Accurate measurement of the increase in patronage attributable to the marketing program requires comparison to a control area without such a system. Although other UCDP projects may appear to provide such control areas, it is doubtful that they are sufficiently alike in other respects to serve as the basis for strong inferences.
4. Detailed plans for application of the marketing program will affect the method to be used in evaluating its effectiveness.

*Factors Affecting Application of Findings to Other Cities*

1. The type of information service or marketing program most appropriate for a particular city may vary significantly between cities, depending on such characteristics as the size of the transit system and the commuting patterns of the area.
2. Comparisons between various types of public information systems and marketing programs being tested by different UCDP projects provide a means for assessing the relative effectiveness of each on a nationwide scale.

*Suggested Items for Evaluation*

Details of the scheme for evaluating the effectiveness of the marketing technique used are best determined on a local basis. However, the following general measures of effectiveness appear appropriate:

1. Degree to which marketing program informs potential patrons (May require a sample of the total candidate population)
2. Extent to which program influences commuters to switch from auto to transit (may require an additional sample from the population of bus riders)
3. Public attitude toward the marketing program

## NEW HAVEN

The Canal Line transit system proposed for New Haven comprises a single improvement on a corridor-wide basis rather than a system of individual improvements. For purposes of evaluation, therefore, the system cannot be readily divided into a series of individual components as is appropriate for other UCDP projects. Rather, the evaluation should concentrate on the impacts of the total system. The effects of the system, however, may be both corridor-wide and localized.

### *Implementation Objectives*

1. To improve accessibility of the CBD to workers by providing more capacity and better transportation service.
2. To improve employment opportunities in suburbs and outlying industrial areas for residents of the central area (relatively low income and low auto ownership).
3. To improve recreational and educational opportunities for New Haven residents, (especially city youths) by providing public transit service to recreational areas and a college located within the corridor.
4. To reduce congestion in the CBD by reducing the number of vehicles required to serve commuters from the demonstration corridor.
5. To reduce rate of air pollution per unit of transportation provided.

### *Relationships to be Demonstrated by Project*

1. Effectiveness of a high-quality public transit system in diverting commuters from automobile to public transit.
2. Effectiveness of the public transit system in reducing the concentration of vehicles in the CBD.

3. Effects of proposed system on environmental quality.
4. Effectiveness of public transit system in improving employment and recreational opportunities.
5. Feasibility of joint use of the same right-of-way by public transit and rail.
6. In addition, the New Haven project tests the economic viability of a new, high-quality public transportation system in serving a corridor with much land development potential.

*Factors Affecting the Outcome of the Demonstration and Its Applicability to Other Cities*

1. Because of the relatively long time period required for implementing and evaluating the system, patronage, travel patterns, levels of congestion, local developments, etc. may be influenced by factors such as regional growth or economic fluctuations. Where possible, trends established on the basis of overall regional activity should be used as bench marks for comparison. It is important, however, that inferences drawn from this project recognize these external influences.
2. Although the opportunity to develop a transit system with the same physical characteristics in other communities may be limited, other systems which differ physically but have similar service characteristics are likely candidates. In documenting the results of this demonstration, the principal emphasis should be given to relating effectiveness to service characteristics rather than to physical characteristics.

*Suggested Items for Evaluation*

1. Effectiveness of system in reducing overall congestion of transportation facilities. (Comparison required between before and after conditions).
  - a. Corridor arterials
    - (1) Travel times along each roadway
    - (2) Delay, acceleration noise, frequency of stoppage, or similar measures for bottlenecks or critical intersections

b. CBD

- (1) Changes in the number of vehicles entering the CBD from this corridor will indicate the relative effect this system may have on vehicular concentration.
- (2) Monitoring traffic entering from all other corridors will be necessary to determine whether such reductions actually reduce congestion in the CBD or simply provide more space for vehicles entering from other corridors.
- (3) Measures such as the time required to park an automobile (before and after project implementation) may provide useful indicators of changes in congestion levels.
  - (a) This time should include travel between the CBD cordon line and the parking garage or lot.
  - (b) To be representative, times should be measured for several potential CBD destinations.

2. Effectiveness of system in diverting commuters from auto to transit

a. Descriptions of the alternative transportation services available are essential to understanding why a particular choice was made and in providing a basis from which these results can be applied to other cities. These descriptions must include the alternatives available before and after project implementation.

- (1) Transit coverage
  - (a) Number of candidate patrons within walking distance of a bus stop
  - (b) Number of candidate patrons with convenient access to a "park-ride" or "kiss-ride" facility
- (2) Travel times - absolute and differential between auto and transit
  - (a) Should be measured for several locations throughout the corridor

- (b) Should be measured for several times during the peak periods
  - (c) Since the system is intended to serve travel in both directions, evaluation of travel conditions should also apply to both directions
- (3) Reliability and frequency of transit service
  - (4) Perceived change in commutation costs associated with switching from auto to transit (i.e., fare and time cost for bus vs. vehicle operation, parking, and time costs for auto)

b. Measures of diversion

- (1) Total patronage and the percentage of the candidate commuters (those who work in the CBD or other major generator locations and live within the area covered by bus service) who switch from auto to bus

Data required include:

- (a) Total corridor travel patterns (Urban Transportation Study may be adequate)
  - (b) Bus patronage counts (This may require boarding and alighting surveys for the major routes and boarding points)
  - (c) Bus origin-destination survey (may be obtained in conjunction with an on-board survey)
- (2) Diversion of patronage from existing bus service to new system
  - (3) Characteristics of bus patrons. In applying these results to other cities and corridors, a profile of the characteristics of the bus riders together with similar information for all residents of the corridor, will indicate more clearly the segment of the total market that improved transit service is likely to attract. On-board or similar direct surveys of bus passengers appear to be the most desirable method of collecting such information. The exact type of information which can be obtained depends very much on local conditions; however, the following items are suggested for inclusion in such a survey where possible:

- (a) Trip purpose
- (b) Origin/Destination.
- (c) Mode and travel time to/from bus at each end of trip
- (d) Was this trip regularly made before improved bus service
- (e) Mode previously used for this trip.
- (f) Availability of automobile for this trip
- (g) Age group
- (h) Income class.

