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International Transit Studies Program
Report on the First Three Missions

This TCRP digest summarizes the first three missions performed under TCRP Project J-3, "International Transit Studies Program. "Included in this digest are information on the cities visited, summaries of topics investigated, and discussions of policies and practices that could be used in the United States. The project is administered by the Eno Transportation Foundation, Inc. This digest was prepared by the Eno Transportation Foundation, Inc., on the basis of reports filed by the mission participants.

INTERNATIONAL TRANSIT STUDIES PROGRAM

About the Program

The International Transit Studies Program (ITSP) is part of the Transit Cooperative Research Program (TCRP). The ITSP is managed by the Eno Transportation Foundation under contract to the National Academy of Sciences (NAS). The TCRP was authorized by the Intermodal Surface Transportation Efficiency Act of 1991. In May 1992, a memorandum of agreement outlining TCRP operations was signed by the NAS, acting through its Transportation Research Board (TRB); the Transit Development Corporation, which is the education and research arm of the American Public Transit Association (APTA); and the Federal Transit Administration (FTA). The TCRP is funded annually by a grant from the FTA.

The ITSP is designed to assist in the professional development of transit managers, public officials, planners, and others charged with public transportation responsibilities in the United States. The program accomplishes this objective by providing opportunities for participants to learn from foreign experience while expanding their network of domestic and international contacts for addressing public transportation problems and issues.

The program arranges study missions where teams of public transportation professionals visit transit operations in other countries. The ITSP also provides financial assistance to enable individuals engaged in U.S. public transportation management, operations, planning, or research to participate in international conferences and meetings held outside North America.

Each study mission has a central theme that encompasses issues of concern in public transportation. Cities and transit systems to be visited are selected on the basis of their ability to demonstrate new ideas or unique approaches to handling public transportation challenges reflected in the study mission's theme. Each study team begins with a briefing before departing on an intensive, 2-week mission. After this stimulating professional interaction, study team members return home with ideas for possible application in their own communities. Team members are encouraged to share their international experience and findings with peers in the public transportation community throughout the United States. Study mission experience also helps to evaluate current and proposed transit improvements and can serve to identify potential public transportation research topics.

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Study missions normally are conducted in the spring and fall of each year. Study teams consist of up to 15 individuals, including a senior official designated as the group's spokesperson. Transit properties are contacted directly and requested to nominate candidates for participation. Nominees are screened by a committee of transit officials, and the TCRP Project J-3 Oversight Panel approves the selection.

Study mission participants are up-and-coming transit management personnel with substantial, sustained knowledge and experience in transit activities. Participants must demonstrate potential for advancement to higher levels of public transportation responsibilities. Other selection criteria include current responsibilities, career objectives, and the probable professional development value of the mission for the participant and sponsoring employer. Travel expenses for participants are paid through TCRP Project J-3 funding.

About the Report

The following is an overview of the first three study missions. This report reflects the views of the contributing participants, who are responsible for the facts and accuracy of the data presented. The contents do not necessarily reflect the views of the TCRP, TRB, NAS, APTA, FTA, or the Eno Transportation Foundation.

Appendix A lists the names of study mission participants and their titles and affiliations at the time of their respective missions.

ENHANCING THE ATTRACTIVENESS OF PUBLIC TRANSIT: MISSION 1, SEPTEMBER 9-25, 1994

INTRODUCTION

Western European cities, historically dependent on urban transit and with a tradition of government support of public transportation, have long been at the forefront of transportation innovation. To learn about the latest European advances in urban transportation, a delegation of U.S. transit officials visited several European countries, from September 10 through 24, 1994.

The study team visited the following cities: London, Manchester, Amsterdam, Paris, Lille, Stuttgart, and Karlsruhe. These cities have a long tradition of public transportation and were chosen for the exemplary planning, management, and operation of their transit systems. While a key purpose of the study mission was to identify practices and service innovations that could be used in the United States, participants were keenly aware of differences in the transportation environment that might make it difficult to use certain European practices and innovations in U.S. cities. For example, most Europeans live in densely developed communities with easy access to public transportation. Transit corridors were fixed long before widespread motorization, and the use of transit is firmly established. In addition, gasoline prices, which are three to four times those in the United States, discourage use of cars. Strong central governments set national transportation policy with a focus on encouraging the use of public transit. Although the automobile has stretched metropolitan boundaries, cities remain relatively compact, which facilitates ubiquitous, efficient transit service.

Given these differences, it is not possible to emulate every aspect of European transportation policies in the U.S. context. For example, providing transit service to most metropolitan residents may be achievable in Europe, where most development is still clustered within transit corridors, but would be extraordinarily difficult and expensive in the spread out American suburbs. Creating dense transit networks modeled after those of European cities would require a financial commitment that would be difficult to obtain in America, given present funding constraints. Finally, excluding cars may be sensible in the fragile medieval town centers of Europe, but would be difficult in the large central business districts (CBDs) of American cities.

However, study mission participants found many innovative practices and technologies that are transferable. This report provides an overview of these innovations and of the visits to the communities in which they have been applied.

LONDON

Bus Deregulation and Privatization

In 1986, the British government took steps to deregulate the bus industry outside London. Private bus operators were permitted to offer commercial services wherever they believed they could make them profitable. Today, more than 75 percent of public bus services outside London are operated commercially. Unprofitable services, often serving low-density routes and at low demand times (evenings and weekends) are provided through contracts with private operations when such services are determined to be "socially necessary." Local authorities have been encouraged to sell their bus companies voluntarily; so far about two-thirds of the companies have passed into private hands.

The deregulated public transport system has received both praise and criticism. According to official reports, bus mileage outside London is up by 21 percent, operating costs are down by one-third in real terms, and local subsidies have more than halved. The one disappointment has been a downward trend in bus ridership, which has declined by 35 percent over the past 10 years. While critics blame this phenomenon on deregulation, other observers tend to attribute it to growing car ownership and a dispersal of jobs and residences to the suburbs.

Although London was not included in the original bus deregulation of the mid-1980s, competitive bidding of public bus service has since been made a requirement in London. About

one-half of London's bus system has been put out to bid, and 23 private bus companies operate within Greater London. The remaining service is operated by London Buses Ltd. (LBL), a subsidiary of the public London Regional Transport (LRT). The LBL network is operated by ten separate bus companies, with a network of some 1,700 mi of routes and a fleet of 5,000 buses.

Pursuant to a 1984 act of legislature, the ten bus companies that make up LBL were to be sold into the private sector (privatized) by the end of 1995. Three of the companies have been sold. Ultimately, the British government intends to deregulate London's bus services and allow unrestricted entry in the same way as has been done outside London.

Smart Cards

In London, more than 200 buses, operated by five private companies over 19 routes in the Harrow district of northwest London, are equipped with proximity smart-card readers. More than 15,000 passengers have obtained the credit card-sized pass. The 18-month test involves two types of smart cards--a prepaid seasonal pass and a proximity (contactless) debit fare card from which the cost of each trip is deducted and which can be recharged after its stored value is used up.

Electronic Information Displays at Bus Stops

In London, automated vehicle location (AVL) technology has been put to work communicating bus schedule information to the public. Microwave beacons that "talk to" onboard transponders have been installed on signposts along a 10-mi bus route. The position of each bus as it passes a beacon is flashed to a main control center, which transmits the information to electronic dot matrix displays at the bus stops to inform waiting passengers of the arrival time of the next bus as well as its destination--thus eliminating one of the most common sources of rider dissatisfaction with public transit. London authorities hope to have a quarter of London's 17,000 bus stops equipped with electronic information displays within 10 years.

Until recently, a big obstacle to implementing bus stop passenger information systems has been the high cost of hardwiring bus stops with dedicated cable links. This obstacle has been overcome in London with cellular wireless data transmission (Radio Determination Satellite [RDS]) technology.

Docklands Light Railway--Automated Guideway Transit (AGT) Systems

The Docklands Light Railway (DLR) is England's entry into the field of automated guideway transit (AGT) systems. Opened in 1987 to provide access to the Docklands' Canary Wharf development, the 21.5-km system connects directly with the London Underground and carries 45,000 passengers a day. The DLR recently has been extended east to Beckton, to provide a ground link to the new London City Airport. A 4.5-km extension is being planned as a joint venture with the private sector.

MANCHESTER

The group was briefed by officials of Greater Manchester Passenger Transport Executive (GMPTE). The briefing covered the automatic fare collection system, which uses smart cards, and the Metrolink system. The group toured the Metrolink system, a light rail line that links northern and southern suburbs with the city center. The infrastructure is owned by GMPTE, but the system is operated by a private company. The line carries 100 million passengers annually.

AMSTERDAM

Amsterdam is unique in its heavy reliance on the bicycle. Of the 700,000 residents in Amsterdam, 65 percent own a bicycle. Of the total 2.5 million daily trips, 27 percent are made on bicycle, 39 percent on public transit, and 34 percent by automobile.

