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VII

INTEGRATION OF TRANSIT SYSTEMS

SUMMARY

October 1973

U.S. DEPARTMENT OF TRANSPORTATION
URBAN MASS TRANSPORTATION ADMINISTRATION
Office of Research and Development
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16. Abstract The objective of this report is to assess the potential for interagency and intermodal integration of transit systems in U.S. urban areas, drawing on an analysis of the successful experience of European systems. Vol. 1 documents the need for transit integration in U.S. urban areas, presents the conceptual and evaluative framework, and reviews current transit integration efforts by Federal, state, and local governments. Vol. 2 describes in detail four major European transit systems (London, Hamburg, Paris, and Munich); gives brief descriptions of six others (Newcastle upon Tyne, Edinburgh, Stockholm, Gothenburg, Copenhagen, and Oslo); and summarizes and appraises the applicability to U.S. transit systems of techniques which have contributed to the success of these European systems. Vol. 3 deals with the application of these techniques to three major U.S. cities (Philadelphia, San Francisco, and Seattle) and to an archetypal smaller urban area, "Middletown." The report is summarized in the fourth volume. Appendices include contacts in U.S. cities, UMTA study grants, and questionnaire forms. Approximately 150 references are listed at the ends of individual sections.

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DISCLAIMER

The contents of the report reflect the views of INTERPLAN Corporation, which is responsible for the facts and the accuracy of the data presented herein. The contents do not necessarily reflect the official views or any policy of the Department of Transportation, nor do they constitute a standard, specification, or regulation.

NOTE: As originally conceived, this study was a program design study conducted for the Office of Research, Development and Demonstration of the Urban Mass Transportation Administration during the period between September 1972 and June 1973. Its intent was to provide UMTA with a three-year plan for a coordinated research, development and demonstration program in transit systems integration. Before the study was completed, however, UMTA program reorientation affected the original intended purpose of the study as a basis for demonstration program planning.

This report, therefore, should not be viewed as describing the beginning of a Government program. Rather, it represents the first broad overview and directed research on transit integration undertaken in the U.S. It is intended that discussion of the concepts advanced will contribute to the search for better ways of solving the problems of urban mass transportation.

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Prepared by
Interplan Corporation
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EXECUTIVE SUMMARY

TRANSIT INTEGRATION

The essence of transit integration is that all transit modes of urban transportation complement each other and work as one unified system. The function of each transit mode—bus, rapid transit, commuter rail, ferry—is well defined, and the most efficient mode is used for each type of travel. Routes fit together into a single interconnected network so that one ticket carries a rider from origin to destination no matter how many transfers he must make. Schedules are coordinated so that a passenger may board a bus within a few minutes of stepping off a commuter or rapid transit train. Intermodal terminals, platforms, and curbside stops assure the passenger of quick and easy transfers. The routes and schedules of all modes are well publicized, and handy printed information is made easily available to all residents and visitors.

Transit integration is one part of the broader goal of comprehensive intermodal integration, which encompasses all urban transportation modes. In a fully integrated system, taxis and other para-transit modes offer service which complements transit. Pedestrian movement and access to transit vehicles are facilitated through the provision of separate rights of way. The movement of trucks and other urban goods vehicles does not unduly interfere with passenger mobility.

Efforts to integrate transit systems can be directed toward three different elements: the organizational structure under which the operators function, the services provided, and the facilities and equipment used. The terms "institutional", "operational" and "physical" are used to distinguish these three elements of transit integration.

The integration of urban public transit operations is more advanced in European metropolitan areas than in major American cities, where, for a variety of reasons, a multitude of independent operators is more the rule than the exception. Integrated European transit systems are generally held to provide better service and draw more ridership than American systems. For this reason, American transit systems can gain valuable insight and learn new techniques from a study of transit integration in European cities.

INTERPLAN's analysis of European experience and of the U.S. transit industry points to the conclusion that transit systems' operational and equipment standards must be high enough to form a firm basis for further improvements in order for integration efforts to bear fruit, and that before operational or physical integration can be effective, there should be an adequate institutional arrangement among the several operators.

PURPOSE AND SCOPE OF THE REPORT

The three-fold purpose of this report is to:

1. Identify the need for transit integration in major U.S. metropolitan areas;
2. Identify European solutions to transit integration problems;
3. Analyze the applicability of European approaches to U.S. public transit systems and suggest specific applications.

Each of these topics is the subject for one of the three study volumes. The following are the major findings of the study.

BASE FOR ACTION

After a review of European and American transit systems, INTERPLAN is convinced that unless there is a satisfactory financial, physical, organizational and managerial base in transit systems which are candidates for integration, there is not much reason for attempting integration. That is, it does not make much sense to attempt to "integrate" transit operations in areas where all elements and/or components of the present operation are in distinctly poor health. On the other hand, transit integration can and should be treated as a plan for uniting into a coherent program a wide variety of actions aimed at drastically improving urban transportation.

ACTION LOCATIONS

In the course of this study INTERPLAN evaluated the "readiness to integrate" of transit systems in the principal American metropolitan areas. A city was given one point for each of the following factors: local willingness or ability to act; transit system's financial health; advanced transit technology; good transit management; good transit organization; transit integration activity already initiated; and existence of a meaningful integration problem.

Eleven cities qualified as ready to integrate on at least two counts. The scores were as follows:

San Francisco	6
Philadelphia, Seattle	5
Baltimore, New Orleans	4
Cleveland, Miami, Tampa, Honolulu	3
Atlanta, Washington, D.C.	2

On the basis of the above evaluation and an in-depth survey of the 30 largest U.S. urban areas, INTERPLAN recommended three areas—San Francisco, Philadelphia and Seattle—for consideration by UMTA as prime candidates for demonstrations of transit integration. Plans for such demonstrations are presented in the body of the report and summarized in Section 4 of this volume. INTERPLAN recognizes that the eight other areas listed above and many other metropolitan areas also have a great need and potential for transit integration and for integration of transit with private and para-transit (taxi) modes. In these areas transit performance must, however, be improved before integration of transit systems can be truly beneficial. The following is a list of nine such areas:

SMSA By Size	Potential and Interest in Integration
1. New York (Tri-State Region)	Greatest potential of any U.S. city. Local response cautious but interested.
*2. Chicago	Second greatest potential after New York. Local response positive.
3. Los Angeles metropolitan area	Very great potential, especially in the integration of transit, para-transit, and private modes. Strong local interest.
4. Detroit	Potential likely to be great. Local studies underway.
5. Boston	Great potential. Low level of local interest.
6. Minneapolis-St. Paul	Good potential. Local study underway.
*7. San Diego	Very great potential, especially in the integration of transit, para-transit, and private modes. Local response positive.
*8. Buffalo	Good long-range potential. Strong local interest.
9. Denver	Good integration potential. Local study underway.

*Good location for eventual integration demonstration.

ACTION PRIORITIES

INTERPLAN evaluated the American transit industry's decline by identifying 62 specific deficiencies which are now widespread and their most immediate causes. The summary of this analysis is shown in Table 1. Lack of management action appears as the most frequent cause for the transit deficiencies cited; it is cited 37 times in the tabulation. Failure of manufacturers and operators to take advantage of available technology, also a management-related deficiency, appears in 20 problem areas, particularly those involved with the comfort and safety of vehicles. Inadequate financing appears as a cause of 22 transit deficiencies. In only 16 cases is lack of integration and coordination a contributing cause.

Therefore, integration per se will not relieve the deficiencies listed in Table 1. However, once a U.S. city's public transit system is ready for integration, certain European approaches to integrated transit may become applicable. Thus, of the major factors affecting the quality of urban public transit, poor integration and coordination is less a cause of U.S. transit deficiencies than poor transportation policy, poor operations, inadequate finance, and poor application of technology. INTERPLAN concluded that integration by itself may be less effective than other measures to improve transit, and moreover that without other improvements, integration may fail to produce the desired results.

This does not mean that individual integration measures should not be attempted until all or most of the transit system's deficiencies have been eliminated. It does mean that in order for a transit integration program to be meaningful, current operations and equipment standards of individual systems should be high enough that a basis exists for further improvements through their coordination.

LESSONS FROM EUROPE

INTERPLAN also studied transit systems in ten European cities, and evaluated them using the matrix of deficiencies and causes presented above. The results of our evaluation for one such system, London Transport, is shown in Table 2. The Hamburg and Paris systems are not significantly different from London in the number of deficiencies, but Munich's system scores the highest, with only two deficiency dots.

Table 1. Deficiencies of U.S. transit systems and their major causes.

DEFICIENCIES \ MAJOR CAUSES	Transportation Policy	Local Political Factors	Financial Factors	Technology	Management	Labor	Integration and Coordination
ACCESSIBILITY							
Inadequate distribution of routes	●		●				●
Excessive headways			●		●	●	
Insufficient evening and weekend service	●		●			●	
Insufficient passenger capacity	●		●		●		
No schedules available					●		●
Route maps not displayed					●		●
No information service					●		●
Vehicles inadequately marked					●		
Stops inadequately marked			●		●		
No image					●		
Exact fare required	●				●		
EFFICIENCY							
Poor match of mode or vehicle to function	●		●		●		
Low vehicle acceleration	●		●	●			
Traffic congestion delays	●						
Excessive delays for loading and unloading				●	●		
Too frequent stops					●		
Uncoordinated routes and schedules					●		●
Uncoordinated transfer points					●		●
Circuitous routing		●			●		●
Duplication of service		●			●		●
Excessive personnel						●	
Equipment requires excessive maintenance			●	●			
Inadequate maintenance facilities			●		●		
Poor management information system					●		●
RELIABILITY							
Schedules not adhered to	●				●		
Frequent breakdowns			●	●		●	
No information on delays					●		●
No special service to compensate for delays					●		●
Connecting vehicles do not wait					●		●

DEFICIENCIES \ MAJOR CAUSES	Transportation Policy	Local Political Factors	Financial Factors	Technology	Management	Labor	Integration and Coordination
COMFORT							
Inadequate ventilation			●	●			
Inadequate temperature control			●	●			
High noise levels			●	●			
Poor lighting			●	●			
Uncomfortable ride			●	●			
Insufficient seating			●	●			
Seats small and crowded				●			
No accommodation for packages				●			
Inadequate handholds for standees				●			
Narrow, awkward doors and steps				●			
Vehicles unattractively designed				●			
Vehicles poorly maintained			●		●		
Difficult fare collection procedures	●				●		●
No weather protection at stops					●		
Dilapidated stations			●				
Dilapidated maintenance yards			●		●		
Excessive noise and exhaust emissions				●			
Noisy, unsightly elevated rail structure	●		●				
SAFETY							
Frequent accidents	●		●	●	●		
Inadequately protected loading zones					●		
Unsafe steps and doors on vehicles				●			
Sharp edges on inside and outside of vehicles				●			
High frequency of theft	●				●		
High frequency of physical violence	●				●		
High frequency of vandalism	●				●		
COST							
Fares too high	●	●	●		●		●
Fare structure not graduated					●		●
Transfers not universally available					●		●
No multiple ride tickets					●		
No monthly or seasonal passes					●		
High equipment costs	●			●	●		

Table 2. Evaluation of the London transit system.

DEFICIENCIES \ MAJOR CAUSES	Transportation Policy	Local Political Factors	Financial Factors	Technology	Management	Labor	Integration and Coordination
ACCESSIBILITY							
Inadequate distribution of routes							
Excessive headways	◉		◉				
Insufficient evening and weekend service							
Insufficient passenger capacity							
No schedules available							
Route nos not displayed							
No information service							
Vehicles inadequately marked							
Stops inadequately marked							
No image							
Exact fare required							
EFFICIENCY							
Poor match of mode or vehicle to function	O		O				
Low vehicle acceleration							
Traffic congestion delays	O						
Excessive delays for loading and unloading				O	O		
Too frequent stops							
Uncoordinated routes and schedules							
Uncoordinated transfer points							
Circuitous routing							
Duplication of service							
Excessive personnel	O				O	O	
Equipment requires excessive maintenance							
Inadequate maintenance facilities							
Poor management information system							
RELIABILITY							
Schedules not adhered to	O						
Frequent breakdowns							
No information on delays							
No special service to compensate for delays							
Connecting vehicles do not wait							

DEFICIENCIES \ MAJOR CAUSES	Transportation Policy	Local Political Factors	Financial Factors	Technology	Management	Labor	Integration and Coordination
COMFORT							
Inadequate ventilation			O				
Inadequate temperature control							
High noise levels							
Poor lighting							
Uncomfortable ride				O			
Insufficient seating							
Seats small and crowded							
No accomodation for packages							
Inadequate handholds for standees							
Narrow, awkward doors and steps							
Vehicles unattractively designed							
Vehicles poorly maintained							
Difficult fare collection procedures	◉					O	
No weather protection at stops							
Dilapidated stations							
Dilapidated maintenance yards							
Excessive noise and exhaust emissions							
Noisy, unsightly elevated rail structure				O			
SAFETY							
Frequent accidents							
Inadequately protected loading zones							
Unsafe steps and doors on vehicles							
Sharp edges on inside and outside of vehicles							
High frequency of theft							
High frequency of physical violence							
High frequency of vandalism							
COST							
Fares too high	O		O			O	
Fare structure not graduated							
Transfers not universally available							
No multiple ride tickets							
No monthly or seasonal passes							
High equipment costs							

◉ Suburban buses.