[These items are not intended to represent a complete survey questionnaire. Additional items may be necessary to evaluate other portions of the demonstration project.]

- (4) Analysis of benefits and costs resulting from implementation of the system. This analysis should identify separately the project costs and the savings to commuters.
  - (a) Project costs, including operation of the new service (see Evaluation Manual for details).
  - (b) Corridor travel costs
    - 1. Changes in the costs of travel should be identified for the following groups:
      - a. Commuters who use auto before and after the improvement
      - b. Commuters who use bus before and after the improvement
      - c. Commuters who switch mode as a result of the improvement
    - 2. Cost items to be used in the evaluation should include: (Cost factors to be used are given in the Evaluation Manual)

- a. Automobile operating cost and/or bus fares;
- b. Value of passenger travel time (including time waiting for bus, transfers, etc.);
- c. Accident costs (If changes in travel conditions are significant enough to affect accidents along paralleling roadways);
- d. Parking costs (where applicable), whether or not paid for by user.

(c) A separate analysis should be conducted to determine the effects of the new system on the revenue-cost characteristics of existing transit routes which serve parts of the corridor. This requires consideration of patronage, boarding counts, schedules, mileage, etc.

(5) Community effects

- (a) Changes in work/residence location resulting from improved bus service
  - 1. Volumes of reverse commuters should indicate whether many central city residents find employment in the suburbs.
  - 2. Information relating to employees who might move into the corridor to take advantage of the bus service can be obtained as a part of an on-board survey.
  - 3. Development of new employment opportunities within the corridor and their relationship to the transit system should be monitored.
- (b) Level of usage by central area residents to travel to recreational areas
- (c) Public acceptance of the system

Present conflicts with the Newhallville community indicate potential problems relating to superimposing a new transportation facility through an existing



neighborhood. Documentation of the problems encountered in dealing with this community together with measures found most effective in responding to the questions raised will provide useful guidelines for other cities facing similar problems.

(d) Land development and activity

With the construction of a high-quality transit system through a relatively low density corridor which also includes the beginnings of a small industrial area, it would appear that the system may have significant impact on land use and development within the corridor.

A comprehensive survey of land use in the area of influence of the corridor should be conducted or updated prior to project implementation. Particular emphasis should be given to undeveloped areas with high accessibility to the transit service (i.e., near the transit stations).

Subsequent surveys should be made to determine changes. Further investigation may be required to determine the extent to which the transit system influenced such changes and whether or not these changes are compatible with the project objectives.

(e) Air pollution (vehicle exhaust emissions)

Substantial diversion of commuters from auto to public transit will significantly reduce the air pollution generated per unit of transportation service provided. It is doubtful that this can be meaningfully measured throughout the corridor; however, based on exhaust emissions for a relatively small sample of vehicles in the corridor, it can be calculated. Since one of the project objectives is to minimize air pollution, such an analysis should be included in the project evaluation.

(f) Documentation of problems relating to joint use of facility by buses and trains and development of design standards for busways

# NEW YORK

## SUMMARY

The main experiment of the New York demonstration project includes two categories of improvements: (1) those which increase the efficiency of the road system in moving vehicles; and (2) those which seek to make public transit more attractive so that more motorists will find it the preferred way to commute. The aggregate effects of these improvements must be evaluated on a corridor-wide basis. This project also permits detailed evaluation of the effectiveness of several individual improvements included in the project.

In applying the results of the New York demonstration project, it should be recognized that this area represents an upper limit of demand for all types of transportation services. The configuration of the New York corridor is also unique in both topographic and demographic characteristics.

### *Suggested Items for Evaluation*

The corridor-wide evaluation should include relatively general indicators of:

1. Changes in mode of travel for corridor commuters (including an estimate of the extent to which the UCDP improvements actually influenced this shift and how much this shift is affected by other external factors);
2. Changes in quality of service (i.e., travel times) for transit users throughout the corridor;
3. Analysis of benefits and costs of the total project including:
  - a. Changes in travel costs for commuters (i.e., time cost, vehicle operation, transit fares, parking, etc.)

- b. Other identifiable public and private costs not accounted for by changes in travel costs.

#### EXCLUSIVE BUS LANE - LINCOLN TUNNEL APPROACH

This project has been implemented, and resulting changes in traffic characteristics have been measured.

These traffic data, together with the cost factors suggested in the Evaluation Manual, provide the basis for estimating the travel cost savings attributable to the project. Specific costs which should be included are:

1. Vehicle operating costs (local bus data may be necessary since these vary considerably between cities);
2. Value of commuter travel times;
3. Accident costs.

#### IMPROVEMENTS IN PORT AUTHORITY TERMINAL BUILDING

Detailed proposals have not yet been presented describing the specific intent and demonstration value of this set of improvements. Since many of the types of problems associated with this terminal are unique to the New York area and to this terminal building, it appears that these improvements will be of limited usefulness in providing results that have nationwide applicability.

#### FRINGE PARKING (INCLUDING INCREASED OR RESCHEDULED BUS SERVICE)

##### *Objectives*

1. To intercept transit riders farther from the CBD and encourage use of less congested feeder roadways.
2. To demonstrate the effects of transit frequency, distance from CBD, and other factors on the demand for fringe parking.
3. To demonstrate the effects of this expanded service on the revenue-cost characteristics of the bus companies providing the service.

*Factors Affecting the Outcome of the Demonstration*

1. Neighborhood characteristics, the feeder street system, available highway interchanges, and similar factors may differ significantly between lots and influence the level of usage. This may affect the comparability between lots.
2. The effects of the parking facility, if any, on land development or activity in the surrounding area will be influenced by the degree of permanence attached to the demonstration.
3. Effects of expanded services on the revenue-cost characteristics of the bus companies may be difficult to evaluate because of the large number of bus companies affected.

*Factors Affecting Application of Demonstration Results to Other Cities*

1. Tests are being made in an urban area that is strongly oriented to transit. This bias should be recognized in applying relationships derived here to other areas.
2. If the demand for this type of service exceeds the supply of parking provided, the demonstration does not measure the actual demand, but only measures a lower limit to this demand.