This modal split is, in part, the result of Amsterdam's willingness to regulate the use of private automobiles. The streets of Amsterdam and its many canals were never designed to accommodate motorized traffic. Yet for many years, the city accommodated ever-increasing numbers of automobiles--with disastrous results for the quality of the environment. Now, public opinion has swung in favor of traffic restrictions. Today, Amsterdam is at the forefront of cities that are limiting automobile traffic in their historic centers. Automobile restrictions have also been adopted in residential neighborhoods. The Netherlands has pioneered the concept of the *Woonerf*--residential areas in which through-traffic is discouraged and pedestrians have priority.

PARIS

The group was briefed by officials of the Regie Autonome des Transports Parisiens (RATP). The RATP operates one of the largest metropolitan transit systems in the world. The network consists of 215 km of rail lines with 438 stations. The rail system operates more than 4,000 rail vehicles; 4,000 city and suburban buses operate over a route network of 3,000 km. The annual operating budget of the RATP is approximately $4 billion, and the system employs 38,000 people. The study mission toured the regional express metro (RER) operations and the Meteor line now under construction. The group was briefed by officials of the Societe des Transports Parisiens (STP), which is the transport authority of the Paris metropolitan region. The STP coordinates four public and private operating authorities (i.e., RATP, SNCF, APTR, and ADATRIF) with a combined total of 6,500 buses and 1,700 km of routes. It is a policy-making body with authority to determine public transit routes and levels of

service, select private operators, set fares, and determine levels of operating subsidies.

Proximity Smart Cards

The use of proximity smart cards as a transit fare medium is expanding rapidly overseas. Smart cards speed up bus boardings, eliminate the need for cash transactions and cash collections, reduce fraud, have safeguards against theft (when reported lost or stolen, the card can be electronically "blacklisted" to prevent further use), can support a more complex regional fare structure, and enable transportation operators to have more accurate ridership data.

The RATP--the Paris regional transit system that carries 9 million passengers a day--has developed and is testing a smart card that will one day replace the current magnetic-strip card, which has been in use since 1960. The RATP smart card will combine the stored-value debit card features of the widely used French telephone card with the "contactless" reading capability of a supermarket check-out counter. People will be able to use the card for other payment purposes, such as utility bills. One version of the card now being tested includes a digital display of the remaining stored value. The decision to convert to smart cards has been driven by the increasingly complex regional fare structure, which has swamped the limited capacity of the magnetic-strip system, and by the desire to make the card forgery-proof.

Meteor--Automated Rapid Transit

Meteor, now under construction, will be Paris' first automated driverless rapid transit line. The line, scheduled to be completed in 1997, will reduce congestion on the main east-west line of Paris' express rail network, which now carries 62,000 passengers an hour during the peak period. The 20-km Meteor line will have 20 stations and a capacity of 40,000 passengers an hour, with headways of 85 sec during rush hours. It will provide interconnections with eight subway lines and four RER commuter lines.

The totally automatic line will be vibrationless because of rubber tires and pneumatic suspension bogies. Curved aluminum alloy cars will have three extra-wide sliding doors. Initially, each train will consist of six cars carrying some 700 passengers at an average speed of 40 kmh. Platform access will be by way of a mezzanine that straddles the tracks. The platforms will be equipped with safety glass doors, similar to those used in the Villeneuve d'Asq Line (VAL) system in Lille and the Westinghouse airport people movers. These safety doors will open automatically when the train doors open.

The funding for this massive project is shared by the national government, the Paris region, local government, and the RATP.

LILLE

The group was briefed by officials of Transpole and Matra (the builders of the VAL system) and then toured the system. The city of Lille holds the distinction of having pioneered citywide AGT systems. The driverless VAL system has been in operation more than 10 years and carries more than 50 million passengers a year over a 25-km 35-station network. Over the past 10 years, ridership and labor productivity have doubled. The entire system is operated by a staff of 200 employees. By the year 2000, the VAL system is expected to almost double in length, to 45 km. Other VAL-type systems operate at Orly airport in Paris and in the French city of Toulouse. In the United States, VAL systems have been installed at O'Hare Airport in Chicago, Illinois, and in Jacksonville, Florida.

STUTTGART

The group was briefed by officials of Studeingesellschaft Verkehr (SNV), a German transportation research organization on major national research and development programs. The group was also briefed by officials of Neoplan on the latest innovations in bus technology and toured the Neoplan facilities. Following was a briefing by officials of SSB, the Stuttgart transit authority, and a tour of a suburban streetcar line that was first established in 1887 and has been recently upgraded to light rail standards. The line is 12 km long and has 28 stations. It is part of SSB's effort to upgrade all traditional streetcar lines to increase comfort, performance, and ridership. All of the converted lines have gained ridership. The group rode on the Lufthansa airport train. Lufthansa has arranged with the German railways to provide short-haul feeder services to the Frankfurt Airport, its main European gateway. Only airline passengers with confirmed Lufthansa reservations have access to these trains, which are treated as a flight segment.

STORM--An Advanced Traffic Management System

STORM, which stands for Stuttgart Transport Operations by Regional Management, is Europe's most advanced regional integrated electronic traffic management system. Elements of the STORM system include (1) a traveler information system that uses variable message signs and kiosks in transportation terminals and public places, (2) an in-vehicle route guidance system, (3) a real-time parking information and guidance system, (4) an incident management system; (5) transit fleet management using an AVL system; and (6) dynamic traffic signal control.

Variable message signs provide up-to-date information on traffic conditions ahead, parking availability in the city center and in peripheral park-and-ride lots, and departure times of trains and transit. Electronic timetable information is provided through interactive kiosks.

STORM is a public-private consortium that includes the Ministry of Transport for Baden-Wurttemberg,

the city of Stuttgart, Daimler-Benz, Siemens, Bosch, and Hewlett-Packard.

Electronic Parking Management Systems

The use of electronic parking management and guidance systems is increasing rapidly in the cities of western Europe, where severe congestion and shortage of space in city centers are strong economic incentives for technological innovation.

In Stuttgart, an advanced electronic parking management system guides motorists entering the CBD to the nearest parking garage with unoccupied spaces. Variable message signs installed at key intersections on approaches to the CBD and at exit ramps from the autobahns indicate which garages have vacant spaces and how many unoccupied spaces remain in each facility. The message signs are linked to a central computer that monitors all public underground and surface parking facilities throughout the city and updates the electronic displays constantly. When all facilities are fully occupied, message signs direct motorists to commuter rail park-and-ride lots and indicate the headways of commuter trains in the direction of the city center. Stuttgart's parking management system is part of the larger "intelligent" STORM system, which aims to improve traffic flow and reduce traffic congestion throughout the Stuttgart metropolitan area.

Similar areawide parking management systems have been installed in Cologne, Berlin, Geneva, and Grenoble. At Munich's new international airport, an automated parking information system monitors more than 9,000 parking spaces and guides drivers by the quickest route to the nearest unoccupied parking space. Illuminated digital displays show drivers the most direct route to the vacant spaces.

Parking information and guidance systems are an effective demand management tool. They disperse parking demand, relieve downtown congestion, and assist visitors who are unfamiliar with the city. They may soon find application in the United States as part of intelligent advanced traffic management systems (ATMS).

KARLSRUHE

To extend the outreach of their light rail services, municipal transit systems in several German cities have entered into track sharing agreements with the German National Railways (BAG). The agreements permit municipal transit systems to interconnect their track with the DBAG's intercity track and provide seamless, transferless service to and from the outer suburbs.

The first such arrangement was concluded in the city of Karlsruhe (pop. 840,000). The track sharing agreement allowed the municipal light rail system to extend its service some 18 mi into the surrounding region, using existing DBAG track. Specially designed rail car units are equipped with on-board transformers and rectifiers that convert DBAG's 15 kv AC current to the 750 volt DC current used by the urban light rail system.

The new track sharing service between the suburb of Bretten and downtown Karlsruhe has eliminated an interline transfer and reduced commuter trips from about 1 hr to 37 min. According to a recent survey, 34 percent of passengers on the new commuter rail line are former automobile commuters. Track sharing agreements are seen as a win-win situation. They provide a source of income for the now privatized German railways, while allowing the municipal light rail systems to expand their outreach at a fraction of the cost that they would have incurred in laying new track.

Track sharing could significantly enhance the service potential of light rail systems in U.S. cities. Track sharing arrangements with commuter rail and other passenger rail operations may offer a cost-effective way of extending the service outreach of light rail systems at a fraction of the cost that would be involved in building extensions--provided that operational and institutional barriers associated with track sharing can be overcome.

INNOVATIVE ROLES FOR TRANSIT IN CREATING LIVABLE COMMUNITIES: MISSION 2, MAY 18-JUNE 4, 1995

INTRODUCTION

On May 18, 1995, 15 transit professionals from around the United States embarked on a 2-week study mission of Europe as part of the ITSP. The mission focused on innovative roles for transit in creating livable communities. The participants were to identify concepts and procedures that have been successfully implemented in six European communities, particularly those applicable to public transportation in the United States. The lessons learned were derived by observing the workings of the communities rather than through study of facts and figures alone.