The experience of the ten European transit systems carries a twofold message for the U.S. transit industry and those concerned with the success of transit in U.S. cities:

1. In order to be fully effective, integration and coordination measures must be backed by a strong regional transportation policy and a willingness on the part of municipal, county, state and national governments to provide sizeable capital and operating subsidies.
2. A well-managed transit operation which combines bus and rapid rail service in a system which is comprehensively integrated on all three fronts—institutional, operational, and physical—stands a chance of contributing significantly to the solution of urban transportation, pollution and energy problems.

More specifically, an analysis of the patterns of European transit operations reveals that the more successful systems tend to:

- Have one institution, or high-level board within the institution, with responsibility for fares and route planning, and a subordinate institution or body for the day-to-day management of operations.
- Emphasize the use of rail rapid transit and use buses as feeders to rail transit.
- Use coordinated fare structures that minimize impediments to transfers.
- Provide extensive public information on schedules and services.
- Establish bus-only lanes in major activity centers.
- Provide extensive park-and-ride facilities, with the most successful being free and supported from downtown parking charges.
- Encourage or develop extensive pedestrian facilities in major activity centers and transfer points.

TRANSIT INTEGRATION GOALS AND TARGET DATES

The findings of the report summarized above are directed to the task of transfering European transit experience and are expressed in terms of individual U.S. transit systems. INTERPLAN believes that a broader set of goals for transit are essential to the eventual success of any transit integration program, whether national or local in scope. Since UMTA has not as yet quantified national objectives for transit, INTERPLAN suggests that the year 2000 be taken as the long-range target date, and that the goal be a bus or rail seat for every car commuter. This target implies some 32 billion transit riders annually, compared to the present 5½-6 billion. The short- and mid-range target dates and objectives required to meet this long-range goal are shown below.

	TARGET AND YEAR			
	1973	1978	1985	2000
Objective:	Starting point	Double 1973 ridership	Quadruple 1973 ridership	A seat for every auto commuter
Annual number of transit riders (billion):	6	12	24	32
Planning horizon:	Current	Short-range	Mid-range	Long-range

INTERPLAN also made a rough estimate of the cost of financing the long-range target. The current replacement value of the industry (bus and rail, equipment and infrastructure) is approximately $20 billion, its annual operating cost is $2 billion, the annual operating deficit is $600 million, and the number of employees is 140,000. On the basis of these figures, some $120 billion would be required for purchasing the equipment to carry 32 billion passengers—six times more than at present. The number of transit employees would have to be increased to 580,000, i.e., by a factor of four. These are greater growth factors than those for any other established American industry.

INTERPLAN also believes that economically solvent transit systems which respond to the demand for high quality service cannot be provided by conventional bus and rail solutions alone. Enlightened development of all para-transit modes (taxis, jitneys, minibuses, car pools), of new systems such as dual mode and personal rapid transit (PRT), and the substitution of travel by communications will be crucial factors in meeting the stated targets.

Plausible responses to the above-suggested transit objectives are tabulated below. In INTERPLAN's understanding, this listing covers all of the actions which should be included in a comprehensive intermodal integration program.

SUGGESTED UMTA INTEGRATION PROGRAM — 1973-2000

Short-range (1973-77)	Mid-range (1978-85)	Long-range (1986-2000)
OBJECTIVE Double transit ridership.	Quadruple transit ridership.	All city commuting by transit.
MODAL IMPLICATIONS Increased use of buses. (from 50,000 to 90,000)	Build new rail systems; begin using PRT.	PRT fully operational.
SPECIFIC ACTION STEPS 1. Upgrade transit systems and market them aggressively. 2. Integrate transit systems. 3. Expand transit service. 4. Encourage para-transit. 5. Create separate rights-of-way for transit and para-transit. 6. Find out the preferred modes for the future; develop, design and test prototypes. 7. Facilitate and encourage pedestrian travel. 8. Support communications substitution of travel.	1. Continue short-range actions. 2. Utilize existing rail rights-of-way and build new rail systems. 3. Encourage light rail. 4. Consolidate urban goods movement. 5. Begin revenue service with new modes.	1. Continue mid-range actions. 2. Promote widespread adoption of new modes.

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SECTION 1
INTRODUCTION

PURPOSE AND ORGANIZATION OF THE SUMMARY VOLUME

This summary volume contains the conclusions reached in the three main volumes of INTERPLAN's report, Integration of Transit Systems. The objective of the report is to assess the potential for interagency and intermodal integration of transit systems in U.S. urban areas, drawing on an analysis of the successful experience of European transit systems.

The report's conclusions are presented in the same sequence as that followed in the three main volumes. These volumes, which amount to 750 pages including appendices, are:

Volume 1: Concepts, Status, and Criteria

Volume 2: Integrated European Transit Systems

Volume 3: Transit Integration in U.S. Urban Areas

In this way, the summary serves as a guide to the location of the detailed factual information on which the conclusions presented here are based, as well as a summary of the study's findings.

This introduction, Section 1, outlines the scope of the study and the steps of its execution. Section 2 of this summary brings together the salient points of Volume 1, including the definition of the forms which integration may take, an evaluation of the deficiencies of U.S. transit systems, a first-cut approach to identifying transit systems which are ready for integration, and estimates of the cost of large-scale expansion and improvement of U.S. transit systems.

Section 3 presents the conclusions drawn at the end of Volume 2 concerning the applicability to U.S. systems of the transit experience of ten European cities described in the bulk of that volume.

Section 4 describes the systematic process of elimination resulting in INTERPLAN's selection of San Francisco, Seattle and Philadelphia as candidate cities for transit integration, and presents the essence of the programs suggested for these three cities and for an archetypal smaller city, "Middletown."

PURPOSE AND SCOPE OF THE STUDY

At the direction of the UMTA Project Manager, the report is written with a triple readership in mind:

1. The staff of UMTA;
2. The managements and planning staffs of the 1100 transit operating companies in the United States;
3. The planning staffs of local and regional agencies concerned with urban transportation.

This report is the first broad overview of transit integration ever undertaken in the United States. Some of the views and suggested solutions may be found to be controversial. INTERPLAN believes that the report will largely serve its purpose if it initiates further work on the subject and stimulates all professionals—UMTA staff, transit operators and planners alike—to contribute to the search for better ways of solving the many problems of urban mass transportation.

Need for Transit Integration

The current status of urban transportation in the United States leaves much to be desired. City streets are congested, freeways are filled to capacity by commuters, and air pollution and depletion of the nation's oil resources have become two of this country's most urgent problems. Solutions to the urban transportation crisis will not be found through the further encouragement of private motoring by construction of new freeways or increasing city parking areas. Such actions not only compound existing problems, but are of no assistance to some 50 percent of urban dwellers who have no cars or cannot drive. U.S. urban areas must depend increasingly on public transit to serve their urban transportation needs.

Urban public transit in this country has been deteriorating over the past half-century. Equipment is old, service is inadequate and ridership has declined. Major improvements are essential if public transit is to perform its proper role in urban transportation.

A key element in the superior transit services provided in many European cities is integration of transit services. Organization of separate transit operations into an areawide system permits optimum distribution of routes,

coordination of schedules, establishment of system-wide fares and transfer privileges, and more efficient and effective planning, application of new technology, and conduct of promotion and public information. The steady financial support given to European transit systems by public agencies prior to and following integration; the tradition of cooperation between transit operators and local authorities; and the high quality of management are three other extremely important factors in the success of transit systems in Europe.

Scope of the Study

INSTITUTIONAL, OPERATIONAL AND PHYSICAL FORMS OF INTEGRATION. Efforts to integrate transit systems can be directed toward three different forms of integration: the organizational structure under which the operators function, the services provided, and the facilities and equipment used. The terms "institutional," "operational" and "physical" are used to distinguish these three elements of transit integration, all of which are considered in this study.

All three elements can be involved in a single integrated system. INTERPLAN's analysis of European experience and of the U.S. transit industry indicates that before operational or physical integration can be effective, there should be an adequate institutional arrangement between the several operators.

INTERMODAL AND INTERAGENCY INTEGRATION. Intermodal integration implies coordination between two or more modes of public transit, such as rapid rail and bus, or bus and ferry. The study scope originally included only intermodal integration. Within the scope of this definition, the study would have been restricted to the examination of integration problems in only nine metropolitan areas where bus service is supplemented by streetcars, ferries, or rail rapid transit.

In the majority of the 243 Standard Metropolitan Statistical Areas in the United States, however, public transit is based on a single mode, bus. Often this service is in the hands of several operators, some public and some private. Interagency integration rather than intermodal integration is therefore needed in these areas, and therefore the scope of the study was extended to include both intermodal and interagency transit integration.

MAJOR U.S. METROPOLITAN AREAS SURVEYED. Thirty Standard Metropolitan Statistical Areas were surveyed for their potential for transit integration. These 30 areas account for an estimated 80 percent of all public transit patronage. They include all metropolitan areas of over one million population and two additional areas where local interest is being included in the study was expressed to UMTA.

EUROPEAN EXPERIENCE DESCRIBED. Four cities were examined in detail: London, Hamburg, Paris, and Munich. Six additional cities: Newcastle Upon Tyne, England; Edinburgh, Scotland; Stockholm and Gothenburg, Sweden; Copenhagen, Denmark; and Oslo, Norway, are reviewed briefly to indicate the variety of experience and to provide adequate background for a generalized analysis of European experience with transit integration.

EXAMPLES OF DIFFERENT EUROPEAN APPROACHES. The representative U.S. cities selected as examples for the application of European methodologies of transit integration offer the potential for three major approaches. UMTA can draw comparisons between these three different approaches in considering the type of RD&D program it should pursue. The approaches suggested are:

1. A series of specific operational and physical integration activities for one city in which a degree of institutional integration has been achieved.
2. An institutional arrangement patterned after the Hamburg and Munich Transit Federations where one of the partners operates a statewide rather than an urban service.
3. A plan along the lines of the organization of the London Transport Executive and the RATP in Paris for combining public transit agencies into a single integrated agency.

EXECUTION OF THE STUDY

The work required for this study was organized into three major efforts:

1. Survey of transit integration needs in U.S. urban areas.
2. Study of European solutions to urban public transit problems.
3. Application of European approaches to integration to U.S. public transit.

The first two study efforts were approached simultaneously. One portion of INTERPLAN's study team developed information on U.S. public transit, evaluating existing services, the role of transit in overall transportation planning, and the current status of transit integration in 30 major metropolitan areas.

At the same time another portion of the study team examined transit systems and approaches to integration in ten European cities, noting successful organizational frameworks, methods of operation and application of new techniques.

The next step was to bring together these two inputs in order to apply the European approaches to the public transit systems of U.S. urban areas. Evaluations were made of the suitability of certain European institutional arrangements to U.S. organizational practices. The feasibility of transferring different European technical and managerial procedures to U.S. transit operations was reviewed. Finally a selection was made of three representative (over one million) metropolitan areas in the U.S. with potential for near-term application of transit integration. A fourth urban area, actually a composite or archetypal example of a small (50,000 - 250,000) city, was also included in the suggested application of European techniques to the U.S. to provide a comparison with the approaches suggested for the large cities.

Evaluation criteria were developed and consideration was given to design standards, increases in transit patronage which might be induced by integration, and the costs and benefits that might be expected.

SECTION 2
CONCEPTS, STATUS, AND CRITERIA

OVERVIEW OF U.S. TRANSIT

INTERPLAN classifies urban transportation modes into three categories: transit, para-transit and private transportation. "Transit" includes high capacity modes such as rail rapid transit and bus which serve masses of public riders. Such systems may be publicly or privately owned but are referred to as "public," because they provide a public service, or "mass" because they are designed to carry a high volume of passengers. In the broadest sense, taxis, jitneys, and minibuses are also "public" modes but are classified as para-transit to emphasize their more limited service functions. Private transportation refers to transportation means owned or rented by a single traveler, such as automobiles and bicycles, and the traveler's own two feet.

Figure 1 illustrates the spectrum of urban transportation modes, grouped into these three categories. In the figure, modes are arranged according to passenger-carrying capacity and the ease with which service can be varied in response to changes in public needs. At the rail end of the scale, service is firmly fixed and can handle large numbers of passengers, while at the private end of the scale, service is limited to a few passengers and is perfectly responsive to the individual's desire or need to travel.

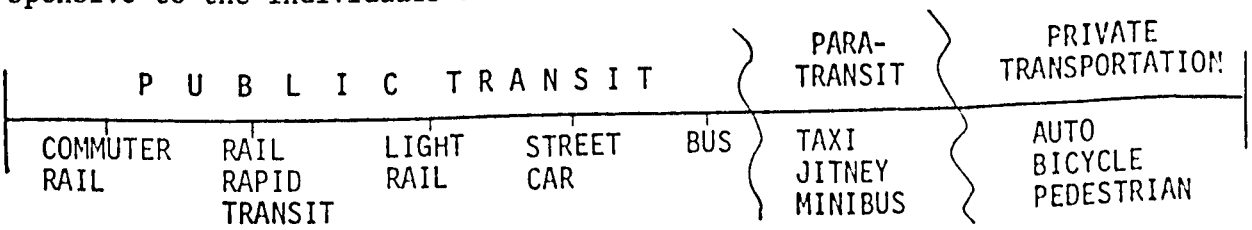

Figure 1. Categorization of urban transportation modes.