*Suggested Items for Evaluation*

1. Level of usage at each facility by time of day (vehicles parked and transit patrons)
2. Characteristics of users (suggest using a survey in the parking lot)
  - a. Travel patterns of users
    - (1) Previous mode(s) and/or route used for trip
    - (2) Origin-destination
    - (3) Frequency of trip (by mode)
  - b. User profile in comparison to profile of corridor in general
    - (1) To determine which segment of the corridor uses the service

- (2) Typical data items
  - (a) Income-occupation.
  - (b) Car ownership and availability
  - (c) Residential density
3. Effects of this service on vehicular volumes along affected routes
4. Effects on local bus operations in the same area served by fringe parking
5. Analysis of benefits and costs
  - a. Costs of improvements
  - b. Savings to commuters
  - c. Revenue/cost characteristics of transit service
6. Community effects
  - a. Except in areas immediately adjacent to new permanent parking facilities, it is doubtful that the facility will significantly influence land use or development. If undeveloped areas do exist next to the proposed facilities, however, periodic surveillance is desirable to determine whether changes associated with the transportation improvement do occur.
  - b. It is doubtful that the impact of this improvement on vehicle exhaust emissions will be measurable, except to the extent that passenger miles by bus are substituted for passenger miles by auto.
  - c. Changes in noise levels associated with the parking facilities would be difficult to evaluate, however, frequency of complaints or similar measures may provide a basis for evaluation. Such evaluations should also consider the character of the area surrounding the facility.

ROADWAY IMPROVEMENTS (INCLUDING SURVEILLANCE AND CONTROL AND PREFERENTIAL BUS TREATMENT)

*Objectives*

1. To test the effectiveness of a package of improvements in reducing vehicular congestion.

2. To test the effectiveness of preferential bus treatment in improving transit travel times.
3. To thereby reduce person travel time in the corridor.

*Suggested Items for Evaluation*

1. Traffic flow characteristics (to be measured before and after implementation of improvements)
  - a. Corridor-wide (i.e., along the controlled facility and the nearby affected routes)
    - (1) Travel times from various points in the corridor
      - (a) Cross classified by mode
      - (b) Cross classified by time of day
    - (2) Accident rates
  - b. Critical locations
    - (1) Delays at ramps and major intersections (including those affected by diverted traffic)
    - (2) Delays at bottlenecks along expressway and other routes within the area of influence
    - (3) Accident experience at specific locations
2. Measure of improvements in bus service
  - a. Comparison of bus travel times with auto travel times for several points within the corridor.
    - (1) To test the effectiveness of preferential treatment, etc.
    - (2) Fringe parking areas may provide good base points from which such comparisons can be made
  - b. Reduction in travel time for bus commuters over the affected section of the route
3. Analysis of costs and benefits
  - a. Project costs
  - b. Savings in travel costs over the improved sections
    - (1) Commuter travel time

- (2) Vehicle operating costs (i.e., total cost per passenger mile-before and after)
  - (a) Automobile
  - (b) Bus
  - (c) Other
- c. Reduction in accident costs
- 4. Effectiveness in detecting and minimizing delays due to incidents

## COMMUTER INFORMATION SERVICES

### *Objectives*

This portion of the UCDP project provides an opportunity to compare the effectiveness of alternative types of systems for providing information to potential users of the transit system.

### *Factors Affecting the Outcome of the Demonstration and Its Applicability to Other Cities*

- 1. These systems are expected to increase transit patronage; however, such an increase will probably be masked by variations in patronage caused by many other external influences.
- 2. Increases in patronage, even if they could be measured and the fraction associated with this program as opposed to other improvements, would not give a true assessment since there is some value in having knowledge of alternatives available, even though another mode is chosen.
- 3. Usage of the system (such as telephone) does not necessarily provide a good indicator of its value (i.e., if a commuter makes a call and obtains the desired information, he may not call again).
- 4. Measures of effectiveness most appropriate for the evaluation depend on the main objective of the system and the market it serves.
  - a. Marketing of a new system vs. providing another convenience to users of the existing system.

- b. Commuter vs. non-commuter (shopper, pleasure, medical, etc.).
5. Specific solutions to the transit and public information problems in New York may have limited application to other cities.

*Suggested Items for Evaluation*

The following general measures of effectiveness are suggested:

1. Complete description of the program
2. Measure of public perception and reaction to the program
3. Measure of the extent to which commuters use public transit as a result of the program
4. Analysis of benefits and costs

## AUTOMATIC BUS IDENTIFICATION SYSTEM

*Objectives*

1. To test the effectiveness of the ABI for automatic toll collection.
2. To test the effectiveness of the ABI as part of a management information system in improving the operation of the transit service.

*Suggested Items for Evaluation*

The specific design appropriate for the evaluation will depend on the ultimate design of the system, but the following general criteria for evaluation should be considered:

1. Time and cost savings to commuters.
2. Operating costs of the toll facilities
3. Improvements in transit service reliability
4. Changes in transit system operating costs



5. Impact on other vehicular traffic

IMPROVEMENTS TO CROSS TOWN BUS SERVICE

*Objectives*

Rerouting of buses to provide better and more direct service from the Port Authority Bus Terminal to Midtown Destinations.

Detailed evaluation of this improvement may indicate the commuter's relative assessment of the importance of various factors which influence his choice of transportation alternatives. Such factors include:

- inconvenience or dislike for entering subway stations
- importance of time savings (whether actual or perceived)
- awareness of alternatives available and the consequences associated with each
- influence of weather

*Factors Affecting the Outcome of the Demonstration and Its Applicability to Other Cities*

1. This service tests the response of potential bus patrons to the change in service. It is not expected that this will measurably affect the congestion levels in the CBD.

*Suggested Items for Evaluation*

1. Description of service alternatives available before and after implementation of the schedule revisions.

Should consider travel times and significant characteristics associated with the trip from the Port Authority Bus Terminal to several midtown destinations to be served by the new bus service.

2. Changes in patronage of alternatives by midtown commuters.
3. Revenue/cost characteristics of service (including costs associated with advertising).

