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International Transit Studies Program

Report on the Spring 1999 Mission

Technology and Joint Development of Cost-Effective Transit Systems in the Asian Pacific Region

This TCRP digest summarizes the Asian Pacific region mission performed under TCRP Project J-3, "International Transit Studies Program." The report includes transportation information on the cities and facilities visited, lessons learned, and discussions of policies and practices that could be applied in the United States. This digest was prepared by Tracy E. Dunleavy of the Eno Transportation Foundation, Inc., on the basis of reports filed by mission participants.

INTERNATIONAL TRANSIT STUDIES PROGRAM

About the Program

The International Transit Studies Program (ITSP) is part of the Transit Cooperative Research Program (TCRP). ITSP is managed by the Eno Transportation Foundation under contract to the National Academies. TCRP was authorized by the Intermodal Surface Transportation Efficiency Act of 1991 and reauthorized in 1998 by the Transportation Equity Act for the 21st Century. It is governed by a memorandum of agreement signed by the National Academies, acting through its Transportation Research Board (TRB); by the Transit Development Corporation, which is the education and research arm of the American Public Transportation Association (APTA); and by the Federal Transit Administration (FTA). The TCRP is managed by the TRB and 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 transport problems and issues.

The program arranges study missions for teams of public transportation professionals to visit exemplary transit operations in other countries. Each study mission focuses on a central theme that encompasses issues of concern in public transportation. Cites 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 better evaluate current and proposed transit improvements and can serve to identify potential public transportation research topics.

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 endorses the selection.

Study mission participants are transit management personnel with substantial knowledge and experience

CONTENTS

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.

For further information about the study missions or individual travel awards, contact TCRP (202-334-3246) or the Eno Transportation Foundation (202-879-4700).

About the Digest

The following digest is an overview of the Asian Pacific region study mission. It reflects the views of the contributing participants, who are responsible for the facts and accuracy of the data presented. The digest does not necessarily reflect the views of the TCRP, TRB, the National Academies, APTA, FTA, or the Eno Transportation Foundation.

TECHNOLOGY AND JOINT DEVELOPMENT OF COST-EFFECTIVE TRANSIT SYSTEMS IN THE ASIAN PACIFIC REGION: MISSION 10, APRIL 8–APRIL 25, 1999

This 2-week mission involved visits and discussions with transportation providers in Kobe, Osaka, Nagoya, and Tokyo, all of which are in Japan, and Hong Kong. The program provided study team members with an opportunity to learn from foreign experience and to expand their network of domestic and international contacts for addressing public transport problems and issues.

In particular, this mission explored technological innovations, joint development efforts, planning issues, disaster recovery plans, intermodal connections, public-private partnerships, and customer service marketing strategies.

The remainder of this digest is divided into three main sections, a glossary, and an appendix. The first section presents transit profiles for each city visited, including information on public and private suppliers of transportation services. The second section focuses on lessons learned by mission participants regarding the main transit strategies and technologies. The third section summarizes the policies and practices applicable to the United States. The glossary defines acronyms. Finally, the appendix lists the names of the study mission participants and their titles and affiliations at the time of the mission.

TRANSIT PROFILES

This section discusses transit services offered in the cities visited. It also examines services provided by some of the public- and private-sector transportation operators.

Kobe, Japan

Public transport in Kobe consists of bus and metro services, automated guideway systems, private railways, Japan Railways (JR) suburban services, and funicular rail services.

Bus and Metro Services

Kobe's bus fleet of 649 vehicles and 71 routes provides more than 120 million passenger journeys annually. A computer-controlled bus location system, which sends information about approaching buses and anticipated journey times to bus stop display panels, has been in operation since 1995.

The metro, which began operations in 1977, covers 13.5 mi and has two lines with 16 stations. Operating costs are financed by fares (19.3 percent), other commercial sources (10.3 percent), and government grants (70.4 percent). The two lines operate as a single route linking central Kobe with the large-scale Seishin new town. The Hokushin Express Electric Railway, a suburban metro that opened in 1988, is jointly owned by Hankyu Electric Railway and Kobe Electric Railway. It is 5 mi long and extends the Kobe metro from Shin-Kobe through a tunnel under the Rokko Mountains to Tanigami, where there is an interchange with Kobe Electric's Sanda line. The railway's rolling stock consists of five six-car electric trains.