In 1970, from 85 to 95 percent of all urban trips were made by private car, leaving a scant 5 to 15 percent to be carried by transit and para-transit modes. Seventy percent of these non-car trips are made by transit; the remaining 30 percent are made by taxi. Table 3 contains key comparative statistics for transit and para-transit modes for 1970. There are about 1100 transit operators in the U.S., carrying about 6 billion revenue passengers a year in about 60,000 rail and bus vehicles. Gross revenue was about $1.7 billion in

Table 3. Selected urban transportation statistics, 1970.

	All Modes	Taxicab	Bus, Rail, and Trolley Coach				Commuter Rail[b]
			Total	Bus	Rail[a]	Trolley Coach	
Revenue passengers (millions)	8,557	2,378	5,932	4,058	1,746	128	247
Percent of total	100.0	27.8	69.3	47.4	20.4	1.5	2.9
Passenger revenue (millions of dollars)	4,065	2,221	1,639	1,194	415	30	205
Percent of all-mode total	100.0	54.6	40.3	29.4	10.2	0.7	5.0
Revenue miles traveled (millions)	-	3,417	1,884	1,409	441	33	d
Number of vehicles (thousands)	-	170	62	50	11	1	d
Average employment level (thousands)[c]	-	111	138	d	d	d	d
Average fare/ride (cents)	-	d	27.63	29.41	23.78	23.84	d

[a]Includes elevated and subway rail rapid transit, grade-separated surface rail, and streetcar operations.

[b]Urban passenger rail service provided by railroad companies.

[c]Taxicab employment believed to be underestimated.

[d]Not available.

Source: For bus, rail, and trolley coach data: American Transit Association, 1970-71 Transit Fact Book.

For taxicab data: International Taxicab Association, American Automobile Association, Bureau of Labor Statistics, Employment and Earnings, United States 1909-70 (Bulletin 1312-7). Employment figures are believed to be understated.

For commuter rail: Interstate Commerce Commission, commuter railroad companies and several independent studies

1971, compared to $2.1 billion in operating expenses and taxes. Bus is by far the dominant mode.

Transit ridership has been declining for nearly 30 years and the downward trend has accelerated within the last decade. The decline in ridership from 1970 to 1971 alone was nearly 10 percent, compared to a 6 percent decrease from 1969 to 1970 and roughly a 3 percent annual decrease for the previous 5 years. The industry's operating deficit has nearly doubled since 1969. While the number of employees is decreasing, average annual earnings per employee has been steadily rising.

Integration of transit systems is a powerful approach to the American urban transportation problem. By working toward an integrated, publicly supported transit system, U.S. transit operators might be able to break the vicious circle of increased car use, declining fare box receipts, and declining service quality which further encourages the use of private cars.

CONCEPTS OF INTEGRATION

Institutional, Operational and Physical Transit Integration

INSTITUTIONAL INTEGRATION. Drs. Homburger and Vuchic have identified four types of institutional arrangements under which public transit can be successfully integrated:*

Tariff associations, limited to contracts on joint tariffs and the distribution of jointly collected revenues. Associations are suitable only in situations where the partners do not compete and share no territory but rather make end-to-end connections. For instance, the airline industry is an example in interurban transport: a passenger can purchase a single ticket covering several flight segments on aircraft of different companies and pays no penalty for using more than one line.

Transit communities, which not only bind themselves to a common tariff but coordinate routes and schedules and, if appropriate, pool or exchange some rolling stock. The railroads in the United States have long operated under such an arrangement.

Transit federations, which establish a formal federated agency and delegate to it certain powers related to planning, tariffs, revenue distribution, etc. The Munich (Germany) Transit Federation is an example.

Mergers, in which portions of companies or entire companies are merged into one firm, within which the companies either operate as subsidiaries or lose their identity altogether (London, Paris).

*"Federation of Transit Agencies as a Solution for Service Integration," Traffic Quarterly, July 1970.

While institutional integration is basic to applying operational and physical remedies, it can be the most difficult and lengthy of the three approaches to achieve. Institutional integration in European experience took many years. In London, the first agreements between independent operators (underground railway, bus and tramway) were made in 1915, but full operational and technical integration was achieved only in the early 1950s. In Hamburg, where the Transit Federation (HVV) incorporates private and public agencies which have voluntarily joined the federation, the idea of such an organization was discussed for 7 or 8 years, and actual negotiations and contracts were in preparation for some 5 years of this period.

OPERATIONAL INTEGRATION. Operational integration includes creation of a single network without wasteful duplication of services, use of joint fares, coordination of schedules to permit smooth and reliable transfers, and development of an area-wide public information system.

As long as there is a suitable institutional arrangement for integration, coordination of transit operations can be achieved in a relatively short time and requires relatively minimal funding. Economies may even be realized by individual companies through joint collection and disbursement of revenues from fares and through a combined public information service.

PHYSICAL INTEGRATION. Physical integration includes standardization of vehicles, fare collection equipment and system signs, joint utilization of rolling stock, construction of joint terminals, and integration of management information systems. In practice, physical and operational solutions are often found jointly, as when a park-and-ride facility or terminal interchange is coupled with an honor payment system.

Major capital investment is required by most forms of physical integration for the construction of new joint facilities and acquisition of new vehicles and equipment. Benefits from physical integration are realized more slowly than those from operational integration.

Integration of Public Transit Within Overall Transportation Policy

The ideal integrated urban transportation system would also require interconnectivity between public transit, and the para-transit and private automobile modes, in order to bring together all urban transportation. Public

transit and para-transit can be integrated through some type of transit-taxi transfer management, such as that now being worked out in Hamburg. Park-and-ride facilities serve to interconnect public transit and private automobile travel.

While this study focuses on public transit services, we have nonetheless borne in mind that transit interconnectivity must be viewed within the context of the larger transportation picture. The interface between public transit and private auto travel is particularly crucial to the success of a transit system in attracting new riders.

STANDARDS FOR EVALUATING PUBLIC TRANSIT SYSTEMS

An Ideal Urban Public Transit System

In order to evaluate existing public transit in U.S. and European cities and determine those areas in which U.S. transit systems could be improved by adopting certain aspects of European systems, it is necessary to define the qualities of an ideal urban public transit system as a goal toward which efforts to improve U.S. systems should be directed. Once the ideal system is defined, it is then possible to identify specific deficiencies and suggest specific remedies. Thus, as an initial step toward providing UMTA with demonstration project evaluation criteria, INTERPLAN developed a preliminary definition of the characteristics of an ideal public transit system.

The essential features of an ideal urban public transit system are classified into six general categories: accessibility, efficiency, reliability, comfort, safety and cost. In defining these desirable features more precisely, the system must be looked at from the different and sometimes opposed views of three interested parties: the passenger, the operator, and the community at large. The list of desirable attributes which emerged from INTERPLAN's analysis may be found on pages 54-56 of Volume 1.

The ideal characteristics which INTERPLAN identified should not be assumed to be unrealistic. They are based on the present state of the art, and each characteristic has been achieved somewhere in practice. Since this is the case, the concept of an "ideal transit system" becomes realistic and relevant for analysis and planning. While it is difficult to find a transit

system which satisfactorily meets all of the ideal characteristics, there are a number of systems which come very close. Unfortunately, most transit experts agree that these are located in European and Canadian cities; no major U.S. city can presently claim to have transit service approaching such a high standard.

Deficiencies of U.S. Transit Systems, Causes, and Solutions

Utilizing the characteristics of an ideal transit system, we have isolated some of the major existing deficiencies of U.S. transit systems and correlated them with seven major factors which affect the quality of urban public transit. Table 1 in the Executive Summary at the beginning of this volume presents a matrix in which one or more causes is indicated for each of the typical deficiencies identified (see page vi).

The final step in the analysis was to describe more precisely the deficiencies and their major causes and to suggest possible solutions, citing the examples of successful solutions in both the United States and Europe. The results of this analysis are presented on pages 62-77 of Volume 1 in the following sequence: first, the deficiency is defined in more detail; causes are specified; then solutions are suggested; and finally, examples are given of cities where these solutions have been successfully applied.

Evaluation of Selected U.S. and European Transit Systems

Using the list of deficiencies common to U.S. transit systems, an evaluation was also made of public transit in four European cities: London, Hamburg, Paris, and Munich, and three U.S. cities: San Francisco, Seattle, and Philadelphia. Table 4 compares the results of the analyses of the seven systems, and Table 2 on page vii of the Executive Summary illustrates for one European city, London, the relative lack of deficiencies in European systems compared to the American systems in Table 1.

DEMONSTRATION PROJECT EVALUATION CRITERIA

Integration and Demonstration Projects

In INTERPLAN's understanding, a demonstration project or capital grant should be considered as a step towards successful overall transit integration.

Table 4. Comparative number of observed deficiencies in four European and three U.S. transit systems.

Location	Accessibility	Efficiency	Reliability	Comfort	Safety	Cost	Total
London	1	4	1	4	0	1	11
Hamburg	2	2	1	0	0	1	6
Paris	2	3	0	4	1	0	10
Munich	0	0	0	1	0	1	2
San Francisco	8	7	2	14	2	3	36
Seattle	7	4	0	12	0	2	25
Philadelphia	10	11	4	14	6	6	51
U.S. in General	11	13	5	18	7	6	60

Thus, while the final objective, i.e., complete and successful integration as in London or Hamburg, can be reached through a series of such steps, the real purpose of each step is to make long-range integration a lasting success. It follows that evaluation criteria for a demonstration project or capital grant proposal should be subject to the overriding criterion that final integration is foreseen to be feasible.

Demonstration projects or grants, however, being fixed in point of time and money, need also to be assessed in terms of existing conditions in the urban area considered and in terms of the multiplier effects which can result if beneficial changes in one area can be demonstrated so that the results are transferrable to other urban areas. The two types of criteria which are presented in the report, transit system evaluation criteria and acceptable location criteria, have been formulated to meet these objectives.

Transit System Evaluation Criteria

Table 1 in the Executive Summary shows that only 10 to 15 percent of the deficiencies in a typical U.S. transit system are directly attributable to a lack of or inadequacies in integration and/or coordination. It follows that integration by itself may, in some cases, be less effective than some

other types of improvement and, alternatively, that without other improvements, integration may not be successful. This is not meant to imply that integration should not be attempted unless all of or most of the deficiencies of the system are simultaneously eliminated. However, it is felt that the importance of integration to the overall improvement of the system should be reviewed as a part of the rational decision-making process.

For meaningful demonstrations of operational and physical integration, the current standards of operations and equipment should, by and large, be satisfactory, i.e., the availability, speed and travel time, frequency, reliability, fares, environmental factors, convenience, and safety should be such that a firm basis exists for further improvements through network integration. If, in any specific location under consideration, this condition is not met, i.e., if the existing system is plainly poor, there seems to be little point in attempting to integrate parts of it.

Acceptable Location Criteria

The following criteria are considered basic to the selection of locations for demonstrations of integration and capital grants:

- The number of urban travelers is large.
- At least two modes and/or operators exist.
- The problems approached in the project are representative of problems in other urban areas.
- Attitudes and capabilities conducive to integration exist on the part of local authorities and operators.

LOCATIONS WITH POTENTIAL FOR INTERMODAL INTEGRATION. Intermodal integration implies coordination between two or more different modes of public transit, while interagency integration implies coordination between two or more different agencies (or operators) which may operate the same mode of transit. Table 5 shows the number of cities with existing or projected transit systems by mode. Cities with more than one mode are candidates for intermodal integration. If the travel needs of U.S. urban residents are met by introduction of transit modes best suited to serve demand, some 120 SMSAs may have light rail and bus systems which could be integrated. At most, 33 areas might contemplate rapid rail/bus integration and a similar number could have potential for integrating over-the-water transportation with other modes.

Table 5. Present and projected number of U.S. cities with public transit modes.

Mode	1973		1990 (INTERPLAN Estimate)	
	SMSAs Served	No.	SMSAs Served	No.
Bus[a]	All SMSAs	243	All SMSAs	250
Rapid Rail	New York Chicago Philadelphia Boston Cleveland San Francisco Washington, D.C.[b] Atlanta[b] Baltimore[b] Miami[c]	6	SMSAs with population over one million	33
Commuter Rail	New York Boston Chicago Pittsburgh Philadelphia San Francisco Detroit Washington, D.C.	8	Same as 1972	8
Light Rail[d]	Philadelphia Cleveland Pittsburgh Boston New Orleans Newark	6	SMSAs with population over 300,000	120
Over-the-Water	Seattle New York San Francisco New Orleans	4	See INTERPLAN's study, Urban Over-the-Water Transportation	30

[a]Electric trolleybuses powered from overhead wires operate in Seattle, Philadelphia, San Francisco, Boston, and Dayton. They are being phased out in Boston

[b]Under construction.

[c]Funds approved.