4. Survey of commuter attitudes to determine preferences for alternative services.

# PHILADELPHIA

## SUMMARY

The wide variety of projects in the Philadelphia UCDP are not concentrated upon one mode of transportation or a single functional system within one of the transportation alternatives. This creates a situation where improvements within one mode may be competing against improvements within and without the same mode. This can be illustrated by reference to the "parking price" program in the CBD and the roadway improvements planned for arterials leading into the CBD. The objective of parking program is to adjust the structure and rates of the parking supply to encourage short time parking and to discourage all day parking. Thus, the parking policy favors increased transit usage and discourages auto trips to the CBD, while at the same time, roadway improvements will make driving an automobile to the CBD more attractive.

Rail improvements concentrate upon improving service and efficiency of existing lines and improving rider conveniences. This will be accomplished by extending service coverage to Elwyn, constructing a double track on portions of the Media Rapid Tramway, and installing a crossover at the Secane station. Improved conveniences for transit riders include various types of shelters, parking facilities for automobiles, and transit identification and information program.

A transit operating plan will be developed to determine basic service levels, operating costs and performance, and an implementation schedule. This plan will be based upon a modal split model, travel demand forecasts and transit demand estimates.

### *Suggested Scheme for Evaluation*

It is expected that the aggregate effects of the total set of improvements proposed for Philadelphia will have significant region-wide impact - if all are implemented. The evaluation plan should, therefore, include a system-wide analysis of these aggregate effects.

More emphasis should be placed, however, on evaluating the effectiveness of the individual improvements. This is conditioned by the fact that the improvements contemplated are largely independent and, at least initially, will have a relatively small effect on the overall transportation system, even though the results of individual improvements may be significant in themselves.

Specific data required for the analysis of total project effectiveness are suggested below. Many of these data items are also required for evaluation of specific improvements as discussed subsequently. The total program should be phased so that the affected characteristics are measured each time a significant improvement or change in the transportation system is made.

### *Suggested Items for Evaluation*

1. Changes in the number of persons and vehicles entering (and leaving) the CBD from routes in the demonstration corridor and adjacent corridors.
  - a. Volume measurements should permit detection of any changes in peaking characteristics (15-minute intervals are suggested).
  - b. Volume counts should be cross classified to give the number of persons entering the CBD by mode for each major route.
  - c. The component of traffic volume changes attributable to other factors such as normal growth, generated traffic, etc. should be identified, where possible.
2. Changes in travel times along major routes in the CBD (including transit and automobile).

3. It is doubtful that the net change in commutation costs resulting from these improvements can be meaningfully measured on a corridor-wide basis.
4. Community effects:
  - a. Significant changes in land use are not anticipated in the corridor or CBD because of the limited amount of time and type of improvements being made.
  - b. Certain improvements, such as park-and-ride facilities will have some localized effects and should be evaluated at that level.
  - c. Changes in noise levels and exhaust levels can be anticipated in some areas and should be measured in evaluating specific improvements.

#### CBD PARKING RATE POLICY

##### *Objectives*

The adjustment of pricing schedules to encourage short-term parking over all-day parking is designed to decrease peak hour traffic congestion by encouraging a shift from the automobile to public transit. This program should test:

1. Feasibility of implementing such a policy
2. Effectiveness in encouraging commuters to switch from auto to public transit
3. Impact of pricing changes on usage, operating costs, and revenues of parking facilities

##### *Factors Affecting the Outcome of the Demonstration*

1. Since CBD parking serves auto traffic from the entire urban area, results of this demonstration may be influenced by changes in other corridors.
2. Implementation of this program along with other improvements which may affect the commuter's choice of mode (roadway improvements and/or transit improvements) may make it impossible to associate observed changes with their actual causes. The importance of this factor will depend on the phasing of implementation for various improvements.

3. Other improvements or conditions may not be compatible with this program (i.e., roadway improvements that facilitate the use of the auto or reduced commuter bridge tolls).
4. Other local characteristics which can be expected to influence the results of the demonstration include:
  - a. Number and proportion of parking spaces involved in the demonstration.
  - b. The proportion and number of parking spaces operated by the public parking authority in relation to the total number of spaces available.
  - c. Stability of employment in the CBD and their working hours.
  - d. Reaction of non-participating parking operators.
  - e. Parking supply and demand within study area.

*Factors Affecting the Applicability of Demonstration Results to Other Cities*

1. Relative dependence upon private automobile and public transit for CBD long term trips
2. The number and proportion of public and private parking spaces
3. Level of parking rates
4. Quality, variety and availability of public transit as an alternative means of transportation
5. Relative size, location and composition of population, work force and employment centers
6. Stability of work hours
7. Climate
8. Problems of personal security

*Suggested Items for Evaluation*

1. Detailed description of the parking pricing program
  - a. Number, location and classification of all parking spaces in the CBD

- b. Parking rates (before and after)
  - c. Classification, occupancy and revenues of parking spaces involved in the demonstration
2. Measures of effectiveness
- a. Changes in travel patterns (if such changes can be associated with the parking pricing program)
    - (1) Changes in mode of travel for CBD commuters
    - (2) Changes in peaking characteristics
  - b. Impact on and response and cooperation of non-participating garages
  - c. Changes in usage, operating costs, and revenues of participating garages
  - d. Acceptance of policy
    - (1) By auto users (may require an attitude survey)
    - (2) By local authorities, businesses, etc.
  - e. Guidelines for applying policy in other areas
  - f. It is doubtful that the benefits in terms of time and cost savings to the users associated with such a program can be meaningfully measured

## ROADWAY AND OPERATIONAL IMPROVEMENTS

### *Objectives*

Roadway and operational improvements are intended to relieve congestion by improving traffic flow through the corridor to the CBD and eliminating bottlenecks along these routes. Improved traffic flow is locally envisioned as a major contribution to improved neighborhood quality and environment in this section of the corridor.

### *Factors Affecting Outcome of the Demonstration*

- 1. Other roadway and operational improvements may influence the results of these experiments,

2. Transit improvements may affect results.
3. Where certain types of improvements are used to improve flow through bottleneck areas, the opportunity may exist to provide evaluations of these types of improvements at critical locations.
4. Variations in travel conditions caused by other factors throughout the corridor may mask the effects of these improvements when considered on a corridor-wide basis.
5. CBD parking policy may influence the number of automobiles using the corridor (i.e., if the parking program and the roadway improvements are implemented at the same time, it will not be possible to determine how each affects the level of congestion within the corridor).