Automated Guideway Systems

The public-private Kobe New Transit Company operates a rubber-tired, automated people mover (APM). Known as the Port Liner, this people mover became the world's first fully automated transit operation in revenue service when it opened in 1981. It provides a 4-mi link from Sannomiya Station to Port Island. The guideway is entirely elevated and forms a loop around Port Island. The Rokko Liner, a second people mover system, opened in 1990. It links JR's Sumiyoshi station with Marine Park on Rokko Island, an artificial island constructed in Osaka Bay for industrial and residential development. The 2.75-mi elevated line has six stations, including an interchange with the Hanshin Electric Railway at Uozaki. Kobe New Transit is owned by the city of Kobe (55 percent) and a coalition of banks, insurance companies, and travel agencies. These public-private partnerships, known as Daisan-sector companies, are common throughout Japan. Daisan signifies "third," and the third sector is a uniquely Japanese concept with a significant economic impact, operating in conjunction with the first (public) and the second (private) sectors of the economy.

Private Railways

The 4.75-mi Kobe Rapid Railway does not operate its own trains, but provides central area access to four private interurban railways that serve Kobe. It is 50-percent owned by the city, with the remainder held by four railways. An

east-west line with six intermediate stations links the Sanyo Electric Railway west of Kobe with the Hanshin and Hankyu Railways to the east. Frequent cross-city trains run from the Sanyo system to the Hanshin-Hankyu lines and vice versa, providing a metro-type service.

Kobe Electric Railway, a suburban and interurban railway, operates a 43-mi system with 167 electric cars on routes to Ao, Arima Spa, and Sanda from Shin Kaichi on the Kobe Rapid Railway. The Hokushin Express Electric Railway, partly owned by Kobe Electric Railway, provides an alternative route to central Kobe from Sanda-line destinations via an interchange at Tanigami. A 3.5-mi branch serving a new town development at Kobe-Sanda Garden City was completed in March 1996.

The Sanyo Electric Railway, an interurban rail system, operates 39 mi with 199 electric cars on the route to Himeji. Trains run via Kobe Rapid Railway to Rokko and Oishi, suburban destinations on the Hankyu and Hanshin Railways, respectively. Sanyo also operates a fleet of 128 buses and 10 coaches. Services include suburban feeder routes that link with railway stations and the metro. Total route length is 30 mi.

Japan Railways Suburban Services

JR, Hankyu, and Hanshin operate competing local rail services between Kobe and Osaka. Local and rapid service trains, operated by JR West, cover 80 mi between Himeji and Kyoto via Kobe and Osaka, with some trains extending further. Journeys on Kobe commuter services are in the range of 140 million annually.

Funicular Rail Services

Two cable railways climb Mt. Rokko and Mt. Maya, which overlook the city.

Osaka, Japan

Osaka public transit services include bus, metro, and an elevated automated guided transport system operated by a municipal authority, as well as a small profile metro line. Several private commuter and interurban rail lines provide suburban services, along with JR. Three of the suburban lines share tracks with the metro.

Rail-based travel is dominant, with a 61-percent share compared with only 3 percent by bus, 4 percent by taxi, and 32 percent by private car. Private railways accommodate 26 percent of the passengers, municipal metro 20 percent, and JR lines 15 percent. Some privately operated buses and ferry services operate on the Yodo River.

Major expansion of the rail network in the Kansai metropolitan region (Osaka, Kyoto, and Kobe) has been proposed. It would involve 27 new lines, totaling 135 mi, with a further 68 mi of additional tracks alongside existing lines. Construction completion is expected by 2005.

Bus Services

Osaka's bus fleet numbers 936 vehicles, with 107 routes. It operates 275 mi, with 65 mi on dedicated bus lanes.

Metro Services

The metro carries the vast majority of city travelers. It is one of the most intensively used systems in the world, with 508,000 people using the busiest station at Ueda daily. A "ride-and-ride" system operates by dividing the city into 18 zones, with public transport organized around area transport for each zone, and with interconnecting trunk services serving the city center. Local zone bus services connect with rail trunk routes supplemented by high-frequency bus corridors. Twenty-five transfer terminal points have been identified for interchange between trunk and local routes.

Rail Services

Kansai International Airport, constructed on an artificial island in Osaka Bay, opened in September 1994. JR West operates a rapid service from central Osaka, using Series 223 electric trains, and an express service from Kyoto and the Shin-Osaka Shinkansen station, using purpose-built five-car Series 281 electric trains. Access to the airport is via a new 7-mi link from JR's Hanwa line. Plans exist for through airport services to Kobe and Nara via existing freight connections on the Sanyo and Kansai lines, respectively. An outer orbital service will be provided through Osaka's eastern suburbs, linking Shin-Osaka, Shigino, Hanaten, and Kami. JR West, Osaka prefecture, and Osaka city have set up a Daisan-sector company to undertake the US$1.1 billion project, which includes double-tracking electrification and new stations and trains. Opening is scheduled for 2005.