[d]Streetcar systems as defined by INTERPLAN are not included under light rail. Streetcars still operate in Philadelphia and San Francisco. The San Francisco streetcars are presently being converted to light rail through the construction of exclusive rights-of-way.

LOCATIONS WITH POTENTIAL FOR INTERAGENCY INTEGRATION. Potential for interagency integration exists where there is more than one transit operation in the area. Table 6 shows that such potential is greatest in the five largest SMSAs.

Table 6. Cities with potential for interagency integration

SMSA	Number of Public Transit Systems/Operators
New York	39
Boston	33
Los Angeles	32
Chicago	28
San Francisco	17
Seattle	12
Philadelphia	12
Detroit	8
Cleveland	8
Washington, D.C.	7
Indianapolis	6
New Orleans	6
Minneapolis-St. Paul	6

READINESS TO INTEGRATE. All the cities listed in Tables 5 and 6 theoretically have the potential for intermodal and/or interagency integration. As a first-cut step to identifying those cities where the practical factors would also favor transit integration activity, INTERPLAN ranked major U.S. urban areas according to their scores on seven readiness-to-integrate criteria:

1. Local willingness to ability to act.
2. Financial health of transit system.
3. Advanced technology in use.
4. Good transit management.
5. Good transit organization.
6. Integration activity initiated.
7. Meaningful integration problem exists.

The results are described on pages iii-iv of the Executive Summary.

This type of ranking exercise is a purely preliminary, subjective assessment of candidate locations for integration activities or for a demonstration. The more systematic method which INTERPLAN used to select the final candidates, involving questionnaires and a thorough literature search, is described in Section 4. It is nonetheless interesting to note that the same three cities ranked at the top in both types of selection process. This would seem to indicate that the readiness-to-integrate criteria provide a useful rule-of-thumb guideline for selecting demonstration sites.

THE BENEFITS AND COSTS OF EXPANDING AND IMPROVING AMERICAN PUBLIC TRANSIT

Benefits

The principal benefit which can be envisioned to result from expanding and improving urban transit is that an increase in the number of users of transit systems will result, with a commensurate decrease in the use of the private automobile. If one were to envision the optimum in expansion and improvement of public transit facilities, virtually all commuters (some 60 million in 1980) would be able to have a seat in a public transit vehicle. They would be collected in the morning close to their homes and, with normally no more than one convenient transfer, they would be delivered close to their place of work. In the evening the process would be reversed. Should the nation fund and implement such a solution, the fact that every working urbanite would be able to use convenient public transportation would be the greatest direct benefit.

The following principal secondary benefits can be postulated:

- Some 40 million automobiles would disappear from city streets during the morning and evening traffic hours. Virtually all streets would be able to accommodate reserved lanes for rapid transit.
- Many of the air quality problems foreseen by the Environment Protection Agency would be reduced since 90 percent of urban air pollution is due to automobiles.
- Some 400,000 new urban jobs would be created.
- Some $8 billion more would be injected into urban economies with the concomitant impact of multiplier effects.

- The civil engineering construction industry, suppliers of rail equipment (including the steel and electricla engineering industry) would have to supply some $100 billion worth of construction and equipment. Naturally, this demand for equipment (and jobs) would be offset by the reduced demand in the automobile industry.

The analysis of U.S. transit system deficiencies indicated that transit integration is only one of the ways to improve transit service, and that unless other deficiencies are removed, integration per se is not likely to increase patronage. Therefore, it is difficult to provide reliable estimates for patronage induced by integration alone. Quantitative estimates such as the amount of system improvement, including integration, which would be required to increase ridership by, say, 10 percent over a 5-year period can only be made on the basis of operations research investigations of the public's response to actual improvements in specific locations, e.g., in demonstration projects.

INTERPLAN has ventured, however, some broad estimates on potential induced patronage in the three cities for which integration activities are suggested. In Seattle, the annual number of ferry passengers without cars may reach the 500,000 level over a period of 3 to 5 years, over and above the present level of patronage (roughly 7-8 million passengers, of which 5-6 million are passengers with cars). In Philadelphia, a patronage increase similar to Hamburg's may be expected, i.e., one percent annual increase. The increase in the initial years could go perhaps as high as 3 to 5 percent. For San Francisco, estimates were made in 1967 that BART-induced transit patronage for all Bay Area transit by 1975 could be 26 percent over the 1965 level (from 535,000 to 670,000 weekly trips). The delay in the opening of BART has pushed back the date by which such an increase could be expected. Thoughtful integration of BART and other Bay Area transit operations, however, might make this increase feasible within the stated period.

Cost-Effectiveness Considerations

Two kinds of cost-effectiveness considerations need to be borne in mind: the effectiveness of public transit versus the private automobile in conserving dwindling energy resources and in reducing air pollution, and the effectiveness of investing in various specific remedies such as management training.

Table 7. Replacement value of U.S. transit systems.

Buses	50,000	@ $50,000 ea.	$ 2.5 billion
Subway, elevated and commuter rail vehicles	11,000	@ $250,000 ea.	2.8 billion
Light rail vehicles	1,000	@ $200,000 ea.	0.2 billion
Track and fixed equipment	1,400 miles	@ 10,000,000/mile	14.0 billion
TOTAL			$19.5 billion

The total annual operating cost of the above investment is of the order of $2.1 billion, of which the payroll for 140,000 employees accounts for $1.4 billion. Gross revenue is $1.7 billion, leaving a 1971 deficit of approximately $400 million ($600 million in 1972).

On the basis of these figures, INTERPLAN has estimated the costs which would be incurred if current transit operations were expanded and improved as postulated in the preceding discussion of benefits, i.e., if U.S. transit systems were to provide virtually all U.S. commuters with a seat in a public transit vehicle, and if the projected number of cities with potential for use of public transit modes as shown in Table 5 were served.

The values estimated in the report are summarized in Table 8. As the

Table 8. Investment and operating cost, staffing and capacity of an adequate U.S. transit system.

System	Capital Investment ($billion)	Annual Operating Cost ($billion)	Number of Employees	Number of Passengers Carried (million)
Bus	2.5	2.0	170,000	10,000
Rapid Rail Transit	68.0	5.0	240,000	16,000
Light Rail	50.0	3.0	150,000	6,250
Commuter Rail	5.0	0.2	10,000	500
Over-the-Water	0.6	0.4	6,000	0.5
TOTAL	126.1	10.6	576,000	32,750.5
1970 Status	20.0	2.1	140,000	4,000

table shows, INTERPLAN postulates that in 20 years investment in transit systems will increase six-fold, and the operating costs of the system five-fold. While such increases far exceed the present provisions of the Urban Mass Transportation Act, the required investment is of the order of the current funding of the Federal Highway Trust Fund. If such increases (in 1972 dollars) were to be approved by Congress, the number of transit employees is likely to increase by a factor of 4, and the number of passengers carried by a factor of 8.

In order to achieve such an appreciable increase in industry's productivity, a carefully integrated program must be prepared for transforming today's declining transit industry into the world's most productive urban transportation system. Many encouraging examples indicate that such a transformation is quite feasible. During the last 30 years the United States has created many service-type industries which are unexcelled in any other country. These service industries, as well as the commercial airlines and the highway systems, have one feature in common: they are capital intensive. It was a long-range policy decision not to develop the urban transit industry to a similar level of excellence. Once this decision is modified, it will take only $126 billion to give U.S. cities the best transit systems in the world.

SECTION 3

APPLICABILITY OF EUROPEAN TRANSIT EXPERIENCE TO U.S. TRANSIT SYSTEMS

OVERVIEW

The central purpose of this study is to determine whether the recognized successes of Europe's integrated transit systems, such as the London Transport, the Paris Metro, and the new Munich Transit Federation system, in attracting a large ridership can be duplicated or at least emulated by U.S. transit systems. Even prior to conducting this study, INTERPLAN's conviction has been that despite the considerable economic, historical, and social differences between Europe and the U.S., the gap in the performance and popularity of American and European urban transit systems could be closed if European experience could be made "real" to American transit operators and the riding public. For this reason, a considerable effort, reported on in Volume 2 of INTERPLAN's report, was devoted to collect and analyze detailed information on many aspects of public transit in Europe, including its role in urban transportation. This section presents the main findings of this work.

Four of the ten cities are examined in detail: London, Hamburg, Paris, and Munich. The six other cities are reviewed briefly to indicate the variety of experience and to provide adequate background for an overall analysis of European experience. The locations of the ten cities are shown on the map in Figure 2.

Selection of Ten European Cities

The ten cities were chosen to provide a good overall picture of European experience with transit integration. While other cities might also have served as examples, these ten provide a sufficiently broad and comprehensive view without unnecessary redundancy. Four cities are large metropolitan areas of over one million population; the rest are smaller, ranging down to 700,000. Six are capital cities. Historically, institutional integration came first in London (1933) and Paris (1949), and more recently in Hamburg (1965) and Munich (1971). The impetus to transit integration efforts has been provided by the national governments in London, Paris, Newcastle, and Oslo; by municipal authorities in Stockholm and Gothenburg; and by operators themselves in Hamburg,

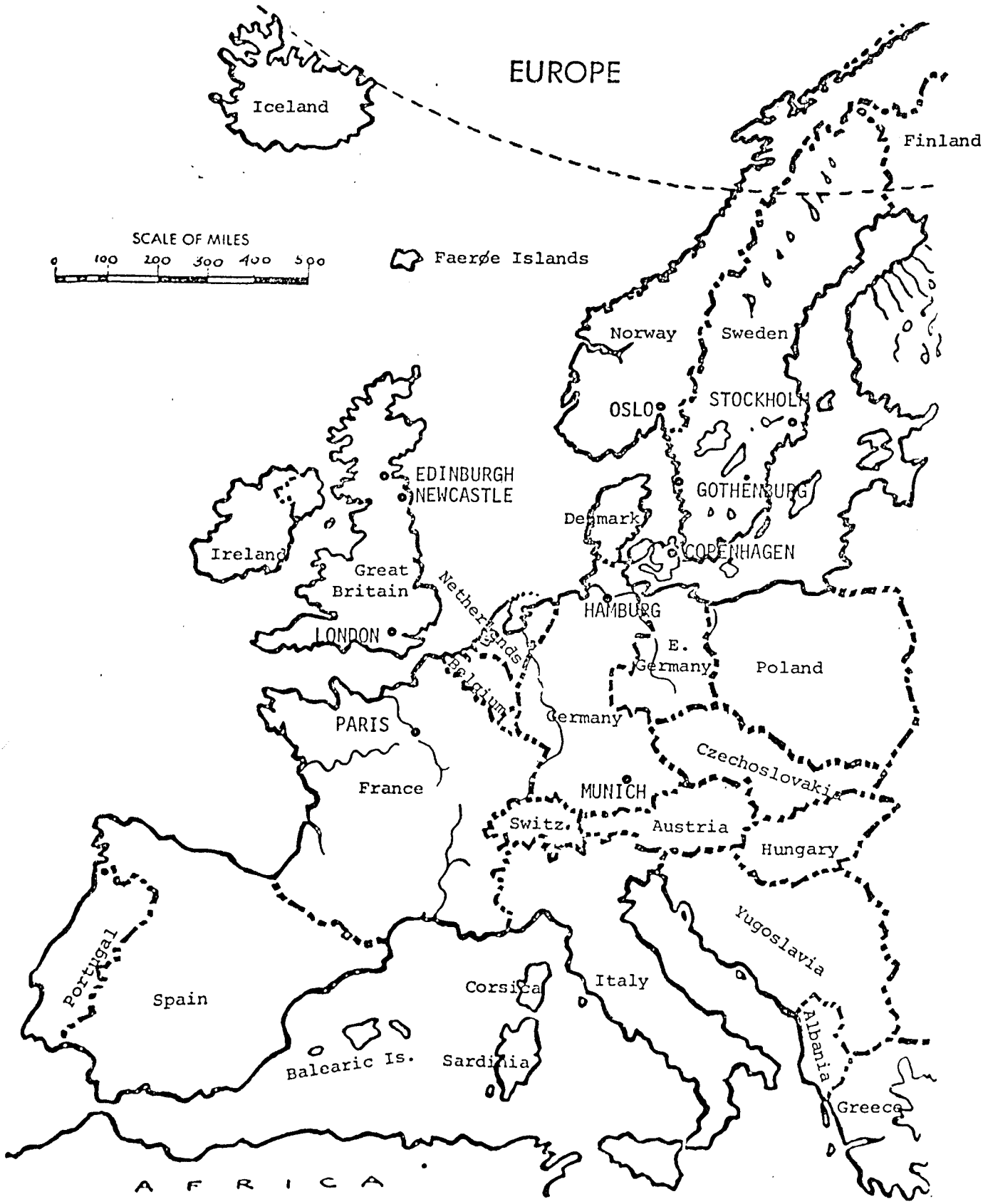

Figure 2. Map of Europe, showing ten cities described.

Munich, and Copenhagen. The cities chosen have not all had equally successful experience. London, Hamburg, and Paris are the outstanding successes; Edinburgh and Copenhagen are examples of partially integrated transit systems; and Oslo has a fragmented but high quality system with a good integration plan.