*Factors Affecting Applicability of Demonstration Results to Other Cities*

1. Certain of the techniques being applied to improve traffic flow along the corridor routes are not unique and their results are generally predictable.
2. Other improvements, such as treatment of the elevated railway structure, are unique to this corridor and have limited demonstration value to other cities.
3. The concept of neighborhood quality varies within areas of the city as well as between different cities.
4. Changes in overall vehicular travel conditions in the corridor will provide a measure of effectiveness of the concerted application of roadway improvements.

*Items Required for Evaluation*

1. Overall corridor travel conditions:
  - a. Distribution of traffic within the corridor and entering the CBD before and after any improvements or experiments have taken place.
  - b. Distribution of travel by mode should be determined before and after improvements have been completed.
  - c. Changes in travel time to the CBD from selected points within the corridor.



2. Traffic flow conditions at critical locations:
  - a. Changes in quality of flow through bottleneck areas. Alternate methods of measuring may include:
    - (1) Travel times
    - (2) Frequency and severity of stoppages
    - (3) Delay as measured by the "Input-Output studies
    - (4) Acceleration noise
  - b. Changes in accident experience at the critical areas.
  - c. Changes in vehicular exhaust emissions and noise through the areas where traffic flow is improved.
  - d. Where the effects of such improvements can be translated into time saved, reduced vehicle operating costs, and/or reduced accident rates, the analysis should quantify these benefits.
3. Community effects:
  - a. Delineate areas for detailed analysis.
  - b. Develop rating scale for neighborhood environmental quality suitable for the selected areas.
  - c. Measure noise and exhaust emissions throughout the study area.
  - d. Prepare detailed land use, population and economic data for the area.
  - e. Prepare procedure for monitoring changes in neighborhood quality quantitatively, subjectively and through interview procedures.

## TRANSIT IMPROVEMENTS

### *Objectives*

Functional and track improvements will be used to raise the level of transit service and efficiency on the Penn Central Railroad and the Sharon Hill Line of the Media Rapid Tramway. The cross-over at the Secane Station will provide a savings in the scheduling of an

additional train during peak hours and greater operating flexibility. Double tracking a portion of the Sharon Hill Line will increase capacity and safety and reduce running time and cost.

*Factors Affecting the Outcome of the Demonstration*

1. Roadway experiments may influence acceptance of transit improvements.
2. Other transit improvements and experiments may mask the benefits of certain service improvements made under the UCDP project.
3. Major labor problems or changes in management and policy of the Penn Central could influence the findings of the demonstration project.

*Factors Affecting Applicability of Demonstration Results to Other Cities*

1. The strong dependence on and historic acceptance of public transit is common to only a few cities.
2. A similar variety of transit modes will not often be found in other cities.
3. The results of certain of the proposed improvements (on an improvement by improvement basis) can be anticipated without the expense and effort required for a demonstration.
4. Terrain and water barriers present topographical problems.
5. Unique situation where peak demand on one line occurs at the suburban end rather than the CBD end.

*Items Required for Evaluation*

To adequately evaluate the effectiveness of the rail and tramway improvements in attracting riders, the documentation should include descriptions of both the changes in service and the measures of effectiveness.

1. Descriptions of changes in transit service:
  - a. Travel times
  - b. Differential travel times between modes
  - c. Transit coverage
  - d. Schedule reliability
  - e. Perceived change in commutation cost associated with the improvements
2. Measures of effectiveness:
  - a. Total corridor travel patterns
  - b. Transit patronage by various modes
  - c. Origin/Destination survey
3. Characteristics of transit patrons:

In applying these results to other cities and corridors, a profile of the characteristics of the transit riders, together with similar information for all residents of the area for which service is improved will indicate more clearly the segment of the total market that improved transit service is likely to attract. On-board or similar direct surveys of transit passengers appear to be the most desirable method of collecting such information. The exact type of information which can be obtained depends very much on local conditions; however, the following items are suggested for inclusion in such a survey where possible:

- a. Trip purpose
- b. Origin/Destination
- c. Mode and travel time to/from transit mode at each end of trip
- d. Was this trip regularly made before improved transit service
- e. Mode previously used for this trip
- f. Availability of automobile for this trip
- g. Age group
- h. Income class

[These items are not intended to represent a complete survey questionnaire. Additional items may be necessary to evaluate other portions of the demonstration project. The applicability of this type of data to Philadelphia will depend in part on the extent to which the transit improvements are successful in attracting new patrons.]

3. Revenue/cost characteristics associated with the transit service:

This may require monitoring over an extended time period and should be re-examined after any significant changes in service or marketing program. Routes with different characteristics should be monitored individually.

## 60TH STREET STATION

### *Objectives*

Improvements to the elevated 60th Street Station are designed to test what effects a major renovation would have on ridership at a dilapidated station in a deteriorating, slum neighborhood that has a high potential for transfers from other areas, but suffers from continuing low performance.

### *Factors Affecting the Outcome of the Demonstration*

1. Fear for personal safety of the potential transit rider
2. Vandalism and poor maintenance
3. Environmental conditions
4. High costs of construction

### *Factors Affecting Applicability of Demonstration Results to Other Cities*

1. Peculiar site and location characteristics
  - a. Elevated structure
  - b. Multimodal nature of stations (rail, bus, major street)
  - c. Environmental conditions

2. Cost of construction
3. Past neglect and current conditions
4. Combination of multimodal improvements under construction

*Items Required for Evaluation*

1. Detailed description of design, materials and construction
2. Reasoning behind final design
3. Cost and maintenance data
4. Rider attitudes and changes in patronage
5. Neighborhood compatibility and attitude toward station
6. Origin and destination of station users
7. Changes in loading counts and relation to other lines and transfers of passengers
8. Recommended guidelines for station renovation

STATION STOP SHELTERS

*Objectives*

Shelters for persons using various types of transit are popular with the public and by increasing their number and by rehabilitating older stations, they seek to raise the image of transit and attract additional ridership. This is applicable to bus and rail transit riders alike.