The study mission participants represented agencies of various sizes. The team was welcomed and briefed in each city by a group of transit agency and city representatives. These representatives provided an overview of the political, economic, and transportation situation, including some historical perspectives. The team was divided into groups of two; each pair was assigned a city upon which to concentrate. The role of each pair was to document the experiences in its respective city and identify the most important lessons learned.

The cities visited by the team ranged in size from 180,000 to 1,500,000 inhabitants. The cities were all superb examples of livable communities, and each faced unique transportation problems. All have realized the importance of regional planning and coordination and have well-structured ways of dealing with these challenges. Moreover, all the communities appear to operate a well-planned and -funded transportation

system where intermodalism is far more advanced than in the United States. Mixing of all modes of transport--pedestrian, bicycling, transit, and automobile--was well designed and implemented. Common to these cities were large areas for pedestrian use only, where commercial, residential, and public spaces were blended to create a pleasant environment. The feeling created by these areas was that of pride, belonging, and overall community.

VIENNA

Background

Vienna (pop. 1.5 mil), the capital of Austria, has a modal split of 37 percent public transit, 37 percent private vehicles, and 26 percent non-motorized traffic. Its goal is to have reduced private vehicle traffic to 25 percent and cut CO_2 emissions in half by the year 2010. The focus of its transport efforts is to reduce traffic congestion by encouraging alternatives to use of cars whenever possible.

The city has one of the largest and most elegant pedestrian shopping streets in Europe, the Kaerntnerstrasse, which runs from the Opera to St. Stephen's Cathedral. It has banned through-traffic in the inner city and doubled the bicycle path network over the past 15 years to more than 300 mi. During this time, the number of traffic accidents has been reduced by 25 percent and the number of fatalities by 55 percent. A system of residential parking permits and short-term parking rules limit access to the inner city.

Incentives to reduce private car use in-city include 50 percent reductions in weekend car rental fees for owners of annual transit passes and a goal of 42,000 peripheral park-and-ride spaces. Public transit (including the U-Ban [metro], Schnellbahn [commuter rail], Strassenbahn [light rail], and a bus network) is being continually modernized and expanded. Shared track for railroad and transit use, as in Germany, is under consideration. Expansion of intersection priority for public transit in the central districts is a policy objective. The same is true of the establishment of the Tempo 30 kmh (18 mph) speed limitation for private vehicles in the city's residential neighborhoods. Fifty-seven percent of the intersections in the city are equipped with signal preemption. To provide additional convenience to nighttime users of transit, bus drivers can call ahead on their radio phones at night to arrange for passengers returning to their homes to be met by a taxi at designated suburban bus stops.

One of Vienna's technical innovations in the public transit arena is the introduction of the world's lowest low-floor light rail vehicle, roughly 6 in. off the pavement. A fleet of 150 of the Vienna-built units, designed by Porsche and Elin, will be phased in up to the turn of the century. The first two are in service. Their hydraulic suspension, which allows the floor height to be lowered to 3.6 in. (or raised to 7.6 in. in case snow blocks the entrance) is a revolutionary feature.

The city of Vienna and its surrounding region (pop. 2.5 mil) were the first in Austria to form a regional transit association 10 years ago. VOR, the eastern regional transport association, carried 741 million passengers in 1994, a gain of about 19 percent since its inception. Like the other regional associations that followed it, the integration of fares is standard practice. Additional operating costs are absorbed equally by the national and regional governments.

What Makes Vienna Livable?

The city and its suburbs are committed to improving the quality of life in the whole region. They faced declining population, poor air quality, and serious congestion in the late 1960s and 1970s. These conditions led planners to take a close look at solutions. They developed a plan to build a subway system and provide mobility and access to many popular destinations. Officials believe that this plan has contributed greatly to the improvement in mobility and the quality of life for residents. The planners also focused on air and water quality and noise pollution. Projects were planned and implemented to preserve the natural resources of the country. (The city consistently capitalizes on its historic and architectural heritage through historic preservation.) Although the planning for infrastructure was well thought out, it was clear that a balance of economic activity was required to sustain a livable community. The goal has been to keep a 50-50 balance between residential and commercial/industrial activity.

To achieve a livable community and maintain this balance, the Viennese have used zoning regulations; long-range planning, including the development of an urban development plan; the political process; and public participation. The expectation is that, by 2010, there will be a doubling or tripling of the demand for public transport. This is mostly due to the increasing geopolitical importance of Vienna since the fall of the Eastern Bloc. Vienna's position as a center of multinational activity will test all aspects of the plan put in place in the Viennese region.

To ensure that the citizens of the region buy into the long-range plans, as well as the major projects under consideration, a public participation process is used. Once a master plan is developed, it is discussed with the community. This is followed by site plans that are debated between the architects/planners and the community affected. A learning process for both sides, this interaction is critical to building grass roots support for the projects. (One project has an 85 percent participation level by the local residents.)

The city of Vienna, the VOR, and the individual transit service providers are also changing and improving the transportation system to ensure the quality of service necessary to attract and keep riders. Some of these changes are attempts to calm the traffic and alleviate the threat to pedestrians. Some officials characterized existing traffic as "brutal." These changes include raising

the sidewalks at transit stops and reducing the floor height of buses and trams, installing islands to make it safer for pedestrians and transit users to wait in the street, and reducing speeds and installing traffic-calming measures in some neighborhoods. Significant efforts to improve the speed of transit vehicles have been undertaken; they include signalization and preemption for vehicles operating in city traffic. Automatic vehicle control systems, where a driver is not needed, have been implemented for the subway system and other transit modes that operate in their own rights of way. These efforts have been well received by the public, and the public transit system is well kept and well used. Information and transit maps can be found in all stations, bus stops, and major public places. The public transport system is easy to use.

What Could Be Applicable to the United States?

To a large extent, the programs instituted in Vienna are transferable to the United States. Although the municipality's control over zoning and land use is considerably stronger than in an American city, the regional transportation agency for Vienna is not unlike those in Chicago and New York City. The agency, however, has more authority regarding fare structures and fare collection. Another important element for the success of public transit is the level of financial support provided by the local, state, and--to some extent--federal government in Austria. It was apparent that a high level of transit financing is well supported by the populace and reinforced by policies of setting prices so as to discourage the use of cars and gasoline and to encourage cross subsidization from other government-operated services, such as utilities. Again, the most important factor for providing this level of support is grass roots affirmation from the populace on a nationwide basis. This affirmation would require a significant level of outreach and marketing, as well as a change in the vision for most urban communities. The transit agencies, however, have within their control the provision of better information and quality service. Vienna's public transport agency is focused on who their market is and what is demanded from their services. Such actions require relatively few resources but a high level of commitment by the transit professionals to provide quality service.

SALZBURG

Background

Noted for its baroque palaces, music festival, and successful historic preservation, Salzburg (pop. 144,000) also shows a special concern for the urban environment. It operates 74 electric trolley buses, one of western Europe's largest environmentally friendly electric fleets. It is extending its Tempo 30 (18 mph) speed restrictions in residential neighborhoods. The city has also just completed negotiations with surrounding jurisdictions for a regional transit association with full fare integration.

Residents of Salzburg like to walk, ride bicycles, and take public transit. Together, these three modes account for 63 percent of total travel, or a total of 68 million trips annually; private cars are used for 37 percent of total travel, or 41 million trips a year.

The city's goal to increase the modal split for transit, bicycles, and pedestrians to 65 percent by the year 2000 depends on implementation of six major strategies, which will reduce noise, pollution, and accidents as follows:

1. Use of bus-only lanes (8 km), which are promoted as a way to get to one's destination faster;
2. Development of a bus acceleration program--this program includes a simple staggering of stopping lines for cars and buses that allow a bus to cross over and be positioned in first place for left turns;
3. Use of bus pull-outs for new street construction and rebuilds--the city plans to use signalization to stop car traffic behind buses at pull-outs;
4. Focus on improvements for bus lines with heavy loads;
5. Development of a parking management program that limits parking spaces and pricing of spaces--there are about 25,000 parking spaces for more than 110,000 jobs in the city; and
6. Implementing a Tempo 30 zone program.

Fifty-six Tempo 30 residential neighborhoods have already been designated by the city authorities. Twenty-two more are to be operating by next year, with plans to add several more each subsequent year. The cost of converting the conventional through-traffic to Tempo 30 neighborhoods (which involves planting, street furniture, and design features) is absorbed by the city budget.

Most of the inner city has been closed to through-traffic. Salzburg's principal shopping street is reserved for pedestrian use, except for emergency vehicles and taxis, which are permitted to drop off tourists at hotels. During the Christmas season, Salzburg encourages a "ride-and-walk" attitude among shoppers by using a "package bus" parked in the main pedestrian square as a parcel-checking facility.