European Approaches to Integration

Broadly speaking there are three major approaches to transit integration observed in European cities which offer potential for U.S. application:

1. A program of specific operational and physical integration activities in a city where some degree of institutional integration has been achieved.
2. A voluntary transit federation, patterned after the Hamburg and Munich cases.
3. A single area-wide agency, such as the London Transport Executive or RATP in Paris, combining all public transit operations, as in a commercial merger.

The characteristics of the transit system and the individual arrangements used, however, are different in important respects for each of the cities. The federation in Hamburg was the first to be formed and its members include the federally owned rail system as well as seven urban operators. The more recent federation in Munich is made up of only two partners, one urban in scope, the other national. Hamburg is most interesting as an example of insitutional integration. Extensive operational integration has also been accomplished there, but physical integration has progressed slowly because the agreements establishing the federation have a limited lifetime. The federation in Munich, on the other hand, has been able to put equally heavy emphasis on institutional, operational, and physical integration efforts.

The public transport organization in Paris is an example of an institutional arrangement which has been in existence for a relatively long period of time, almost a quarter of a century. Other unique features of the French system are its close relationship with the central government and its intimate involvement in the daily lives of all classes of Parisians.

Transit systems in Great Britain provide examples of both relatively recent and longstanding efforts on the part of the national government to precipitate institutional integration of public transport. The London Transport

Executive has operated an integrated transit system since 1933, but in 1969 it was also made responsible to the municipal planning authority to further intensify its responsiveness to the city's transport needs.

The 1969 legislation also placed responsibility for public transport in five other major conurbations in Great Britain into the hands of newly created area Passenger Transport Authorities (PTA). The Tyneside PTA, centered on Newcastle upon Tyne, may be considered the most successful of these authorities, and is the example chosen for this report. In order to provide a contrasting example of experience in a city where institutional integration has not yet been encouraged by the British government, the system in the city of Edinburgh is also examined.

Stockholm and Gothenburg provide examples of highly coordinated transport and city planning. Stockholm has the powers for both functions within a single organization and Gothenburg does not, but both achieve a high degree of coordination. Both cities have a single operator responsible for all urban public transport service.

FACTORS INFLUENCING APPLICABILITY

Though the U.S. is late in taking action on urban transit and therefore faces a harder task, the nature of the basic problem of urban transit is the same on both continents. Its main causes are rising affluence, the availability of private cars, and the spread of the centers of residential growth to locations outside the city.

Those responsible for transit in many European cities have met these challenges with success. The main difference is that the Europeans had a triple headstart. First, unified transit networks were operating under a single public management as early as 1933 in London and 1949 in Paris. Secondly, the post-war modernization of European transit systems gained new momentum about 10 years ago. Thirdly, motorization occurred much later and more gradually in Europe.

The remaining differences between U.S. and European conditions which encourage European ridership are largely beyond the control of transit interests. Gasoline is two to three times more expensive in Europe, on the order of $1 a gallon. Though motorization has increased phenomenally in Europe

over the past decade, nowhere is it as high as in the U.S. even 10 years ago. Street crime and vandalism are much less of a problem in most European cities because of the more stable and traditional social environment. Travel habits are also more old-fashioned. In general, Europeans make more and shorter trips than Americans and travel less often by car.

These differences do not alter the basic applicability of European approaches to transit integration. U.S. transit systems have simply started later and have further to go before they can expect to see the results of successful integration programs.

CHARACTERISTICS OF SUCCESSFUL EUROPEAN SYSTEMS

All ten European transit systems share a number of common characteristics. The five most important are: public ownership, high quality management, adequate funding, early institutional integration, and stability of demand for transit.

Firstly, in all ten cases, all or part of the public transit operations in an area are state or city owned. In all European countries the government owns the railroads which provide commuter rail service.

Secondly, management of transit systems is given strong policy backing by an effective regional planning authority, and is encouraged to use its authority. Partly for this reason, the transit industry rates higher prestige in Europe and attracts high quality management. In France, for example, the urban transport is managed by the same professional elite which administers the French government.

Thirdly, in Europe most cities adopted the policy that both transit and auto modes should be improved in parallel, and this basic policy led to sufficient financing. When transit operators ran into financial difficulties, they were given aid at a level which allowed them not only to maintain, but to improve and expand service.

Table 9 documents the universal involvement of national and local governments in transit finance in the ten cities. The British, German, French, and Swedish governments all offer generous capital grants for urban transit. Except for the Edinburgh system, all city-owned systems operate at a deficit

Table 9. Financial sources of ten European transit systems.

System	Capital Costs	Operating costs
London Transport	Receives capital grants from GLC. Receives infrastructure grants from British government for capital costs: 75%: new major projects 50%: rail or intermodal facility improvements 25%: bus facility improvements 25%- New one-man bus 50%: vehicles	Must be covered from revenue, plus £ 2 million to go to reserve. GLC will not subsidize operating expenses. Profits taken in by the Underground cross-subsidize bus services. Federal government refunds a portion of tax paid on bus fuel.
Hamburg Transit Federation partners	Have been covering capital and operating expenses from revenue and making modest profits. Financial success based on greater labor productivity in face of rising labor costs. Exception: DB received guarantee from City-State of Hamburg that city would take over DB deficits on Hamburg service and would share capital costs of S-Bahn expansion and modernization.	
Paris RATP	Subsidized by the French government: direct subsidies (30% in 1971), new loans (43% in 1971), and renewed loans (27%).	About half of operating expenses covered by revenue from fares (46% in 1971) and advertising and space rentals (7% in 1971). Balance paid by French government.
Munich Transit Federation members	New rapid transit system funded by Federal government (50%), the State of Bavaria (25%), and the city (25%). Federal funds come from special gasoline tax fund for transit.	Revenue covers only 45% of total operating costs. Rest is supplied by Federal, state, and city governments.
Tyneside PTA	British government provides grants for new and improved facilities and equipment (same as for London Transport above).	Bus profits used to subsidize rail losses. British government also contributes to rail operations deficit on a sliding scale:

Table 9. (continued)

System	Capital Costs	Operating Costs
Tyneside PTA (cont'd)		90% in 1972 to 60% in 1975. Same refund on fuel tax as for London Transport.
Edinburgh City Transport	Same vehicle grants as for London Transport.	City-owned, revenue-generating operation. Same fuel tax refund as for London Transport.
Stockholm SL	Prior to formation of SL in 1966, T-bana financed from city taxes. Since 1965, Swedish government has given a lump sum from motor fuel taxes to local government to be allocated to highway and transit projects. These grants have provided up to 95% of public transit infrastructure cost for some localities.	T-bana covers 80% from fares. Rest comes from gasoline tax and motor vehicle tax. SL goal is to cover 80% of operating cost from fares with balance from county income tax. But in 1971, operating income was only 56% of operating expenses. Stockholm County Council must pay deficit as owner of SL.
Gothenburg GS	Same form of national government subsidy as Stockholm.	GS owned and operated by the city.
Copenhagen KS	KS is owned and operated at a deficit by the city.	
Oslo OS	OS is city owned and operated at a deficit. City paid for construction of rapid rail system. Proposed transit federation would grant franchises to operate transit, set fares to maintain operators' present income levels, subsidize operating deficit 75% from Oslo and 25% from Akershus County. Capital grants of 50% would be made by the national government for fixed facilities.	

paid by the city. The Paris, Munich, and Stockholm systems meet barely half of operating costs from fare box revenues. Several other systems are breaking even or making modest profits: London Transport, Hamburg Transit Federation members (except the Federal Railroad), and Tyneside Passenger Transport Executive's bus operations.

Fourthly, in nine of the ten cases studied, a high degree of institutional integration in public transport operations either already exists or has been seriously proposed for the near future. Historically, successful extensive operational and physical integration has in fact been preceded by the creation of an appropriate institution for accomplishing it.

A fifth general characteristic is the relative stability, and in some cases growth, of the demand for rail rapid transit in the cities which have it. This experience has proven that adequately financed public transit can attract riders and accomplish the long-range goals of reducing congestion and pollution.

EVALUATION OF TEN EUROPEAN SYSTEMS BY RIDERSHIP TREND

In Table 10, the ten European transit systems are classified according to whether total public transit ridership is increasing (Munich, Hamburg, Stockholm), stable (Paris, Copenhagen, Oslo), or decreasing (Gothenburg, London, Newcastle, Edinburgh). For each of the systems, the table indicates the status of major institutional, operational, and physical integration techniques.

Several patterns associated with successful public transit systems are discernable from Table 10. The systems which have succeeded in increasing or retaining their ridership have done so in the face of a greater motorization than those systems which have not. Increasing congestion may have something to do with this phenomenon, but INTERPLAN suggests that a revolution in public transport management thinking, brought on by the problems associated with increased motorization, is the most likely cause. Other patterns which emerge from this table are listed on page viii of the Executive Summary.

Table 10. Selected integration characteristics of ten European public transit systems.

	Increasing Public Transit Ridership			Stable Public Transit Ridership			Decreasing Public Transit Ridership			
	Munich	Hamburg	Stock-holm	Paris	Copen-hagen	Oslo	Gothen-burg	London	New-castle	Edin-burgh
CITY CHARACTERISTICS										
Population (millions)	2.1	2.5	1.5	10.0	1.4	0.7	0.7	7.5	0.9	0.7
Persons per car	3.2	3.8	3.8	4.6	5.2	4.4	3.5	4.7	9.1	5.9
TRANSIT RIDERSHIP										
Annual trips (millions)	289	645	326	1690	285	175	98	2200	387	168
Trend (annual % change)	+3.3	+1.7	+1.1	cyclic	cyclic	cyclic	-1.0	-1.7	-1.7	-2.0
RAIL RAPID TRANSIT*										
System name or type	U-Bahn	U&S-Bahn	T-Bana	Metro	none	T-bane	Lt.rail	Undergr.	none	none
Annual ridership (millions)	7	344	137	1076	n.a.	30	n.a.	700	n.a.	n.a.
Ridership trend	+	+	+	stable	n.a.	+	n.a.	stable	n.a.	n.a.
FINANCIAL STATUS										
Buses	deficit	mixed	planned	planned	deficit	deficit	deficit	deficit	surplus	surplus
Rapid transit	deficit	mostly	deficit	deficit	n.a.	on city-	n.a.	surplus	n.a.	n.a.
Commuter rail	deficit	surplus			--	owned op.	n.a.	--	deficit	deficit
INSTITUTIONAL INTEGRATION										
Transit planning and operator coordination										
Single regional transport and land use planning agency			SCC					GLC		
Single transit planning organization, several operators	MVV	HVV							PTA	
Single area-wide transit operator/transit planner				RATP			GS			
Multiple planning agencies and operators					KS et al.	OS et al.				ECT, SBG, BR
Degree of operator coordination	Federation control	Federation control	One Operator	One Operator	Some agreements	none	One Operator	legal requirements	PTA control	none

*Rail systems providing primarily commuter service are not included (e.g., RER in Paris, S-Bahn in Munich).

n.a. Not applicable.
-- Not available.

Table 10. (continued)

	Increasing Public Transit Ridership			Stable Public Transit Ridership			Decreasing Public Transit Ridership			
	Munich	Hamburg	Stock-holm	Paris	Copen-hagen	Oslo	Gothen-burg	London	New-castle	Edin-burgh
OPERATIONAL INTEGRATION										
Fare structure characteristics										
Coordinated system-wide inter-modal fares	yes	yes	yes	yes	no	no	GS sys-tem	no	no	no
Coordinated bus mode fares	yes	yes	yes	yes	some rtes.	OS sys.	GS sys.	no	no	no
Zonal fares	yes	no	in city	no	no	OS sys.	no	no	no	no
Flat fares	no	no	no	Metro	KS sys.	Central zone	no	some routes	no	no
Distance graduated or staged	no	yes	suburban	buses & RER	no	other systems	yes	yes	yes	yes
Seasonal passes for zones or routes	yes	yes	no	no	KS system	OS sys-tem	no	yes	--	--
Seasonal passes for whole system	yes	no	yes	yes	KS system	no	yes	yes	--	ECT system
Special rates for socio-economic groups	yes	yes	yes	yes	yes	no	yes	yes	yes	yes
Free return trips under time limitations	no	no	yes	no	no	--	yes	some BR routes	no	no
Modal transfer, individual fares available	no	no	no	RATP-SNCF	KS-DSB	OS system	no	LTE-BR	no	no
Modal transfer, seasonal passes available	no	no	no	RATP-SNCF	no	OS system	no	yes	--	no
Free transfers within mode	yes	yes	yes	Metro	KS system	central zone	yes	Under-ground	no	no
Free transfers for whole system	yes	yes	yes	no	KS system	central zone	yes	no	no	no
Honor system	yes	yes	--	partial	partial	no	yes	no	no	no
Automated ticket sales	yes	yes	--	yes	yes	--	--	yes	no	no
Emphasis on buses as feeders to rapid transit	yes	yes	yes	yes	n.a.	within agencies	most routes	yes	n.a.	n.a.
Bus/Tram-only lanes and streets	some	yes	yes	yes	some	some	yes	some	no	planned

n.a. Not applicable.
-- Not available.