*Factors Affecting the Outcome of the Demonstration*

1. The impact of transit shelter improvements on patronage may be masked by variations due to trends in patronage and other transportation improvements or changes in the corridor. Evaluation may require monitoring a set of unimproved "control shelters."

2. The extent to which the shelters serve captive vs. non-captive riders may affect their ability to attract additional patronage.
3. Plans for testing bus passenger shelters are not sufficiently detailed at this time to suggest the types of effects which will be demonstrated or the criteria for evaluation.
4. It is doubtful that the benefits from the program can be quantified, although they may be evaluated subjectively through a user attitude survey.

*Factors Affecting the Applicability of Demonstration Results to Other Cities:*

1. Differences in climate between cities require different levels of amenities and protection.
2. Crime rate and vandalism impose different requirements on design and construction.
3. Value judgements of the public may differ between cities regarding compatibility, function and utility.
4. Shelters of the type contemplated for renovation along the tramway are not common to other corridors. Evaluation of their design characteristics, etc. may have little applicability to other cities, although their effectiveness in improving the image of public transit may have a significant and measurable effect.

*Items Required for Evaluation*

1. Description of improvements
  - a. Detailed description, drawings, and photographs of the completed shelters and the strategy or criteria that determined the final product
  - b. Cost and maintenance data
  - c. Functional characteristics
2. Measures of effectiveness
  - a. Usage
    - (1) Changes in volumes using improved shelters (including comparisons with unimproved control shelters)

- (2) Characteristics of users
- b. Public acceptance
  - (1) Compatibility with neighborhood environmental and resident attitudes
  - (2) Rider attitudes
3. Recommendations for shelter improvements

## TERMINALS AND PARKING FACILITIES

### *Objectives*

1. To test the effectiveness of public transportation terminals in encouraging commuters to switch from auto to public transportation.
2. To test the improvement of outlying stations as a means for relieving congestion of other terminals facilities.

### *Factors Affecting the Outcome of the Demonstration*

1. For the commuter rail service, the frequency of service may be increased along with the construction or improvement of the terminal and parking facilities. Separation of the effects of these improvements, therefore, may not be possible.
2. Plans for the 69th Street terminal are not sufficiently defined at this time to indicate its value as a demonstration project.
3. Present trends in transit patronage may mask changes attributable to the terminal improvements.
4. Roadway improvements within the corridor may affect the ability of terminal improvements to generate additional patronage.

### *Factors Affecting the Applicability of Demonstration Results to Other Cities*

1. Peculiar location and site characteristics

2. Historic trends, diversity and magnitude of the Philadelphia transit system
3. Population and land use characteristics of the service area may differ
4. Relatively high level of demand already exists

*Suggested Items for Evaluation*

1. Detailed description of improvements (including project costs)
2. Changes in patronage at each location
  - a. Commuters who switched mode
  - b. Commuters who diverted from other terminals
3. Characteristics of users
4. Attitudes of riders toward station
5. Changes in level of congestion at other terminals
6. Changes in traffic flow of all modes of transportation in the area
7. Changes in land use, population, and development of the surrounding neighborhood
8. Cost analysis
  - a. It is doubtful that the benefits from the terminal and parking improvements can be meaningfully measured
  - b. The analysis should consider the revenue/cost characteristics (where applicable)
9. Recommendations for design and implementation of similar improvements in other corridors



## COMMUTER INFORMATION SYSTEMS AND MARKETING PROGRAM

### *Objectives*

An improved public image, recognition, and acceptance of public transit by corridor residents will be facilitated by the design and installation of directional signs and graphics along trail blazer routes and throughout the transit stations and shelters. Corridor maps and timetables will be prepared and provided in appropriate locations and coordinated with SEPTA's existing travel information system and telephone service.

The marketing plan will be designed to inform the public of transit improvements and advantages in order to increase transit patronage.

### *Factors Affecting the Outcome of the Demonstration and Applicability of Results to Other Cities*

1. These programs are intended to improve the total quality of service to the transit commuter and to stimulate patronage. However, increases in patronage attributable to these programs may be masked by variations in patronage caused by other factors such as transit system improvements.
2. Measures of effectiveness most appropriate for the evaluation depend on the main objectives of the program and the market served.
  - a. Marketing of a new system vs. improving convenience to users of existing system
  - b. Work trip vs. non-work trip
3. In the absence of a marketing program for new or improved service, many potential patrons will discover the improvements eventually, but possibly at a slower rate.
4. The type of information service or marketing technique most appropriate for a particular city may vary significantly between cities, depending on such characteristics as the relative scale of the transit system and the commuting patterns of the area.

### *Suggested Items for Evaluation*

Detailed schemes for evaluating the marketing technique or information system depend on specific characteristics and objectives of these programs. In general, the evaluation should include the following:

1. Complete description of the program
2. Measure of public perception and reaction to program
3. Measure of the extent to which commuters switched mode as a result of the program (may require a follow-up attitude survey)
4. Analysis of costs
  - a. Costs of program implementation
  - b. It is doubtful that the benefits of the program can be meaningfully quantified, although a subjective evaluation may be appropriate

## WASHINGTON, D. C.

### SUMMARY

The Washington, D. C. Urban Corridor Demonstration Project is designed to relieve congestion and improve travel conditions in the South Capitol Street-Indian Head Highway Corridor. This corridor extends from southern Prince George's County, Maryland to downtown Washington D. C. in a north-south direction. Major constraints to improved travel conditions are the Anacostia River near the CBD terminus and the limited number of crossings in that area.

Demonstration objectives are to improve the peak period travel conditions in the corridor in the following manner:

1. By increasing bus ridership through the provision of improved bus service and frequency, express buses and preferential treatment for line-haul buses, parking, and terminal facilities; and improved collection and distribution services
2. By improving and/or maintaining existing service levels for vehicular flow
3. By encouraging an increase in car pooling through the provision of parking facilities in suburban areas

Traffic operations and roadway improvements will be critical factors in providing for better transit service. These improvements are designed to provide for "free flow" bus operations during the rush hour periods along the predominantly line-haul segment of the corridor. CBD distribution will be aided by a preemptive signal system that recognizes bus "platoons" and other preferential bus treatment measures. Other operational improvements such as alternate routes for reverse commuters and roadway improvements on the collection and distribution ends will be provided.