The city aims at a 20 percent traffic participation by bicycles in this decade. It has spent the equivalent of $7 million to expand its 120-km network of bicycle paths over the past 10 years. It has also canceled the construction of a 3,000-space car park that was to have been built under the Salzach River, which traverses the city and gave it its name. Instead, the city has devoted funds to the completion of a missing bicycle path link along the river in the historic city center. Since it was finished 5 years ago, the daily bicycle count along the riverside path has risen from 900 to more than 5,000. One-way streets have also been opened to two-way bicycle traffic, and bicycle paths have been equipped with traffic signals and destination signs.

Salzburg's main railway station has been modernized and updated as an intermodal terminal, and pedestrian zones have been expanded. The city's nighttime taxi connection, operated in close cooperation with the private Salzburg radio taxi association, has expanded to 13 routes and was used by nearly 50,000 passengers last year.

What Makes Salzburg Livable?

The location of this picturesque city imposes geographic limitations on its growth; therefore, the management of growth is imperative. The cooperation of the traffic department, area businesses, and the region is visible in the way transit is provided and in the sharing of transportation costs.

To achieve this growth management, there is an increasing level of regional cooperation which became reality with the formation of a regional planning agency. Formerly, the duties of managing growth and protecting greenfield areas were shared by the planning and traffic departments in the city of Salzburg.

The city promotes public participation. Salzburg holds monthly forums to discuss traffic issues. The members of the forum are technical-expert representatives of various interested groups who debate an issue in order to achieve consensus.

The financial support for transit is fairly secure--it is subsidized by other profit-generating departments of the city, especially the utilities. This relationship ensures that the transit department's operation is cost-effective. Although Salzburg pays a fee to the highway department for the use of the roads, the city has a fare recovery ratio of 64 percent.

The Salzburg transit department contributes to livability through its operation of electric buses, which are quiet and emission-free. The department is also concerned with providing a quality service to its customers and the city overall. Its desire to maintain high quality explains its commitment to operate the electric fleet, which is substantially more expensive than buses using diesel or other types of fuel. This level of quality is justified by the average number of rides per capita--about 330 per year.

What Could Be Applicable to the United States?

Many of the small innovations that Salzburg has implemented to improve the flow and speed of buses can be implemented in the United States. Such innovations must be well promoted. Salzburg illustrates how bicycles can help reduce noise, pollution, and accidents. Despite severe winters, bicycles enjoy high use. Also, citizen participation has been well defined and implemented as an efficient process.

MUNICH

Background

Munich (pop. 1.2 mil) boasts a 2-sq-mi pedestrian zone, one of the largest and oldest in Europe. This zone has become a boon to business and a major tourist attraction. The city administration has been a strong advocate of public transit and a promoter of the regional transport association (MVV). Double-decker suburban railcars are now used to cope with increasing ridership demand. The city has gone so far as to ban all on-street parking in the downtown area, except for residents of the historic old town.

Curbside parking meters have been eliminated and, contrary to U.S. practice, permission to build new offices in the CBD is given only on condition that no parking be provided. Innovative public transit marketing initiatives include the subsidized annual "job ticket" negotiated with public and private employers, including the city of Munich. This fare medium is provided by the private sector, which promotes the use of public transportation rather than private automobiles. In this program, public transit becomes a benefit provided by the conscientious employer. Another innovation, the "combi ticket," allows transit use by ticket holders to major cultural or entertainment attractions without extra charge; the ticket itself serves as the transit pass and is another way of promoting transit use.

What Makes Munich Livable?

The city is a center of commerce and industry. The wide streets are segmented so that pedestrians and bicyclists move about without worrying about cars traveling at high speeds. The level of access and mobility is well above expectations for a city of Munich's size. The combination of the S-Bahn, the U-Bahn and buses provides frequent, dependable service. The city's commitment of funds to integrate suburban railways into the transit system through construction of tunnels and formation of transit associations also enhances the city's livability. This level of service and its integration, along with the clear, well-positioned information kiosks, make it easy to use the system.

Much of the city consists of green space used for sports and entertainment. The shopping streets, as well as areas where cultural institutions are housed, are surrounded by pedestrian-only areas. These provide a relaxing setting for shopping, outdoor cafes, and so forth. Transit comes to the borders of these areas; in the case of the subterranean rail lines, stations are in the middle of these high-activity centers. Flowers, trees, and art enhance the environment and create a soothing effect in a city full of hustle and bustle. The mode split for transit is more than 40 percent.

The transit system is accessible because of a commitment to using low-floor vehicles. These make it easy to bring bicycles, strollers, and other mobility devices aboard. The changes and programs that have been implemented in Munich, while not on a grand scale, blend with the environment and encourage interaction.

The Munich transit system is very aware of special markets, and they

segment these markets to improve ridership. Good examples are the promotion of first-class seating for commuter rail and the use of different fare media to serve pensioners, students, and art and theater patrons. The city has implemented programs to encourage people to come to the center of Munich.

What Could Be Applicable to the United States?

The commitment of the local, regional, and federal government to public transportation is the driving force for the level of service of this city. The competitiveness of the city and the region depends on the quality of life that distinguishes this city from its competitors. As a result, the issue of transportation is high on the local and regional governments' agendas.

What can be implemented in the United States, however, is the level of involvement of the private sector. In Munich, the job ticket is a major fare medium. This is a win-win strategy for the transit agencies and the employer. The latter is contributing to a cleaner, safer environment where competition is enhanced because mobility and access are improved. The combi ticket offers a similar benefit. Also, commuter rail could be developed in many U.S. cities.

ZURICH

Background

The most populous urban region in Switzerland, the canton of Zurich (pop. 1.2 mil) has been served since 1990 by a transit association called Zuercher Verkehrsverbund (ZVV). This association comprises more than 40 public and private transit providers, operating a total of 262 commuter rail, light rail, mountain rail, bus, trolley bus, and cable car lines and passenger ferries. The network consists of 2,700 route km. The regional rail (S-Bahn) serves as the main distributor, with 27 station stops inside the city limits. Neighborhood feeder buses and vans bring passengers to the main stop. The canton's goal is to have a bus stop within 300 m of each doorstep.

Since the passage of a 1988 referendum supporting an integrated rail network, daily public transit passenger totals have increased by more than one-third in Zurich and by about 14 percent in the ZVV region, to just under 1 million total. The transit mode share among daily commuters to Zurich has increased from 50 percent to 59 percent in the last decade. Farebox receipts cover 56 percent of the system's current annual operating costs, amounting to SFr 800 million ($715 million). The shortfall is covered in equal parts by the canton and its 171 communities. Calculation of the local contributions uses a complicated 80/20 formula that takes into account the number of daily departures from station stops in each community, along with the community's tax base.

Unlike most transit operators, the Zurich S-Bahn light rail system has the avowed objective of offering a seat to every passenger. Standing is considered an exception to be tolerated only for the briefest of periods. This requirement reflects the desire for comfortable travel and an amenable egalitarian transit environment for all passengers, whether they be top government officials, bank presidents, white or blue collar employees, homemakers, or students.

There is full fare integration throughout the region, which is divided into 45 tariff zones. About 35 million single, multiple, monthly, and annual tickets are sold each year. According to a study conducted by an independent research institute (Social Data of Munich), this works out to about 400 public transit trips per inhabitant per year, a level well above that registered by other metropolitan regions in western Europe.

What Makes Zurich Livable?

Zurich offers the most comprehensive and customer-friendly transit system of all the cities that the group visited. The policy decision to keep most of the transit system above ground and to make transit easy to use contributes to its high use. Because public transit provides a competitive advantage for Zurich, it is supported by the populace and the government. The various transit agencies focus on transit availability, speed, and reliability in order to maintain this position.

The region, through the regional transportation agency, coordinates fares and provides for services through long-range (10-year) contracts with private contractors. The region also strives for stability in the level of service. In this way, people who depend on it are not faced with a changed schedule as often happens in the United States.

The commitment to availability, speed, and reliability necessitates that the transit agency spend significant resources on providing high-quality information that is well placed and complete. Meanwhile, it is also striving to provide technological improvements to ensure that the transit vehicles are moving through intersections and on main streets without being impaired by traffic lights, cars, or bicycles. It was interesting to watch a traffic police-officer direct traffic, with the cars definitely getting second or third priority after trams and pedestrians. The policy of not making trams wait at traffic lights has improved the speed of trams so that they achieve higher speeds than cars in the city.

The livability of the city and the level of transit services is also increased because of a well-designed method of financial participation by the beneficiaries of transit service. The federal government participates in the subsidization of new transit rail services and facilities. However, it is the locals' responsibility to fund current services for both operating and capital costs. Fares, which recover over 50 percent of costs and are zone-based, provide the bulk of funding. However, the canton and the individual municipalities must supply the rest. This approach allows a municipality to establish its own level of support for transit services. As a policy, however, it must maintain a minimal level of service. In many of the rural or suburban areas, buses must

meet trains that provide hourly service. The system of bus meeting train has been perfected in Switzerland.