Table 10.(continued)

	Increasing Public Transit Ridership			Stable Public Transit Ridership			Decreasing Public Transit Ridership			
	Munich	Hamburg	Stock-holm	Paris	Copen-hagen	Oslo	Gothen-burg	London	New-castle	Edin-burgh
Controls on Automobile Traffic										
Parking controls	--	yes	yes	yes	yes	yes	yes	yes	--	no
Pedestrian malls and streets	yes	yes	yes	--	yes	yes	yes	--	--	--
Comments			no sig-nificant impact	policy of benign neglect			traffic restraint scheme	auto system favored		
Network rationalization (re-moval of redundant services)	in progress	complete	--	yes	no	no	yes	some	yes	no
Integrated public informa-tion system	yes	yes	yes	yes	--	--	yes	yes	--	--
PHYSICAL INTEGRATION										
Park-and-ride facilities for										
Commuter rail	yes	yes	yes	yes	no	--	n.a.	yes	no	no
Rapid transit	some	yes	yes	no	n.a.	--	planned	yes	n.a.	n.a.
Rights-of-way & stations shared by rapid transit & commuter rail	yes	some	--	yes	n.a.	no	n.a.	yes	n.a.	n.a.
Emphasis on pedestrian facilities and services	yes	yes	yes	yes	some	some;more planned	yes	some	no	no
Airport-city rail connection	no	streetcar	no	planned	no	--	no	under con-struction	no	no

n.a. Not applicable.
-- Not available.

Based on Sections 2-6, the references for these sections, and INTERPLAN's direct experience.

TECHNIQUES OF INTEGRATION

The items described in full detail in the report and briefly presented in this summary are as follows:

- Institutional Integration
  - Merger
  - Federation
  - Passenger transport executive
- Operational Integration
  - Adaptation of mode to service requirements
  - Public information systems
  - Unification and coordination of fares
  - Honor payment system
  - Fare discounts
  - Parking control
  - Bus-only lanes and streets
  - Staggered work hours
- Physical Integration
  - Intermodal terminals
  - Pedestrian facilities
  - Park-and-ride facilities

Some of these are beginning to be implemented in the U.S., such as exclusive bus lanes and park-and-ride lots. Others are truly innovative, such as the federation form of institutional integration. But it should be borne in mind that it is not just the individual techniques which are of significance but the way in which all three aspects of integration are dealt with in a single, comprehensive program that has made integrated European transit systems work.

Institutional Integration

Alternative organizational forms for institutional integration are listed on page 8, Section 2. Merger is the recommended form where possible in preference to a federation because a single agency can function with greater flexibility and efficiency than can an association of separate agencies.

Federation is a comparatively unwieldy institutional arrangement for achieving integration and is adopted in situations where merger is impractical because one operator is state or federally owned or because some operations are public and some private. Federation is also useful as an interim solution until the consolidation of operations into a single, region-wide transit agency is possible.

The British PTA-PTE arrangement is something of a hybrid. While it is not voluntary like a federation, it has the broad planning powers of a federation which a merged single operator usually lacks. On the other hand, it is directly responsible for operations in a way in which a federation is not. The PTA-PTE example is proof that elements of merger and federation may be combined into a new and unique institutional form suited to the needs of a particular transit system.

Operational Integration

ADAPTATION OF MODE TO SERVICE REQUIREMENT. For high density, corridor-type service, commuter rail or rapid transit is the most economical and efficient system. For light density routes, rail cannot compete with bus. In very light density areas, there is no substitute for para-transit and the private automobile.

While these principles are generally recognized, they are more widely practiced in Europe than in the U.S. Rail, feeder bus, and park-and-ride services are being expanded or altered continually in an effort both to rationalize networks and to anticipate long-term movements of population. In the downtown areas, rapid transit is available for long trips, taxis and buses for short distance hops, and pedestrians are given every inducement to walk. Only parking facilities are relatively scarce and expensive. Thus the full range of modes is in use, from walking to express trains, each adapted to its best use.

PUBLIC INFORMATION SYSTEMS. To be integrated, an information system must provide information on all area transit services whether they are run by a single operator or many operators. The system should include both a publications program (e.g., route maps, information brochures) and a unified vehicle and station graphics program (e.g., logo on all vehicles, direction

signs at stops and in stations). The important qualities of good transit information are that it be clear, attractive, and above all ubiquitous. The wide range of publications produced by London Transport should serve as an example and source of ideas for U.S. systems. In addition to a telephone inquiry service, there are pocket maps, display maps, timetables, tourist guides, entertainment and historical guides, leaflets, posters, and films.

UNIFICATION AND COORDINATION OF FARES. A good unified, coordinated, and graduated fare structure should permit passengers to pay a single fare for a single trip and transfer from mode to mode and line to line without further charge. The Hamburg and Munich Transit Federations have set up a single graduated fare system with complete transfer privileges for all riders between all forms of transportation. In Paris, the fare system is effectively coordinated through the use of the same tickets for the Metro and the buses.

HONOR PAYMENT SYSTEM. Another way to make transit travel easier is to eliminate barriers, turnstiles, and ticket-punching operations. In Hamburg, a rider need not show his ticket or pass unless the train or bus on which he is riding happens to be subjected to a spot check. This honor system may cost the HVV a few free rides, but it has also cut costs by eliminating hundreds of ticket-takers and conductors. In Gothenburg, Munich, Paris, and Copenhagen where honor systems are in effect, authorities estimate that possibly 2 to 3 percent of the total ridership may be riding without valid tickets.

Since financial considerations obviously encourage initiation of the honor payment system, the only other serious consideration is the "honor" of the American public. If inspections are done on a well-planned random schedule and negative reinforcement through heavy fines is consistently applied, "intrinsic honesty" does not come into question, and "honest" behavior will be bound to result.

FARE DISCOUNTS. In every European system studied, special rates are offered for age and occupational groups such as students, senior citizens, commuters, transit company employees, and tourists. Most systems also offer discounts for purchasing a multi-ticket booklet or a time pass. The Hamburg system also has used fare discounts as an excellent marketing tool,

offering a fascinating variety of seasonal trip-purpose discounts, including those for vacationing elementary school children, families on weekend trips, and families shopping for Christmas.

PARKING CONTROL. When downtown parking rates are prohibitive, automobile travel becomes less attractive and the merits of public transit are enhanced without intrinsic changes in either mode. Because parking rates are an out-of-pocket cost, they tend to function as a more direct deterrent to automobile use than do gasoline taxes and registration fees.

The London County Council's authority to license off-street car parks and its powers over on-street parking enable it to exercise indirect control over the volume of private traffic by limiting the total number of parking spaces. Rates increase with land values so that the closer one parks to central London, the more exorbitant the rates become.

While most efforts to control parking have relied primarily on the pricing machanism, Gothenburg has gone one step further and created traffic control barriers to auto traffic in the downtown area, strategically locating large car parks just outside the area of the traffic restraint scheme.

BUS-ONLY LANES AND STREETS. Bus-only lanes and streets have a dual effect in encouraging public transit use. First, restricting street space, like parking controls, discourages automobile travel downtown by limiting its mobility. Secondly, the reliability and speed of bus transit is significantly improved when buses run on separate rights-of-way.

Eight of the ten European cities provide at least some bus-only lanes and streets. Streets reserved for public transit can be found in Gothenburg, London, Copenhagen and Oslo. The results have been considered successful and transit operators in several cases would like to see more bus-only lanes established.

STAGGERED WORK HOURS. Campaigns to stagger work hours in London have been fairly successful in changing office hours in Central London as well as factory hours in suburban industrial colonies. Experience has shown that success is greater in these suburban operations since the smaller relative scale is much more manageable than is the vast complex of Central London offices.

Physical Integration

INTERMODAL TERMINALS. Experience in London suggests that the provision of costly and specially designed interchange terminals cannot easily be proved to result in sufficient additional revenue to offset the cost of provision. However, good interchange facilities are thought to be important in improving the image of public transport, and capital grants are provided by the central and municipal governments to assist in their financing. The same approach characterizes the Paris and Munich treatment of terminals for their new rail systems (U-Bahn and RER). Good intermodal terminals are designed to serve multiple functions: as terminals where vehicles of several modes must deliver and pick up passengers; as transfer points handling moving masses of people; as shopping centers; and as pleasant architectural environments which communicate something of the spirit of the city and its people.

PEDESTRIAN FACILITIES. Ease of pedestrian movement is an important factor in the acceptability and performance of a transit system. Grade-separated pedestrian walkways or underground passageways across traffic arteries, escalators, moving sidewalks, and signs orienting and directing the pedestrian all facilitate and expedite movement by foot. The transit systems of Paris, Stockholm, Hamburg, Munich, and London are amply provided with such facilities and more escalators are being installed to replace existing stairways.

PARK-AND-RIDE. In support of efforts to reduce downtown congestion in London through regulation of parking, approximately 11,000 car spaces are provided at surface car parks operated by London Transport at 68 stations on the Underground system. By deliberate policy, hardly any car parks are provided in the inner suburban area.

Hamburg is still expanding its park-and-ride facilities with the goal of enabling any motorist to easily switch to rapid transit with no charge for parking—outside the city center, that is. The HVV estimates that in 1970 these lots spared the center city 20 percent of all long-term parkers. Hamburg has also used some unusual ideas in building and promoting use of park-and-ride facilities. For one thing, facilities are provided for both

cars and bicycles. Lots have been built from revenues earned by parking meters in the congested central city. Thus parking revenues have paid for parking facilities rather than being swallowed up as general revenues.

APPLICABILITY TO AMERICAN CITIES

Perhaps the most important lesson to be learned from the European case studies is that successful transit improvement occurs only within the framework of a sound transportation policy. Sound transportation policy recognizes the interactions of public transit planning with regional land-use planning as well as with environmental planning, automobile traffic management, and financial management which recognizes the non-revenue producing benefits of public transit. These interactions vary a great deal and each case should be studied individually to determine the applicability of European methods.

European solutions to transit problems currently facing the United States can be grouped into solutions immediately applicable and solutions which should await institutional integration to become applicable. Solutions which can be implemented independently of institutional integration include higher operating standards of individual transit systems (e.g. punctuality, frequency, reliability, bus shelters), provision of adequate public information system, parking control, expansion of park-and-ride facilities, bus-only lanes and streets, staggering of work hours, enacting an honor payment system, and other novel approaches relating to fares.

Solutions largely dependent on institutional integration include coordinated bus feeder service and other adaptations of mode to service requirements, an integrated public information system, a unified system-wide fare structure, intermodal terminal interchanges and extensive pedestrian facilities.

Solutions which can be furnished by UMTA include centralized research and development, guidance for operational improvements, creation of a nation-wide "ride-transit" movement, and an enlighted capital grants program incorporating incentives which would reward local effort and performance.

SECTION 4
TRANSIT INTEGRATION IN U.S. URBAN AREAS

OVERVIEW

Major U.S. Metropolitan Areas Surveyed

Thirty Standard Metropolitan Statistical Areas were surveyed for their potential for transit integration. These 30 areas account for an estimated 80 percent of all public transit patronage. They include all metropolitan areas of over one million population and two additional areas where local interest in being included in the study was expressed by UMTA. On the basis of information obtained through a literature search, from written response to INTERPLAN's inquiries, and from field trips, these 30 cities were narrowed down to three for which specific integration approaches were suggested. In order to provide an example of how transit integration applies to the needs of a smaller urban area and how such an area might approach transit integration, a "typical" small city, "Middletown," was examined in the same way as the three in-depth cities.

Examples of Different European Approaches

The U.S. cities selected as examples for the application of European methodologies of transit integration offer the potential for three major approaches:

1. A series of specific operational and physical integration activities for one city in which a degree of institutional integration has been achieved.
2. An institutional arrangement patterned after the Hamburg and Munich Transit Federations where one of the partners operates a statewide rather than an urban service.
3. A plan along the line of the organization of the London Transport Executive (or RATP in Paris) for combining public transit agencies into a single integrated agency.

The first approach applies to both Philadelphia, where institutional integration is close to realization following a series of acquisitions by one public agency (SEPTA), and Middletown, where institutional integration of transit is of little consequence because there is only one bus company. In Philadelphia, four mini-projects are suggested: an honor

fare system, restructuring of fares, network integration, and an integrated public information system. In Middletown, the proposed emphasis would be a para-transit, walking, biking, and transit's interfaces with these modes. Route and schedule restructuring, an auto-free zone, a pedestrian mall, and a special "package" bus to serve shoppers are also suggested.

Both the second and third approaches to institutional integration are considered in the context of transit operations in the San Francisco Bay region. It is suggested that both merger and federation would have a place in the long-range realization of an integrated regional transportation system.

The federation approach is felt to be most applicable to transit operations in the Puget Sound region (Seattle), with a specific suggestion to integrate bus and ferry service. The application of the federation approach is also reviewed in the Philadelphia discussion as an eventual goal of transit integration activities.

In all cases, discussion of the most appropriate solution to an area's institutional integration problems is followed up by further suggestions on operational and physical measures.