Implementation in the early stages will concentrate upon fringe parking lots, increased bus service, employment demand surveys and public information programs. Roadway and operational changes will follow as engineering studies are completed and funds are available. This will provide an opportunity for measuring individual system changes.

External factors which may affect the inferences which can be drawn from this demonstration include:

1. Major reconstruction of roadway facilities (i.e., Shirley Highway) which may cause significant diversion of out-of-corridor traffic through the South Capitol Street Corridor
2. Subway construction in the CBD
3. Possible changes in parking policies or prices
4. Large vehicular demands from other corridors are likely to mask any improvements of congestion in the CBD attributable to the demonstration project

*Suggested Scheme for Evaluation*

Evaluation of the UCDP project should focus on measuring the effectiveness of the individual techniques or improvements being tested for relieving congestion or improving travel conditions. However, the overall effectiveness of the combined set of improvements should also be measured.

Specific data required for the analysis of total project effectiveness are suggested below. Many of these data items (in the same or greater level of detail) are also required for evaluation of specific improvements as discussed subsequently.

TOTAL PROJECT

*Suggested Items for Evaluation*

1. Cost of the improvements (see draft of Evaluation Manual for details).
2. Corridor travel and congestion:

- a. Changes in the number of persons and vehicles entering (and leaving) the CBD from routes in the demonstration corridor and from routes in adjacent corridors to/from which corridor traffic might be diverted.
    - (1) To maintain comparability between projects, and to measure changes in peaking characteristics, these volume measurements should be obtained for intervals no greater than 15 minutes.
    - (2) Volume counts should be cross classified to give the number of persons entering the CBD by mode for each major route.
    - (3) Where possible, the portions of the traffic volume change attributable to normal growth, generated traffic, and diverted traffic should be identified.
  - b. Changes in accident rates associated with the improvement.
  - c. Changes in travel times along major routes serving the corridor.
3. Corridor travel costs:
- a. Changes in the costs of travel should be identified for the following groups:
    - (1) Commuters who use auto before and after the improvement.
    - (2) Commuters who use bus before and after the improvement.
    - (3) Commuters who switch mode as a result of the improvement, including car pooling.
  - b. Cost items to be used in the evaluation should include:
    - (1) Vehicle operating cost and/or bus fares.
    - (2) Value of passenger travel time (including time waiting for bus, transfers, etc.).
    - (3) Accident costs.
    - (4) Parking costs (where applicable).

- c. In estimating changes in travel costs, emphasis should be given to those routes which are affected by the improvements, either by physical changes or by diversion to/from other routes.

4. Community effects:

- a. It is doubtful that the transportation improvements within the corridor will have significant corridor-wide impact on land use or other socio-economic characteristics because of the limited time period of the program and nature of the improvements.
- b. Individual improvements are likely to have some localized impact, but these effects should be considered during the evaluation of the individual improvement.

## IMPROVED BUS SERVICE

### *Objectives*

Bus service improvements are intended to increase transit patronage and to relieve traffic congestion through the following measures:

1. Increased bus services in the Anacostia area of the corridor.
2. Adding and expanding express services to new and existing public parking lots; express service will also be expanded to a new transfer terminal.
3. Using parking lots of existing commercial shopping areas for fringe parking.
4. Public information program.
5. Determination of demand for reverse commuting to improve bus routings. The demonstration is aimed at testing the effectiveness of this improved service in increasing transit patronage and in relieving vehicular congestion within the corridor.

### *Factors Affecting the Outcome of the Demonstration*

1. Changes in patronage patterns will be due to the combined set of improvements. It is doubtful that the effectiveness of individual elements can be separated in terms of increase in patronage.
2. Disruption of traffic during the construction of the proposed subway and highways in other corridors may cause diversion of traffic into the study corridor and may also provide additional incentive to use bus service.
3. Improvements in travel times are dependent upon one-way bridge operations and special signal systems. These will not be implemented initially.
4. Incremental changes in transit service may provide a limited amount of information regarding the relationship between quality of transit service and the patronage generated.

### *Factors Affecting Applicability of Demonstration Results to Other Cities*

1. Constraints imposed by limited crossings of the river and other topographical considerations.
2. Diversion of traffic to the subject corridor from other corridors due to subway and highway construction in these other corridors might cause inflation of patronage and thereby result in over estimates in regard to application in other cities.
3. Population characteristics, income levels and racial composition change dramatically at the boundaries of Washington, D. C. rather than having a more routine transition.
4. Rapid growth of the corridor may mask many valid improvement results.
5. Corridor presently has high transit patronage.
6. Large areas of undeveloped land are owned by the federal government and their future use cannot be controlled or accurately anticipated by local governing bodies.

### *Suggested Items for Evaluation*

To adequately evaluate the effectiveness of the bus improvements in attracting patronage, the documentation should include

descriptions of both the changes in service and the measures of effectiveness.

1. Descriptions of changes in bus service:
  - a. Travel times by bus from selected points within the corridor to selected points in the CBD.
  - b. Differential travel time between bus and auto (before and after the improved service) from selected points within the corridor, including transit stations and collection routes.
  - c. Transit coverage:
    - (1) Number of potential patrons within walking distance of a bus stop.
    - (2) Number of potential patrons with convenient access to park-and-ride or kiss-and-ride facilities.
  - d. Schedule reliability.
  - e. Frequency and time required for transfers along principal routes.
  - f. Perceived commutation cost associated with switching from auto to bus (i.e., fare and time cost for bus vs. vehicle operation, parking, and time costs for auto).
2. Measures of effectiveness of improved bus service:
  - a. Total patronage and the percentage of the candidate commuters (those who work in the CBD or other major generator and live within the area covered by bus service) who switch to bus. Data required would include:
    - (1) Total corridor travel patterns (Urban Transportation Study data may be adequate).
    - (2) Bus patronage counts (this may require boarding and alighting surveys for major routes and boarding points).
    - (3) Bus origin/destination survey (may be obtained in conjunction with on-board survey).