Land use policy has also contributed to the livability of the city by encouraging dense developments, whether residential or commercial, around transit facilities. In addition, planners and traffic engineers have been able to increase the level of transit without having to build roads or acquire right of way. They were successful in getting public support to implement their plans because they did not ignore the car. When they needed space for transit, whether it was a dedicated lane or a complete street, they made improvements to the rest of the system to improve speed or increase capacity for the automobile.

A major accomplishment of the Zurich transit agency is the level of use of the assets of the company, especially the station areas. The largest shopping area in the central city, outside of the Bahnhoffstrasse, is the large mall at the main railroad station. The quality and quantity of shops equals that of many large shopping centers in the United States. The layout of this station, which is extremely accessible, especially to those people with visual impairments, encourages people to stop and shop before their trip home. The Swiss Federal Railroad is so successful in this area that 50 percent of their revenues are from retail and other non-fare revenue sources.

Another major commitment of the Swiss government that improves the livability of Zurich, and of Switzerland in general, is the commitment to use electric trains throughout the country. This clean fuel does not result in odors at the stations, making it pleasant to do errands and shopping. It also helps maintain the beauty of the countryside.

What Could Be Applicable to the United States?

The most impressive program, which also appears to have the highest level of success, is that of traffic signalization and the tram/bus management system, which can easily be implemented in many cities here. The benefits of such a system were so clear in Zurich that the costs became secondary. Another critical element to providing quality service that can be implemented here is the "pulse" system of bus meeting train. This convenience creates a feeling that the passenger is valued. The barriers to these programs are mostly financial; the long-term benefits of such programs should be examined carefully.

Another lesson that can be learned from Zurich is that clear roles for the organizations involved (e.g., local, canton, and federal governments, as well as the transit agency and the communities) result in better transit service.

FREIBURG

Background

Freiburg (pop. 191,000) enjoys an international reputation as one of Europe's most environmental and ecology-minded cities. It pays heed to public art, amenities, and historic preservation. The business community helps the city pay for the unique sidewalk mosaics in front of most downtown stores.

For the past 10 years, Freiburg's light rail system has pioneered the discounted "environment pass." This has helped change the modal split in favor of public transport and has become a model for other German cities. More than 4 million environment passes have been sold in the 10 years since it was introduced. Over this period, the number of passengers carried by the Freiburg public transit system has more than doubled.

A regional transit association started 3 years ago, covering Freiburg and three surrounding counties with a comprehensive network of transit lines. It consists of 3 commuter rail, 5 urban light rail, and 77 bus lines--some 2,000 line km that can be traveled with a single, transferable flash pass.

The super-sized, triple-articulated light rail transit vehicle--the backbone of the Freiburg fleet--is 33 m (108 ft) long, can carry 260 passengers, and has eight powered axles. It connects with the suburbs on its own grassy right of way that blends into the environment.

The city's extensive network of bicycle paths, about 410 km at last count, is used by more than 100,000 bicyclists.

What Makes Freiburg Livable?

The most noticeable feature of this small city is its "texture." The streetscape, street furniture, pavement variety, and artistic blend of color, shape, and texture make walking interesting. The sidewalks are embedded with art to keep the pedestrian interested. Flowering plants, trees, and shrubs enhance the view and promote a feeling of belonging and of being part of the neighborhood. The bicycle paths are similarly well defined and pleasant.

Car garages are hidden or obscured with rooftop shrubbery and balcony plantings. These structures, which include some housing, become part of a neighborhood and are useful without being eyesores. The housing, partly dictated by the historic character of the city, is close to the street and is built within a rather strict zoning code. New structures, even though clearly modern, reflect the characteristics of the gothic look and enhance the texture of the overall environment. Public buildings are primary examples of architecture that enhances the environment. The policy decision to use public design competition for these structures contributes to the livability of the city.

The light rail system that bisects the city was designed to provide easy access while blending with the environment. The railbed is cobblestone, brick, or grass, depending on the area that it crosses. This system, combined with a bus network, aims to provide access to 90 percent of the population with a walking distance of about 300 m to a stop. The residential neighborhoods

are slowly, but carefully, converted to Tempo 30 zones through the use of various traffic-calming methods. This commitment to transit and the environment has made this city an example of a livable community. These programs have helped the city to decrease traffic accidents by 50 percent and to decrease the severity of accidents by 60 percent.

In recent years, after the unification of Germany, several military bases have been closed. One such base is in the outskirts of Freiburg. The process for developing this valuable land is a good example of what good planning and regional cooperation can achieve. The planning process included much public participation; a policy decision was made that the development would take place around a light rail line. The mixed-use community was designed with the best features of a neotraditional approach, where the residential streets are Tempo 30 zones with the arterial streets feeding to the rail line. Green spaces are located where they will benefit the most people.

What Could Be Applicable to the United States?

Freiburg shows how to design and implement new development so that it does not detract from a fragile gothic city. The focus of the city on its magnificent old architecture has not stopped it from growing and providing new opportunities for industry and populace. The transit innovations and expansion occurred even in the middle of this historic environment. This city is a good example of how to improve the infrastructure without compromising a cultural heritage. The changes made in this city are of human scale and encourage human interaction.

STRASBOURG

Background

The Strasbourg light rail transit line, inaugurated in November 1994, has been designed to serve as the mainstay of the metropolitan region's public transit system. The region has a population of 435,000, the city about 250,000. The light rail transit system, described as revolutionary, is expected to dramatically change the modal split by the 21st century. Prior to its recent introduction, 75 percent of all daily trips in the region were made by private car, 11 percent by transit, and 15 percent by bicycle.

To deal with congestion and pollution, the city banned through-traffic by private cars in 1992. A series of unconventional initiatives were launched, ranging from a rental bicycle fleet and electric rental cars downtown to a public works department that uses horse-drawn farm equipment to maintain forest tracts along the Rhine.

The light rail system consists of 26 low-floor cars built by ABB Traction Ltd. The cars feature huge picture windows and a spacious interior, have a capacity of 290 passengers, and are expected to transport 75,000 people each work day along a 12.6-km route with 18 station stops. More than 1,000 full-sized trees have been planted and nurtured along the tram route, which is decorated with works by well-known artists.

The new line traverses the city in a north-south direction, on a 4-min headway, including a tunnel segment of nearly 1 mi under the main railway station. The line cost more than $400 million at the current exchange rate, of which the national government supplied about $72 million, the remaining coming from local funds. This action was part of a new public transit-oriented strategy designed to overcome the pollution and traffic congestion that has plagued the historic center of the Alsatian region. As a result, Place Kleber, the central square, which used to be jammed with some 50,000 cars daily, now has been returned entirely to pedestrian and supertram use.

What Makes Strasbourg Livable?

The city has embraced a vision of itself as a competitive commercial center. Its movement from a car-dependent, polluted, old city to a modern metropolis with many large plazas and people-friendly amenities has given it a new character. The planning and execution of this vision are the major attributes of this livable city.

The city is focusing on improving access and mobility. In addition to transit and ride-sharing, the city has introduced car-sharing. This concept allows people who do not use cars extensively to participate in "car cooperatives." These arrangements increase the availability of cars while reducing each individual's car costs.

What Could Be Applicable to the United States?

Strasbourg is the only city visited where evidence of transformation from a congested and polluted city to a more livable, people-friendly city is visible. The city faced significant deterioration of its architectural marvels because of the recently achieved mobility of its citizens. The movement toward a new vision for a sustainable community had to be well defined and executed quickly.

The process that Strasbourg used to achieve its transformation is what can be transferred to the United States. What happened in Strasbourg is a good example of "top-down" leadership. Here a visionary political leader, the mayor of the city, initiated a bold program, which included the introduction of pedestrian-only zones, limitations on cars in the center of town, and construction of a new light rail system and supporting infrastructure. The infrastructure would create a set of aesthetically pleasing public spaces that would be supportive of a light rail system. This leader had to convince a conservative, skeptical populace through extensive education and marketing of the benefits of this vision. The public eventually supported this vision, which was comprehensive, well defined, and detailed. The marketing campaign for this project explained clearly the benefits of the program to all the stakeholders, including

merchants, residents, and employees. Within 6 years, the vision was implemented, and the populace showed its support by recently re-electing the mayor. The vision was positive, inspiring, and supported by the people. The obstacle with such a process is, as usual, finding the money to pay for such a project. This was accomplished in Strasbourg.