Checklist of Integration Activities

In order to facilitate the comparison of the integration activities suggested for the four representative cities, INTERPLAN prepared a highly detailed, exhaustive, eleven-page checklist of all imaginable activities which might be part of a city's transit integration program, categorized as being institutional, operational, or physical and according to the organizations which would be involved (operators only, government agencies and local businesses). A completed checklist is given for each of the four cities in Volume 3 of the full report. The checklist is also designed to be useful as a source of ideas and as a worksheet for cities interested in designing their own transit integration programs.

SELECTION OF REPRESENTATIVE METROPOLITAN AREAS

In broad outline, the selection process was carried out by the following steps:

- Thirty major metropolitan areas initially investigated were selected from the 243 Standard Metropolitan Statistical Areas (SMSAs) defined by the U.S. Bureau of the Census primarily on the basis of size.

- Seventeen of these 30 areas were selected for closer examination on the basis of apparent need for transit integration and interest in participating in the study.

- Nine of the 17 SMSAs were selected for field investigation on the basis of population size, location and ease of access to necessary information.

- Three of the nine SMSAs were finally selected to serve as examples of the application of European integration techniques on the basis of size, location, and their potential for different approaches to achieving transit integration.

The results of these investigations are summarized in Table 11.

INITIAL INVESTIGATION OF 30 METROPOLITAN AREAS

In an analysis of the relation of transit patronage to population size,* it was found that 70 percent of the total transit ridership in the United States is concentrated in the 15 largest SMSAs. In cities of less than 500,000, no substantial transit patronage exists. Therefore, INTERPLAN decided to limit its investigation to the 28 metropolitan areas with populations of one million or more, in which an estimated 80 percent of all U.S. public transit patronage is concentrated. Two other metropolitan areas were added to the list of those to be investigated (Honolulu and Hartford) because local transportation authorities expressed to UMTA their special interest in this study.

To each of these 30 urban areas, INTERPLAN sent a letter describing the purpose of our investigation and the information we hoped to obtain. All but three of the areas responded. On the basis of the information received

*History of Transit and Innovative Systems, Richard J. Solomon and Arthur Saltzman, Urban Systems Laboratory, MIT, Cambridge, 1971.

Table 11. Summary of INTERPLAN's investigation of 30 major metropolitan areas.

Rank in 1970 Population	Standard Metropolitan Statistical Area	1970 Population (1,000)	Public Transit Systems in Operation: Total Systems	Rail Rapid Transit	Bus	Commuter Rail	Ferry	Other	Systems in Planning Stage	Letter of Inquiry Sent	Reply Received	Questionnaires Sent	Field Investigation	Need and Potential for Integration	Evaluation of Potential for Demonstration
A. SMSA's with population of 1,000,000 and over:															
1	New York, N.Y. (Tri-State)	11,572	39	4	31	4	1			x	Fare-box level integration only is possible in the short run.	No	No	Greatest in the USA.	Problems too complex for feasible demonstration at this stage.
2	Los Angeles—Long Beach, Ca.	7,032	32		32					x	Wants interagency cooperation.	Yes	Yes	Very great, especially in the field of public-para-private transportation.	Problem too complex for demonstration at this stage.
3	Chicago, Ill.	6,979	28	1	18	9				x	Interest of Transit Carriers Coordinating Committee.	Yes	No	Second greatest potential after N.Y.	Potentially very great.
4	Philadelphia, Pa.—N.J.	4,818	12	2	8	2				x	Strong interest.	Yes	Yes	Very great.	Good potential for operational demonstration
5	Detroit, Mich.	4,200	8		6	2				x	Integration studies under way. No interest at this time.	No	No	It is likely to be great.	Not at this time.
6	San Francisco—Oakland, Ca.	3,110	17	1	13	1	2			x	Needs integration. Some studies under way.	Yes	Yes	Great. May be achieved earlier than in N.Y. and Chicago. Under local study.	Good potential for London-type merger.
7	Washington, D.C. —Md.—Va.	2,861	7	1*	4	2				x	Integration studies under way. No interest now.	No	No	Great. Could be achieved relatively quickly.	Not at this time.
8	Boston, Mass.	2,754	33	1	30	2				x	No response.	No	No	Very great potential.	Not sufficient local interest.
9	Pittsburgh, Pa.	2,401	4	1	1	2			RRT	x	No response.	No	No	All services integrated under Port Authority.	Not sufficient local interest.
10	St.Louis, Mo.—Ill.	2,363	1		1				RRT	x	Integration achieved. No interest.	No	No	Possible for operational and technical integration with para- and public.	Not sufficient local interest.
11	Baltimore, Md.	2,071	3		3				RRT	x	Strong interest.	Yes	Yes	Great for operational and technical integration with para- and public.	Good long-range potential.
12	Cleveland, Ohio	2,064	8	2	6					x	Interest of local operators and planners.	Yes	Yes	Great at institutional, operational and technical levels.	Expect large T-9 grant to study integration. Demonstration not needed.
13	Houston, Texas	1,985	1		1					x	No response.	No	No	Possible for operational and technical improvements.	Not sufficient local interest.

Table 11. (cont'd)

Rank in 1970 Population	Standard Metropolitan Statistical Area	1970 Population (1,000)	Public Transit Systems in Operation: Total Systems	Rail Rapid Transit	Bus	Commuter Rail	Ferry	Other	Systems in Planning Stage	Letter of Inquiry Sent	Reply Received	Questionnaires Sent	Field Investigation	Need and Potential for Integration	Evaluation of Potential for Demonstration
14	Newark, N.J.	1,857	(included in New York)												
15	Minneapolis—St.Paul, Minn.	1,814	6		6				RRT	x	Integration being studied.	Yes	No	Under local study.	Not at this time.
16	Dallas, Texas	1,556	1		1					x	Only one operator.	No	No	Possible for operational and technical improvements.	Not at this time.
17	Seattle—Everett, Wash.	1,422	12	1	5		6		RRT	x	Needs integration of ferry with urban and suburban buses.	Yes	Yes	Great, including integration with para and private modes.	Good potential for Hamburg-type association.
18	Anaheim—Santa Ana—Garden Grove, Ca.	1,420	(included in Los Angeles—Long Beach)												
19	Milwaukee, Wis.	1,404	2		2					x	Not interested in integration at present.	No	No	Not studied. Possible needs for operational and technical improvements.	Not at this time.
20	Atlanta, Ga.	1,390	1		1				RRT	x	Fully integrated bus-rail system achieved.	No	No	Because of MARTA likely to be great.	Not at this time.
21	Cincinnati, Ohio-Ky.—Ind.	1,385	1		1					x	City is interested.	Yes	No	May be significant for physical integration.	No information received as yet.
22	Paterson—Clifton—Passaic,N.J.	1,359	(included in New York)												
23	San Diego, Ca.	1,358	4		4				RRT	x	Interest in integrating proposed RRT system with bus.	Yes	Yes	Very great, especially in the field of public-para-private transportation.	Needed later when RRT system is developed.
24	Buffalo, N.Y.	1,349	4		4				RRT	x	Strong interest.	Yes	No	Likely to be great.	Good long-range potential for demonstration.
25	Miami, Fla.	1,268	4		4					x	Needs integration. Studies under way. Strong interest.	Yes	Yes	Especially great for public-para-private integration with special reference to airport access.	Good long-range potential for demonstration.
26	Kansas City, Mo.—Kansas	1,254	1		1				RRT	x	Integration already achieved.	No	No	Possible for operational and technical improvements.	Not at this time.
27	Denver, Colo.	1,228	4		4					x	Transit study now under way.	No	No	Likely need for operational and technical improvements.	Not at this time.

Table 11. (cont'd)

Rank in 1970 Population	Standard Metropolitan Statistical Area	1970 Population (1,000)	Public Transit Systems in Operation: Total Systems	Rail Rapid Transit	Bus	Commuter Rail	Ferry	Other	Systems in Planning Stage	Letter of Inquiry Sent	Reply Received	Questionnaires Sent	Field Investigation	Need and Potential for Integration	Evaluation of Potential for Demonstration
28	San Bernardino—Riverside—Ontario, Ca.	1,143	(included in Los Angeles—Long Beach)												
29	Indianapolis, Ind.	1,110	6		6					x	Needs integration. Interested.	Yes	No	May be significant.	More information needed.
30	San Jose, Cal.	1,065	(included in San Francisco—Oakland)												
31	New Orleans, La.	1,046	6		4		2		RRT	x	Needs integration. Interested.	Yes	Yes	Great for integration of public-para-private modes.	Good long-range potential.
32	Tampa—St.Petersburg, Fla.	1,013	4		4				RRT	x	Needs integration. Interested.	Yes	No	Significant, including over-the-water modes.	Good long-range potential.
33	Portland, Ore.—Washington	1,009	3		3					x	Integration achieved through merger of principal systems.	No	No	Possible for operational and technical improvements.	Not at this time.
B. Smaller SMSA's of special interest:															
36	Hartford, Conn.	664	1		1					x	Strong interest of CONN-DOT to integrate transit districts statewide.	Yes	No	Need for statewide operational and technical integration.	Statewide problem needs assistance under other UMTA programs.
53	Honolulu, Hawaii	629	1		1				RRT	x	Strong interest.	Yes	No	May be significant.	Further investigation needed.

*Under construction.

in response to these letters, an evaluation was made of the potential for integration in the 30 urban areas. Of the 30 metropolitan areas studied, only three—Houston, Dallas, and Hartford—have no current or future needs for transit integration. Each is served by a single bus system. Four other areas—St. Louis, Atlanta, Kansas City and Honolulu—are also served by single bus systems, but will need to integrate these with the rail rapid transit systems they are planning to construct. Rail rapid transit is also being planned in eight other metropolitan areas: Pittsburgh, Baltimore, Minneapolis-St. Paul, Seattle-Everett, San Diego, Buffalo, New Orleans and Tampa-St. Petersburg. Not only will integration of these new systems be necessary in the future, but each of these SMSAs has immediate need for integration of their existing systems.

There is a greater need for interagency integration than for intermodal integration. In 23 of the SMSAs, transit service is provided by more than one operator, but in ten of these areas, the only mode involved is bus. Immediate needs for intermodal integration exist in only 14 SMSAs, and future needs will be experienced in three others only when rail rapid transit is constructed.

Further Investigation of 17 Metropolitan Areas

On the basis of the initial investigation of 30 SMSAs, INTERPLAN selected for further study 17 SMSAs where there was felt to be immediate potential for transit integration and where the cooperation of local transit agencies and operators essential to the study could be expected. Figure 3 shows locations of these 17 cities, and Table 12 shows their distribution with regard to population size and geographical location.

Four methods were used to develop further information about the integration needs of these 17 SMSAs:

1. Literature search and review of data supplied by local agencies;
2. Questionnaires;
3. Wish Lists;
4. Field investigations in selected SMSAs.

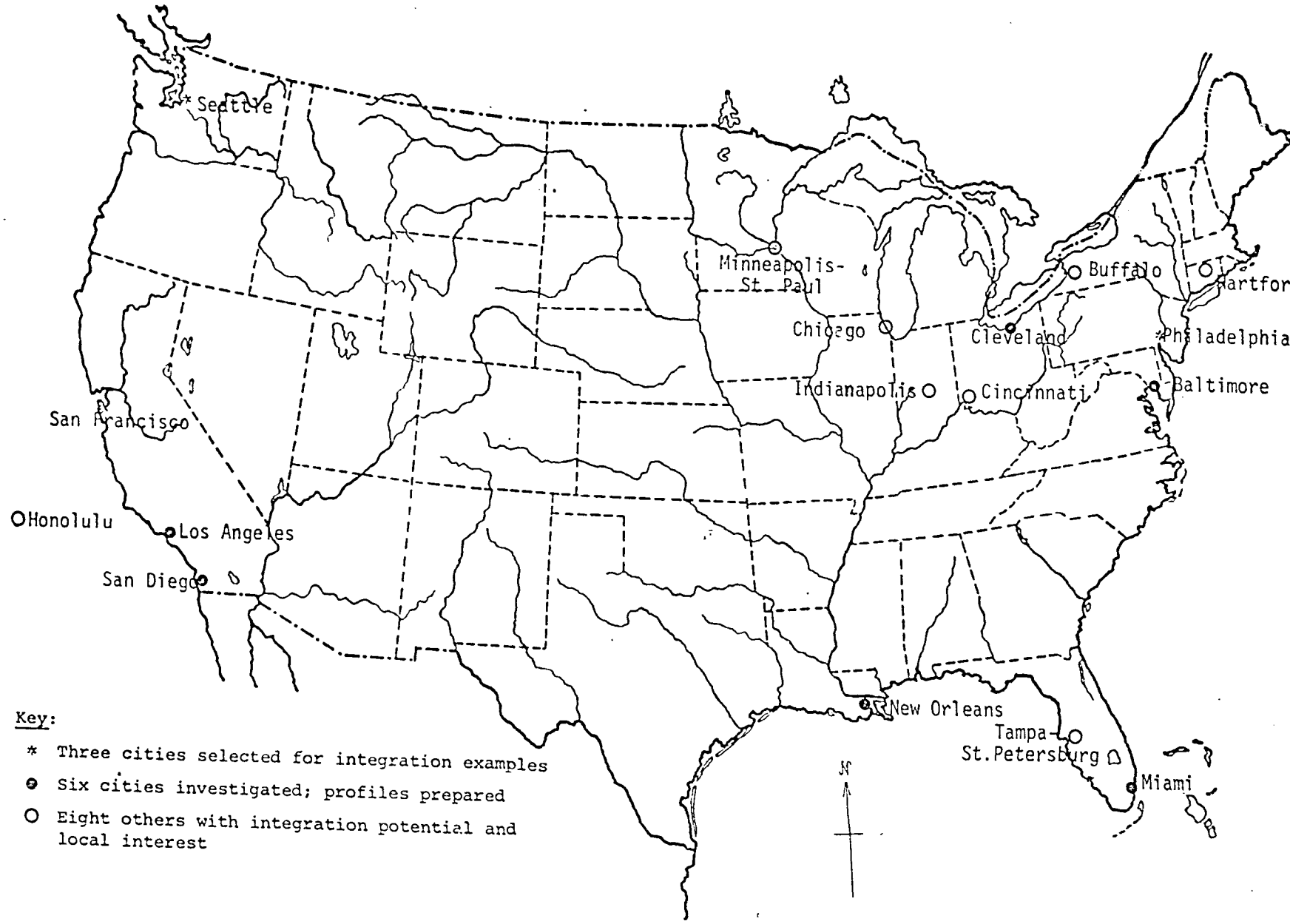

Figure 3. Map of the United States, showing 17 cities investigated.