b. Characteristics of bus patrons. In applying these results to other cities and corridors, a profile of the characteristics of the bus riders together with similar information for all residents of the corridor, all indicate more clearly the segment of the total market that improved transit service is likely to attract. On-board or similar direct surveys of bus passengers appear to be the most desirable method of collecting such information. The exact type of information which can be obtained depends very much on local conditions; however, the following items are suggested for inclusion in such a survey where possible:

- (1) Trip purpose
- (2) Origin/Destination
- (3) Mode and travel time to/from bus at each end of trip
- (4) Was this trip regularly made before improved bus service
- (5) Mode previously used for this trip
- (6) Availability of automobile for this trip
- (7) Age group
- (8) Income class

[ These items are not intended to represent a complete survey questionnaire. Additional items may be necessary to evaluate other portions of the demonstration project.]

c. Revenue/cost characteristics associated with the bus service:

- (1) This may require monitoring over an extended time period and should be re-examined after any significant changes in service or marketing program. Routes with different characteristics should be monitored individually.
- (2) This provides a means for assessing the cost-effectiveness of the bus service improvements.

d. Changes in work-residence location resulting from improved bus service. Although very significant changes of this nature are not likely during a relatively short time period, this should be monitored if feasible.

- (1) Volumes of reverse commuters should indicate whether many central city residents find employment in the suburbs.
  - (2) Information relating to employees who might move into the corridor to take advantage of the bus service can be obtained as a part of an on-board survey.
3. This UCDP project is particularly suited to conducting individual experiments within the overall framework of the program without jeopardizing the integrity of either. Implementation requires staging because of funding and design requirements; therefore, these experiments appear feasible in light of present planning:
- a. Increased local service on existing routes
  - b. Express service to and from existing and new parking lots
  - c. Measurement of car pooling tendencies at existing and proposed lots
  - d. Changes in travel times and service resulting from operations and signal improvements on the one-way bridge projects
  - e. Changes in travel times and service resulting from preferential treatment of buses on downtown streets through signal and operational improvements
  - f. Use of taxis and "jitney services" as collection and distribution systems in Washington
  - g. Measurement of diversion from Virginia corridor due to highway construction
  - h. Integration of temporary parking lot design and use into long-range plan for subway station
  - i. Changes in accident patterns and rates
  - j. Evaluation of public information program
  - k. Evaluation of transit demand estimates obtained from employment study

## ROADWAY IMPROVEMENTS

### *Objectives*

Roadway and signalization improvements are intended to relieve congestion by giving preferential treatment to buses and utilization of one-way traffic over the South Capital Street bridge during the peak rush hours. These improvements are essential to providing improved bus service and travel times to downtown employment centers.

### *Factors Affecting Outcome of the Demonstration*

1. Many of these improvements may have to be applied concurrently and it may not always be possible to identify the effects of each type of improvement on overall travel conditions within the corridor.
2. Where certain types of improvements are used to improve flow through bottleneck areas, the opportunity may exist to provide evaluations of these types of improvements at critical locations.
3. Subway construction in the CBD and in adjacent corridors may disrupt traffic flow to such an extent that measured results in such areas are not representative of actual accomplishments.
4. Traffic growth may appear to nullify some of the benefits gained from these improvements.

### *Factors Affecting Applicability of Demonstration Results to Other Cities*

1. The particular set of improvements being applied, together with the characteristics of the transportation facilities and the topographic constraints which restrict the types of improvements which can be made, are not common in other cities.
2. Changes in overall vehicular travel conditions in the corridor will provide a measure of effectiveness of the concerted application of roadway improvements.

*Suggested Items for Evaluation*

1. Overall Corridor Travel Conditions
  - a. Diversion of traffic into the corridor from other areas
  - b. Most of these effects will be evaluated by the total project evaluation discussed in the preceding sections
2. Traffic Flow Conditions at Critical Locations
  - a. Changes in quality of flow through bottleneck areas. Alternative methods of measuring may include
    - (1) Travel times
    - (2) Frequency and severity of stoppages
    - (3) Delay as measured by the "input-output" or similar technique
    - (4) Acceleration noise
  - b. Changes in accident experience at the critical areas
  - c. Changes in vehicular exhaust emissions and noise through the areas where the traffic flow is improved
  - d. Where the effects of such improvements can be translated into time saved, reduced vehicle operating costs, and/or reduced accident rates, these benefits should be estimated
3. Evaluation of Preferential Bus Treatment Measures
  - a. Travel times of buses vs. automobiles
  - b. Functional and geometric problems
  - c. Experience of using "bus platoons "
  - d. Rider and non-rider attitudes toward giving buses preferential treatment
  - e. Changes in accidents
  - f. Enforcement problems of exclusive bus lanes, etc.

## FRINGE PARKING LOTS AND PASSENGER SHELTERS

### *Objective*

The provision of expanded and new fringe parking lots is intended to reduce traffic congestion through a reduction in the number of automobiles used by intercepting them outside of the CBD and encouraging increased bus patronage and car pooling. These lots will be served by express buses and provided with bus shelters and light to improve the convenience and comfort of the bus riders.

### *Factors Affecting the Outcome of the Demonstration and Its Applicability to Other Cities*

1. Diverted traffic may be difficult to count.
2. Extent of car pooling may not be measurable on a "before" and "after" basis.
3. The effectiveness of these facilities will also be influenced by other types of collection-distribution systems (demand responsive bus, taxi, etc.) contemplated for this corridor if they are implemented.
4. Dependency upon bus transit is very strong in Anacostia area.

### *Suggested Items for Evaluation*

1. Description of improvements
2. User attitudes and preferences
3. Patronage (much of this data can be obtained in conjunction with surveys of transit riders)
  - a. Counts of passengers and vehicles
  - b. Characteristics of users
  - c. Origins/Destinations of persons using lot
  - d. Area from which each lot draws its users

4. Extent to which car pools use lots
5. Analysis of costs
  - a. Detailed records of construction and operation should be maintained
  - b. Analysis of revenues depends on pricing policy for parking and/or bus service
6. Community effects
  - a. Changes in commercial activity, land development, etc. in the immediately surrounding area (where applicable)
  - b. Noise and air pollution attributable to the facility.
  - c. Traffic flow on nearby streets