LESSONS LEARNED

The findings of the mission are as follows:

1. There must be a unified vision of the community's future, supported by a complementary action plan and funding. Plans that are inconsistent with the vision must be discarded if progress is to be made.
2. Livable communities favor human scale over grand scale. Direct human interaction is encouraged.
3. Plans and decisions concerning transportation and land use must be made and implemented on a regional basis. The central city cannot go it alone.
4. Individual choice and freedom are strengthened and broadened by investing substantial public funds in walking, bicycling, and public transportation modes.
5. Changes can be implemented that have tremendous effect on the livability of a community, even with old systems and infrastructure.
6. The goals of major capital investments must be clear and derived from, and supportive of, the service philosophy of the community.
7. Consistent and adequate funding must be available to provide high levels of service and routine replacement and capital renewal of transit systems.
8. Transit services from various carriers in a given region must be properly coordinated.
9. Transit systems cannot try to be all things to all people. The markets pursued must be those where transit is likely to be the appropriate choice.
10. High-quality, consistent customer information (especially at the point of sale--usually the bus or train stop) is essential for useful and used public transportation systems.
11. Electrically operated transit modes are valued for their environmental contribution to livability, even though they may cost more to operate.
12. The bicycle can be a significant factor in the daily commute, even in colder climates.

HIGH-TECH SOLUTIONS TO TRANSIT PROBLEMS: MISSION 3, NOVEMBER 1-18, 1995

INTRODUCTION

The cities of Asia, whose high population densities have made them highly dependent on public transportation, have been at the forefront of transportation innovation. To learn about the latest Asian advances in urban transportation, a delegation of U.S. transit officials embarked on a 2-week study mission to Far Eastern cities in November 1995.

The study team's itinerary included Tokyo, Yokohama, and Nagoya in Japan, as well as Hong Kong and Singapore. These cities were chosen because of their established reputation of excellence in public transportation and a record of pioneering innovative approaches to solving the problems of metropolitan mobility.

While a key purpose of the study mission was to identify practices and service innovations that could be applicable to the United States, participants were keenly aware that the differences in the transportation environments of Asia and the United States might make a transplantation of certain policies and practices impractical. For example, the densities of development in the cities of the Far East far exceed those found in the typical American cities. The high densities create a far greater reliance on public transportation and, conversely, inhibit the use of automobiles. Indeed, Hong Kong's transportation system is used so intensively that it requires no public subsidies and has consistently shown an operating profit. Another disincentive to using cars in Asian cities is the high price of gasoline, which is three to four times as high as in the United States. Finally, although the automobile has stretched metropolitan boundaries, the cities of the Far East remain relatively compact, which encourages accessible, efficient transit service.

There are also important differences in the policy environments of Asia and the United States. In the Far East, central government fiscal policies strongly support public transit and discourage automobile use. In the United States, transit has never been a strong government priority, and strict automobile controls--of the kind that have been adopted in Singapore, for example--would be politically impossible.

Nevertheless, study mission participants found many examples of innovative practices and technologies that are potentially transferable to U.S. cities. The report discusses those opportunities under five headings as follows:

- Metropolitan Rail Systems and AGT
- Urban Bus Systems
- Multimodal Fare Integration
- Automobile Control Policies
- Advanced Traffic Management and Information Systems

METROPOLITAN RAIL SYSTEMS AND AGT

In Asian cities, team members found the following items particularly noteworthy: (1) the dominant role that rail transit plays in the life of the Asian cities; (2) the close coordination between rail planning and regional development; (3) the extensive use of AGT technology (people movers) in providing mobility in new suburban

developments; (4) the symbiotic relationship of suburban (commuter) railways and urban rail transit as evidenced in physical interconnections and track sharing; and (5) the large-scale participation of private capital in construction and operation of rail transit infrastructure.

Necessity of Rail Transit

For Tokyo, Nagoya, and Hong Kong, rail transit is not a luxury--it is an essential piece of urban infrastructure without which these cities could not function. In Tokyo, for example, the combined rail system moves about 7.5 million passengers a day and carries 72 percent of all trips. In Osaka, the rail system carries 61 percent of all travelers, and Nagoya's rail system carries more than 1 million passengers each day. In Hong Kong, the 43-km rail transit system carries 2.5 million passengers daily, and the entire public transit system carries more than 90 percent of all journeys on trains, buses, minibuses, trams and ferries, making it one of the most heavily used transit systems in the world. Without these vast metropolitan rail networks, the economies of these cities would collapse.

Fixed Guideway Transit as a Tool of Regional Development

Rail transit is an integral part of regional development, and all development schemes, whether commercial or residential, must include a comprehensive transportation plan. To help balance the excessive concentration of activity in the center of Tokyo, for example, the Tokyo Metropolitan Government has been developing new subcenters and transportation systems to serve them. Because land is scarce, there is a strong emphasis on AGT systems running on elevated structures, popularly known as people movers. People movers reduce right-of-way requirements and allow use of streets during construction. They are also less costly to build than full-fledged underground heavy rail systems. One example is the just completed Rinkai (waterfront) New Transit System, a 12-km, 12-station people mover that will be the centerpiece of the planned waterfront Teleport Town, a new mixed-use "in-town new town" built on reclaimed land in the Tokyo harbor. The computer-operated rubber-tired people mover will run on 2-min headways and will have a capacity of 17,000 passengers per hour. Another new subcenter, Tama City, will have a 16-m monorail line circling the city interconnected with a 93-km network of lines radiating from the city. The Tokadai Line, serving Tokadai New Town, 14 km north of Nagoya, is another example. This 7-km people mover system links Tokadai New Town and its 24,000 residents to a commuter rail line. Other AGT systems operate in Kobe (Portliner, Rokko Line).

Singapore has also embarked on construction of feeder systems using automated people mover technology. The people movers, 10-km in length, will link housing estates on the outskirts of the city to suburban rapid transit stations.

System Interconnectivity

Unlike U.S. cities, where rail transit is operated under a unified management, the Tokyo system is operated by two entities. The Teito Rapid Transit (TRTA) jointly owned by the national and metropolitan governments, but in the process of privatization, operates 8 of the capital's 12 subway lines with a total length of 162 km and 148 stations. The remaining four lines are operated directly by the Tokyo Metropolitan Government. Suburban services, operated by private commuter railway companies, are physically interconnected to seven of the Teito lines and run on Teito tracks inside the cities, thus eliminating the need for commuters to transfer from suburban to urban trains. This tradition of interconnection and track sharing, which started back in 1964, extends the metropolitan rail network more than 50 km from the city center and expands its length to more than 630 km.

"Third Sector" (Daisan) Public-Private Financing of Transit Infrastructure

Many of the aforementioned Japanese projects are being financed by public-private consortia (Daisan or Third Sector) in which local jurisdictions are shareholders. At last report, more than 5,400 Daisan ventures have been established in Japan. They represent capital investment in excess of $10 billion, of which about one-half is contributed by central government and local public agencies. Each Daisan project can have anywhere from several to hundreds of private participants. The Tokadai Line, for example, has been financed by the prefecture (which holds controlling interest), several banks and public utilities, the private Nagoya Railway Company, Mitsubishi, Toyota, Nippon Steel, and several other industrial companies. The greatest concentration of Daisan projects is in Yokohama, the port for the Tokyo area and now the second largest city in Japan. Yokohama's Century 21 Port project (Minato Mirai) is one of the largest Daisan projects, transforming 460 acres of waterfront property into a high-technology urban center with a huge convention center.

Lessons for the United States

Although AGT technology has been accepted in the United States since the early 1980s, it has been applied primarily in the context of "downtown people movers" (e.g., Detroit and Miami) and airport systems (e.g., Atlanta, Chicago, Orlando, and Houston). The only truly suburban people mover--in Las Colinas, Texas--has been decommissioned because of high operating costs and inadequate

patronage. Several other suburban people mover projects (e.g., City Post Oak, Texas; Irvine, California; and Montgomery County, Maryland) have never progressed beyond the planning stages. However, as our suburban centers expand and increase in density, the use of people movers may become economically more attractive as internal circulators in suburban downtowns and suburban feeders to rapid transit.

The concept of track sharing and interconnecting suburban and urban rail networks is also of potential interest to U.S. cities. Given the expected reductions in federal transit subsidies, there will be less money available for extensions to existing light rail systems. Track sharing arrangements with commuter rail and other passenger rail operations may offer a cost-effective way of enhancing the service potential of light rail systems in U.S. cities and extending their service outreach at a fraction of the cost that would be involved in building extensions. However, in order to make track sharing a reality, numerous operational and institutional barriers must be overcome.

URBAN BUS SYSTEMS

Despite the unquestionable importance accorded to rail transit, bus services also receive a great deal of attention in Asian cities. The bus systems of Singapore, Hong Kong, and the Japanese cities all use technical innovation to enhance the quality of service and attract more riders. Three innovations particularly impressed the study team: (1) electronic passenger information systems; (2) customized bus services; and (3) the concept of "key routes."