Table 12. Seventeen SMSAs selected for further study.

	Location
Over 4 Million Population	
1. Los Angeles	West Coast
2. Chicago	Midwest
3. Philadelphia	East Coast
2-4 Million Population	
4. San Francisco-Oakland	West Coast
5. Baltimore	East Coast
6. Cleveland	Midwest
1-2 Million Population	
7. Minneapolis-St. Paul	Midwest
8. Seattle-Everett	Northwest
9. Cincinnati	Midwest
10. San Diego	West Coast
11. Buffalo	Northeast
12. Miami	South
13. Indianapolis	Midwest
14. New Orleans	South
15. Tampa-St. Petersburg	South
Less Than One Million Population	
16. Hartford	Northeast
17. Honolulu	Pacific

Selection of Three Representative Areas

Philadelphia, San Francisco, and Seattle were selected to serve as representative U.S. urban areas to which European approaches to transit integration could be applied. Four criteria were used. The most important was that each area provided an opportunity to apply different European methodologies for achieving integration. The second criterion was that each area should present problems in both intermodal and interagency integration. The last two criteria were that each should represent a different population size group among the major SMSAs, and that so far as possible they should be located in different parts of the United States. Table 13 shows how the three representative areas meet these criteria.

Table 13. Rating of three representative cities by four selection criteria.

Area	Type of European Approach to Integration	Type of Integration Potential		Location and Population
		Inter-Modal	Inter-Agency	
Philadelphia	Specific techniques for operational integration	X	X	Eastern Central 4.8 million
San Francisco	Open choice between London (Paris) or Hamburg (Munich) examples of institutional and operational integration	X	X	West Coast 3.1 million
Seattle	Hamburg example of institutional integration	X	X	Pacific Northwest 1.4 million

Integration Potential in the Three Selected Areas

INTERMODAL. All three cities present high potential for intermodal integration. Both Philadelphia and San Francisco are served by commuter and light rail, subway, streetcar, trolley and bus. Both areas are also in good position to experiment with solutions to the problems created by transit operations which cross municipal, county, and, in the case of Philadelphia, state lines. While Seattle does not presently have a rapid rail system, a demonstration which involves its ferry system will throw light on the interface problems between a bus mode and a high-density "corridor" mode.

INTERAGENCY. With regard to interagency integration potential, the greatest progress has been made in Philadelphia. A demonstration there which would concentrate on operational and physical (technical) problems could therefore be a good example of what can be achieved when many but not all institutional problems have been solved.

In Seattle, unification of two operators under Metro, approved by voters in September 1972 and operational since January 1, 1973, goes a

long way toward meeting the requirements of institutional unity. Metro's willingness to cooperate with the state-operated ferry system also augurs well for the future of further institutional integration.

In San Francisco interagency integration is least advanced and therefore the potential is the greatest. While reaching an agreement will not be easy, the situation is considerably less complicated than in New York, Chicago or Boston. Also, the advent of BART has created pressure to coordinate its services with those of Muni, AC Transit and other operators in the Bay Area. The able leadership of the Metropolitan Transportation Commission is a valuable asset in local efforts toward interagency integration.

Transit Integration in a Small Urban Area: Middletown

There are 243 Standard Metropolitan Statistical Areas (SMSAs) in the United States. Of these, INTERPLAN was able to examine, albeit superficially, the thirty largest; within the scope of this study, only nine could be studied in some depth. It follows that more than 200 SMSAs were overlooked. While the most serious difficulties with public transportation in the U.S. occur in the 30 largest urban areas, UMTA's legal responsibility extends to all SMSAs and also to smaller "urban areas". INTERPLAN therefore felt that this study would be incomplete without an attempt to examine the problems and potential solutions in medium-sized and small cities.

Obviously an individual approach to every SMSA was not feasible. Therefore INTERPLAN examined in some depth the problems of public and para-transit in one city and verified its findings on the basis of more superficial surveys of a few other small cities. The composite picture which emerged was labeled "Middletown". On the basis of this work, an outline of a transport integration demonstration in Middletown was prepared.

CHECKLIST OF TRANSIT INTEGRATION ACTIVITIES

In order to provide a single format for recording transit integration activities in the three U.S. cities and Middletown, INTERPLAN compiled a

listing of integration activities. The major headings of this list are given in Table 14; the complete listing is given on pages 52-62 of Volume 3. A commentary covering individual items is provided in Appendix D to that volume.

Table 14. Summary of categories of transit integration activities.

INSTITUTIONAL

Operator and City/County/State Planning Coordination
- Set up Regional Planning Coordinating Organization
- Requirements for Successful Demonstrations
- Set up Single Transportation Transit Planning Authority

Operator/Operator Coordination
- Set up Coordinating Structure for Intra-region Public transit
- Set up Coordinating Structure for Out-of-region/Intercity Transportation

Transit/Para-Transit Operator Coordination
- Set up Coordinating Structure

Public Transit Financing Arrangements
- Sources for Financing Capital Investment Other Than Rolling Stock
- Sources for Financing Rolling Stock and Buses
- Sources for Financing Operating Costs

OPERATIONAL

Activities Requiring Coordination with City/County/State Agencies
- Auto Parking Policy in Major Activity Centers
- Auto Use Restriction Policy
- Traffic Management in Support of Public Transit

Activities Requiring Coordination with Government Agencies and Local Businesses
- Changing Transit Demand Characteristics

Activities Requiring Operator Coordination
- Basic System-wide Fare Structure
- Supplementary Policies on Fare Structure
- Fare Collection Procedures
- Coordinated Routes
- Coordinated Schedules
- Public Information System

PHYSICAL AND TECHNICAL

Activities Requiring New Technology and Coordination with Government Agencies
- Automated Operations

Activities Requiring New Technology Which Can Be Adopted Directly By Operator(s)
- Automated Operations

Activities Requiring Proven Technology and Coordination with Government Agencies
- Facility Provision

Activities Requiring Proven Technology Which Can Be Accomplished By The Operator(s)
- Facility Provision
- Vehicle Acquisition
- Equipment to Aid Operations
- Operators' Pooling Agreements

The activities in the list are arranged by institutional, operational, and physical categories. They are further grouped according to the kinds of organizations which must cooperate to implement them (government agencies, operators, local businesses), and the status of the technology required (new or proven). Individual activities in the list may be mutually exclusive, such as flat fare or zonal fare systems, or they may be complementary, such as the various sources of financing indicated.

INTERPLAN feels that this checklist can be valuable in a number of ways beyond its use in this report:

- As a source of ideas for transit planners and operators;
- As a worksheet to be used during the planning and negotiating process;
- As a means of recording a final transit integration program or program proposal;
- As a means of recording programs of several cities on the same list for purposes of comparison.

PROPOSED APPROACHES TO INTEGRATION

In the full version of the report, individual sections of Volume 3 are devoted to each of the three cities selected and to Middletown. In addition to outlining the possible integration approach, the section devoted to each urban area includes the following background information:

- A description of geographical features, population distribution and growth, regional economy and local political setting as they affect the development of transportation.
- A review of local efforts in transportation planning.
- A description of existing public transit services.
- An evaluation of prior and current attempts to achieve transit integration.

In this summary, a brief account of the proposed approach to integration for each city is presented to indicate the way in which the results of the European transit experience can become the basis for a specific series of activities to improve individual U.S. urban transit systems.

Philadelphia and the Delaware Valley Region

Philadelphia appears to offer a number of possibilities for limited attempts toward integration, possible through demonstration projects, which can be worked out well within the existing legal and organizational structure. Four mini-projects, covering an honor fare system, integration and graduation of fares, network integration, and an integrated public information system are suggested for consideration within the SEPTA system. Local attitudes toward integration and timing considerations are favorable and encouraging. Steps toward establishing an area-wide transit federation in Philadelphia along the lines of the Hamburg Transit Federation are presented as a long-range solution which will consolidate and extend these partial approaches.

San Francisco Bay Area

The San Francisco Bay Area presents a unique potential for a long-range, multifaceted pilot program in the development of an integrated regional transportation system. Such a program would include not only the coordination of public transit services through mechanisms such as federation or merger, but also the interrelation of public transit with para-transit and private transportation of people and goods throughout the area.

Two specific approaches outlined in the report could contribute to the long-range realization of an integrated regional transportation system. These are focused on the coordination of public transit through changes in the institutional make-up of existing transit operations. The first presents a plan for a federation of independent public agencies and companies, based on the example of the Hamburg and Munich Verkersverbund (HVV and MVV). The second proposes a merger between three of the major public transit agencies into a single three-county district, based on the example of the London Transport Executive. Each is discussed in the context of local geographical, economic and political conditions and past and current efforts toward developing and coordinating public transit in the Bay Area.

The proposed approaches are not mutually exclusive. Not only is it possible to accommodate a merger of three separate systems within the larger framework of the transit federation, but it is also possible that the total

membership of the federation may eventually be absorbed into a single region-wide transit agency.

Seattle and the Puget Sound Region

The approach proposed for the Puget Sound Region would involve intermodal integration of ferry and bus systems to provide for continuous public transit from the residential areas on the west side of Puget Sound to the Seattle Metropolitan Area. Interagency integration would also be treated through the involvement of state, metropolitan and municipal governments as well as private operators, using some of the solutions suggested by the experience of the Hamburg Federation. This approach would encompass a full range of urban environments from low-density residential areas, through a single-access transportation corridor, to the high-density CBD. The public directly affected would number between 5,000 and 10,000, permitting intensive surveys and analysis of the impacts of the demonstration for evaluation purposes.

Specifically, this proposed plan would call for the integration of public transit of three geographical subareas: the City of Seattle, Puget Sound, and the residential areas of Kitsap County and Vashon Island. Such integration would cover:

- Formation of an association of participating operators
- Coordination of routes and schedules
- Convenient and comfortable transfer facilities
- Single fares for the total three-part journey
- Distribution of revenues from fares
- Coordination of public information, promotion, and ticket sales

At the same time, the study plan would include tasks directed toward improving service within each of the subareas so as to bring all elements up to a level of performance high enough to attract passengers to the total integrated system.

An example is given of the application to the proposed Puget Sound Transit Association of the method of revenue sharing developed by the Hamburg Transit Federation (see pages 224-228, Volume 3). The Hamburg formula is used to calculate the various operators' shares of fares collected by an individual

operator for trips made on his and other lines. This type of revenue redistribution is necessary when a single system-wide fare structure is established by the independent partners of a transit federation.

Middletown: A Smaller Urban Area

"Middletown" is a hypothetical small urban area, designed to be representative of the 50,000-250,000 population group. This group is made up of the 120 smallest SMSAs; about 90 other SMSAs have populations of over 250,000 but fall below the one million population cutoff point used in the selection of three major urban areas in Section 2. Therefore Middletown can be taken to be typical of about half the SMSAs in the United States.

The proposed approach for integration in Middletown would build on the existing public and para-transit networks to achieve a fully responsive transportation system with a minimum of financial and organizational effort. The approach has two main thrusts: operational integration of the existing publicly owned bus company with the privately owned cab company, and increased emphasis on the utilization of para-transit modes, walking and biking. A series of other institutional, operational and physical measures is also suggested in the description of the proposed integration program, presented following a description of the current status of Middletown's transportation system.

The suggested approaches to integration are those which might be undertaken by a small city which is served by a single bus company, and which has no other major mode of public transit. In cities such as Middletown, the changes required to promote integration may be less sweeping than in larger cities which are served by several modes of public transportation. However, the basic problems of auto congestion, air and noise pollution, and the need for a more effective public transportation system are the same, though on a smaller scale.

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	John Paul Jones, President, Cincinnati Transit, Inc.
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Cleveland	David N. Goss, Director, Research and Planning, Cleveland Transit System.
Dallas	Ben E. Tonick, Assistant Manager, Operations, Dallas Transit System.
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Detroit	Thomas H. Lipscomb, General Manager, Southeastern Michigan Transportation Authority.
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