Electronic Passenger Information System in Singapore

To make transit more customer-friendly, the Singapore transit providers--Singapore Mass Rapid Transit (SMRT); Singapore Bus Service (SBS); and the private bus operator, Trans-Island Bus Service (TIBS)--have formed a consortium, TransitLink, Ltd., for the purpose of integrating fares, routes and customer information. One element of this venture is the TransitLink Guide--electronic touch-screen kiosks that provide information on bus fares, routes, and service changes. The kiosks also provide general information on schools, libraries, hotels, and recreational facilities. Systemwide installation of the kiosks is to be completed in 1996. A second element is an electronic passenger information system, to be installed during 1996-97. The system will display estimated arrival and departure times of the next bus at bus stops and bus terminals, using an AVL system that will monitor the location of individual buses in real time throughout the system.

Premier Bus Service in Singapore

Singapore's "Bus Plus" program, a joint venture of the public and private bus companies, offers deluxe transit service from residential subdivisions directly to the CBD to customers willing to pay more for customized service. The Bus Plus program operates air-conditioned minibuses during peak hours on weekdays, as well as on-demand "maxi-cab" service.

"Key Routes" in Nagoya

In Nagoya, buses form the major component of the transit system. To increase ridership, the bus company has developed a "key route" system. The key routes have dedicated bus lanes in the center median during the morning and afternoon rush hours and receive extra service enhancements, such as electronic passenger information systems in bus shelters, bicycle parking facilities, and other passenger amenities. To date, two of the most heavily patronized bus routes have been converted, resulting in a 23-min reduction in travel time and a 38 percent increase in ridership.

Lessons for the United States

All three service innovations mentioned above are eminently transferable to U.S. cities. Electronic passenger information displays at bus stops have been made feasible with the advent of AVL technology, which is being deployed by a growing number of urban bus systems. The remaining obstacle--the high cost of hardwiring bus stops with dedicated cable links--may soon be overcome with the advent of wireless data transmission technology. Bus arrival information displays inform waiting passengers of the arrival time of the next bus and its destination--thus eliminating one of the most common sources of rider dissatisfaction with public transit.

Customized transit services that target the discretionary transit rider are also beginning to appear in the suburban communities of the United States. These services employ smaller capacity vehicles; offer more flexible, demand-responsive service; and use advanced communications technology to enhance system performance. Three examples of such services are Houston METRO's FasTrak; OmniLink in Prince William County, Virginia; and Seattle's LINC service.

FasTrak is a jitney-like service designed to complement METRO's existing fixed-route bus service and, eventually, to replace unproductive bus routes altogether. FasTrak vehicles, owned and operated by private entrepreneurs, shuttle along METRO's regular bus routes within designated service areas. Individuals may flag FasTrak vehicles anywhere along the route and be dropped off at destinations up to 1/4 mi off the assigned route. OmniLink in Prince William County, Virginia, combines "flag-stop" routes feeding commuter rail stations and daytime "flex-route" (i.e., route deviation) service. Seattle's LINC service provides vans that deliver passengers to any location within the service zone. The vans operate without specified bus stops, permitting passengers to hail, board, and get off the bus at any location along their travel path. With

more and more U.S. transit systems exploring "niche markets," there will be increased emphasis on customizing transit service and providing greater amenities. Electronic passenger information systems, flexible routing, and equipping transit vehicles with added creature comforts are among the bus service enhancements that deserve serious attention.

MULTIMODAL FARE INTEGRATION

Because of the multiplicity of modes and transit service providers, Hong Kong has a long tradition of multimodal fare integration. The rail transit company (MTRC) has been using stored-value magnetic-strip farecards for the past 20 years. The farecards are accepted on the commuter rail (Kowloon Canton Railway), Citybus, and on certain bus feeder lines operated by the private Kowloon Motor Bus (KMB). However, the magnetic-strip technology in use has limited data storage capacity and is running out of capacity to accommodate complex fare structures.

To meet the demands of an ever-expanding transportation system, these companies, together with the Hong Kong and Yaumati Ferry, have formed an independent consortium to develop and implement a "Contactless Smart-card" (CSC) system.

Proximity smart cards combine the stored-value debit card features of the widely used telephone cards with the "contactless" reading capability of a supermarket check-out counter. The benefits of smart cards as a transit fare medium are obvious. They speed up bus boardings, eliminate the need for cash transactions and cash collections, reduce fraud, have safeguards against theft (when reported lost or stolen, the card can be electronically "blacklisted" to prevent further use), can support a more complex regional fare structure, and enable transportation operators to have more accurate ridership data. The transaction, including card-processor authentication and data encryption, takes place in about one-third of a second, making it possible to handle high volumes of passenger traffic without any loss in productivity. Economics also favor the smart card. Microchip costs have been declining by 30 to 50 percent annually, and the cost per data bit now favors the smart card by a factor of 10. Finally, smart cards are reliable. The minimum guaranteed life of the cards is 100,000 transactions, or 7 to 10 years. This compares to 120 transactions for the life of the used stored-value magnetic-strip cards.

The consortium identified several requirements that had to be met in order to satisfy the transit providers. These requirements were as follows:

- New components had to be integrated into existing equipment and revenue collection systems without disrupting normal revenue collection operation.
- Downtime because of equipment failure had to be minimized; fault diagnostics and modular replacement of components had to be provided for in order to expedite system recovery.
- Revenue and traffic data had to be secure.
- Each transit provider had to be allowed to determine its own fare policy.

In June 1995, the contract was awarded to develop a CSC system for Hong Kong. Once the development phase is completed, the consortium will contract with the rail transit company (MTRC) to manage the system. The major players will be a *Central Body* to operate the central clearinghouse and apportion the collected funds among the participating service providers; *Service Providers*, who will act as agents for the sale of farecards and collection of fares; and the *Acquirer*, who will negotiate commercial arrangements with nontransport service providers and collect transaction records with such providers.

The CSC will have the following user-friendly features:

- The card will be accepted on all forms of public transportation, enabling transit users to transfer from mode to mode with a single fare medium.
- Visual (and, for those with visual impairments, audible) means will be used to inform the user of the status and value of the transaction.
- Users will be able to verify the remaining stored value and to add value to their farecards at many convenient locations.
- Users will have a choice of adding value using either cash or electronic funds transfer. A pre-arranged credit line will enable users to complete a journey even if the card shows a negative balance.
- The card will have a capability of being used for other transactions, such as telephone, parking, road tolls, and payment of utility bills.
- To preserve privacy, users will be able to obtain a personalized or an anonymous farecard; all data collected will be treated confidentially.

The CSC system is being tested. Full service is expected to begin toward the end of 1996. The system is designed to handle between 3 to 4 million transactions per day. Three million smart cards will be in use when the system is fully operational.

Lessons for the United States

The use of smart cards in the United States has lagged behind the rest of the world. However, their use is expected to grow rapidly in the future. Proximity smart cards have found their first application in electronic toll collection (ETC) systems where they permit motorists to pass through toll gates without stopping. The amount of the toll is deducted electronically from the stored value in the card. Thirteen toll agencies in 10 states operate ETC systems; additional systems are planned in another 11 states. The application of smart card technology to transit is a logical extension of the electronic fare payment systems. Prime candidates for

this technology are large metropolitan transportation systems, where the stored-value smart card could be used to allow seamless transfer between transit modes and to pay for highway and bridge tolls, parking charges, and possibly taxi fares. Some U.S. systems are already conducting pilot smart card projects.

AUTOMOBILE CONTROL POLICIES

Singapore's Area Licensing Scheme

In June 1975, Singapore introduced a cordon road pricing system called the Area Licensing Scheme (ALS). Originally aimed at discouraging commuter traffic from entering the CBD, and applied only to private cars during morning peak hours, its objective was broadened in June 1989 to include the overall management of traffic congestion. Now, the ALS covers all vehicles (cars, taxis, delivery vehicles) and the afternoon as well as morning rush hours.

The Singapore concept involves four components: a restricted zone, restricted hours, a restricted class of vehicles, and license fees. The restricted zone is defined by an imaginary cordon drawn around the most congested part of the city. During the restricted hours (7:30 a.m. to 10:15 a.m. and 4:30 p.m. to 6:30 p.m.) all vehicles except transit buses and emergency vehicles have to display "area licenses" to enter the cordoned area, called the restricted zone. Originally, carpools were given free entry into the zone. The carpool exemption was revoked with the introduction of the broadened ALS in June 1989.

A daily license costs $3 Singapore ($1.87 U.S.) for private cars, taxis, and delivery vehicles and double that amount for company-owned cars, which are often used to chauffeur senior executives to and from work. Monthly licenses are available for $60 Singapore ($37.50 U.S.).

Enforcement is carried out by policing entrances to the restricted zone. Visual inspection is facilitated by windshield stickers that come in different shapes and colors for different months and types of vehicles. Taking advantage of recent advances in electronics, Singapore authorities have decided to automate the ALS. Beginning in 1997, an Electronic Road Pricing (ERP) system will replace the current visual inspection of windshield stickers. The system will involve roadside transponders installed at entry points that will cause units installed in vehicles to deduct the amount of the toll from a stored-value smart card. Vehicles with no smart card or an insufficient balance of money on the smart card will be photographed and a collection notice will be sent to the vehicle owner by mail. With the automation of the system, it will be possible to apply variable charges varying with the time of day, thereby endowing the system with a true congestion pricing capability.

Effects of the ALS on Traffic and Modal Split

Initial implementation of the ALS in 1975 resulted in a 44 percent decrease in inbound morning traffic, from 74,000 to 41,500 vehicles. Subsequently, inbound traffic began to creep up and eventually reached 60,000 vehicles in 1985. The inclusion of delivery vehicles in the revised ALS in 1989 resulted in a dramatic 51 percent reduction in inbound morning truck traffic and a 60 percent reduction in afternoon truck traffic. In addition, afternoon automobile traffic decreased by 56 percent as a result of the afternoon restrictions on private cars.

The reduction in truck traffic had a noticeable effect on speeds within the restricted zone. Afternoon travel speeds increased by nearly 30 percent, from 25 kmh to 32 kmh. However, truck restrictions caused a deterioration in travel speeds in areas outside the restricted zone, as more delivery vehicles began to use bypass routes. Average speeds along the ring road, for example, declined from 31 kmh to 19 kmh during the afternoon peak period, after truck restrictions went into effect in 1989.

Implementation of the ALS also affected modal split. Transit's share of work trips into the restricted zone increased from 33 percent in the pre-ALS years to 69 percent in 1983. The opening of a rapid transit system in 1988 diverted about 11 percent of former bus riders to rail, but the auto/transit modal split remains roughly the same to this day. The volume of carpools as a percentage of all automobile traffic peaked at 54 percent in the early 1980s and has since declined to 34 percent, probably as a result of the lifting of the carpool exemption in 1989.

Lessons for the United States

In operation for nearly two decades, Singapore's ALS has proved to be an effective congestion management tool. Is Singapore's experience transferable to the United States? Specifically, can the ALS concept be adapted for use in congestion management systems (CMS) and other local efforts to manage traffic? The following important distinctions between Singapore and U.S. cities must be noted:

1. The Singapore congestion pricing scheme covers a well-defined and densely populated area of a limited size (725 hectares or 2.8 sq mi). The geographic areas subject to congestion management in American cities are likely to be far more extensive. The larger the area, the more entry points must be controlled, and the more costly and difficult it becomes to monitor and enforce a cordon-based congestion pricing scheme. Thus, even with the advent of ETC, areawide congestion pricing would be far more difficult to implement in a typical U.S. metropolitan area than in Singapore.
2. The key difference lies in the vastly different political and institutional environments of the two countries.

Evidence so far indicates little public support for areawide congestion pricing schemes in the United States. Faced with what it perceived as lack of local interest in congestion pricing, Congress rescinded the Congestion Pricing Pilot Program after 2 years of unsuccessful efforts to mount congestion pricing demonstration projects. A proposal by San Francisco's Metropolitan Transportation Commission to institute variable pricing on the Bay Bridge--the first project to be approved under the pilot program--had to be shelved for lack of a political sponsor.

The only other local initiative the program was able to stimulate was a series of "pre-implementation studies." Three of these studies involve evaluation of high-occupancy vehicle (HOV) "Buy-In" or high-occupancy toll lane projects in North San Diego (I-15), Orange County (SR 91 Express Lanes), and Houston (Katy Expressway). Other feasibility studies of congestion pricing are underway in Boulder, Colorado; Minneapolis-St. Paul, Minnesota; New York State; Portland, Oregon; and Los Angeles, California.

Crucial to local and state officials' support of congestion pricing is the attitude of the public. The Singapore evaluation noted that Singapore citizens tend to view road pricing "as a necessary nuisance, and grudgingly accept it." In the United States, experience suggests that public reaction to congestion pricing would be far less restrained. Charging people for the use of formerly free roads is likely to provoke intense public outcry, not unlike the reaction provoked by "taking away" an existing freeway lane to create an HOV lane. Thus, even if the theoretical benefits of an ALS seemed overwhelmingly persuasive, it is doubtful that state or local officials could be convinced to implement such a far-reaching scheme, especially if its primary objective were to limit entry into a CBD.

The Singapore experience is not entirely irrelevant--there are indications from around the country that there may be a willingness to try differential tolls on new and existing toll roads and bridges, by experimenting with differential peak-hour surcharges and/or off-peak discounts. Although the effect of such experiments would be limited to a single facility or a single corridor, they would throw light on questions that should be answered before we engage in more ambitious experimentation. Pilot projects would help to answer such questions as: How would differential tolls affect ridesharing and transit? What fraction of drivers would shift their travel to off-peak times, and to what extent would time-sensitive commuters be willing to pay the higher tolls? To what extent would traffic be merely diverted to "free" facilities? Would environmental interests support congestion pricing despite its adverse effect on low-income population? What other constituencies would support and oppose congestion pricing, and for what reasons?

These uncertainties can best be resolved by means of carefully designed pilot demonstration projects. Singapore's experience, especially with its new ERP system, can help minimize the risk of experimentation and provide a benchmark against which to measure progress.

ADVANCED TRAFFIC MANAGEMENT AND INFORMATION SYSTEMS

Japan's Advanced Traffic Information Service (ATIS)

Barely 6 months after it was formed, Japan's Advanced Traffic Information Service (ATIS) Corporation has become a major supplier of traveler information in the Tokyo metropolitan region. Formed as a joint venture between the city of Tokyo and private sector interests, ATIS began to provide real-time information on traffic congestion, travel time, parking lot availability, traffic flow restrictions, and incidents 24 hr a day. The company plans to add event, weather, and intermodal information soon. Information is transmitted over telephone wires, cellular phones and cable to personal computers and television monitors in homes, offices, and in-vehicle displays.

The service via telephone line costs 2,000 yen ($20) per month, with a one-time registration fee of 15,000 yen ($150). Special service, using a dedicated line, costs $200 per month, with a registration fee of $800.

The decision to go commercial was based on wide public acceptance of intelligent systems technology by Japanese motorists. According to Japanese transportation officials, ATIS has outpaced radio stations and variable message signs in providing information to motorists.

Tokyo's Traffic Control Center

What may be the most elaborate traffic management center in the world is in Tokyo. The Tokyo Traffic Control Center, which the study team visited during its tour of the city, controls about 7,000 traffic signals on line (out of a total of 14,000 signals in the Tokyo metropolitan area). The Center's computer controls the timing of green lights to maximize traffic capacity and alleviate congestion by estimating traffic demands. Preference control over conflicting traffic flow and inflow control to the congested area are also applied.

The traffic control center provides motorists with information on congestion, travel times between origins and destinations, traffic regulation, and parking availability through radio broadcasts, variable message signs, fax, and call-in telephone service. Center personnel monitor traffic 24 hr a day with the help of a battery of television monitors. The monitors show traffic on arterials and freeways throughout the vast metropolitan area. Center operators can override the computer to trigger traffic control functions and provide traffic information from the consoles on their desks. Each console is equipped with a database showing past

and present traffic patterns on a map, graphs, and charts and can communicate with safety, transportation, and police organizations through telephone and wireless radio. The system includes some 120 computers on a local area network connected with high-speed fiber-optic cables.

Lessons for the United States

Urban areas in the United States are taking tentative steps to deploy intelligent transportation infrastructure. Cities such as Houston, Minneapolis, San Antonio, Seattle, and suburban Detroit have instrumented large portions of their freeway networks with an array of roadway sensors, closed-circuit television cameras, and roadside beacons that send a continuous stream of data to central traffic operations centers. Personnel in those centers can monitor traffic, control the timing of signals and detect incidents. U.S. cities, however, seriously lag behind Japanese cities in their ability to communicate travel-related information to the public. Although several metropolitan areas can depict traffic conditions and transmit visual images from their video surveillance cameras, there is no concerted effort, as there is in Japan, to provide real-time traffic information to the general public and to motorists in their cars. It has been argued that U.S. commercial traffic information providers, such as Metro Networks and Shadow Traffic, keep the traveling public sufficiently informed and that investment in more elaborate information delivery systems, therefore, would not be economically justified. However, the success of Tokyo's ATIS suggests that the U.S. appetite for accurate real-time traffic information may have been underestimated.

APPENDIX A

MISSION PARTICIPANTS AND THEIR TITLES AND AFFILIATIONS AT THE TIME OF THE MISSION

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Mission 2--May 18-June 4, 1995: Innovative Roles for Transit in Creating Livable Communities (Europe: Vienna, Salzburg, Munich, Zurich, Freiburg, Strasbourg)

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Mission 3--November 1-18, 1995: High-Tech Solutions to Transit Problems (Asia: Tokyo, Yokohama, Nagoya, Hong Kong, Singapore)

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