The Hankai Electric Tramway, which is 100-percent owned by the Nankai Electric Railway, became a separate operation in 1980. It serves the southern part of Osaka and Sakai City from two terminals in Osaka. The tramway operates two lines on three routes with 40 stops. Its network is 11.5 mi long and makes 46,000 passenger trips per day.

The Osaka monorail opened in 1990. This 7-station, 64-mi orbital monorail line around northeast Osaka links Shibahara and Minami-Ibaraki and provides interchange with the North Osaka Express Electric Railway at Senri-chuo, the Hankyu Senri line at Yamada, and the Hankyu Kyoto line at Minami-Ibaraki. About 23,000 passengers use this line daily. In 1994, the line was extended 2.25 mi. It will eventually link up with the Osaka International Airport.

Nagoya, Japan

Unlike most major Japanese cities, Nagoya is marked by a relatively high use of private cars. Although there are 105 mi of subways and commuter rail, only 28 percent of

the travelers in Nagoya use rail (compared with 72 percent in Tokyo). Still, five Nagoya subway lines carry more than 1 million passengers a day over the 47-mi, 74-station network, while the upgraded bus network currently transports 580,000 passengers daily with a fleet of 1,300 vehicles.

Public transit in Nagoya includes bus and metro services operated by the city and suburban and interurban rail services operated by private railways and JR. Additional bus services are operated by private railways. Nagoya's municipally owned metro holds an 11-percent share of the daily travel in the city, with bus accounting for an additional 6 percent. Private-sector and JR rail services are also important for commuting, but are not used as heavily as in other Japanese cities. A network of eight metro lines is envisaged, and construction of new sections is underway to link existing lines with commuter railways to provide easy interchange and a comprehensive network supplemented by upgraded trunk bus services on other corridors.

Bus operations recover 77 percent of costs from the farebox; subway operations recover 78 percent. Both systems recover a few percent of costs from nonpassenger commercial operations and advertising, with the balance of costs met by national, prefectural, and city governments. Personnel costs make up 76 percent of bus and 34 percent of subway expenses.

Bus Services

Two center-city busways, introduced in the 1980s as a way to increase speed and provide service levels comparable to the subways, operate during rush hour with 1- to 2-min headways. (These busways are based on the Curitiba model, just like the bus rapid transit concept being promoted in the United States.) Average speeds and passenger loads have increased by a third on the two busways that wind their way through the Nagoya central business district (CBD).

The municipal bus system consists of 1,310 buses covering 413 mi on 120 routes. There are blue and white city buses and maroon and white key route buses. The key route bus priority system features exclusive bus lanes, priority at traffic signals, and stop spacing similar to that on the metro, raising scheduled running speeds to 15 mph.

The exclusive, distinctly marked rush-hour bus lanes with reddish pavement are the first of their kind in Japan. They run in the center of the street with bus priority signals. Passengers board from shelters located on transport islands in the median strip. The transport islands are fitted with bus approach indicators and information boards. Besides the two novel key route lanes, 29 more exclusive bus lanes, totaling 57 mi, operate in the Nagoya area.

Six demonstration routes have digital electronic displays to provide real-time information to passengers waiting at bus stops. The displays show when the next bus is due, as well as travel time to main stops along the route. Audio announcements are given in Japanese and English.

Eight key routes are planned over a distance of 50 mi to fill gaps in rail coverage and feeding railheads. Buses on key routes use special lanes during the morning rush hour; at ordinary bus stops, bus bays allow key route buses to pass ordinary buses easily. Traffic signals are controlled for smooth bus operation. During the morning peak, buses operate at 1- to 2-min intervals, providing as frequent a service as the metro. A reduced-fare system is in operation for transfers between ordinary city buses and key route ones. Complete construction of a guided busway on the Shidami route in northeast Nagoya is scheduled for the end of 1999. The system consists of an elevated guideway and bus stops sited above existing roads.

Metro Services

The five subway lines in Nagoya (Higashiyama, Meijo, Tsurumai, Line 4, and Sakura-dori) have a total route length of 47 mi with 74 stations. The fare is set at five rates, varying according to the number of predetermined "price zones" traveled. A network of eight lines is planned, totaling 80 mi. Construction of the 4-mi section of Line 4 between Ozone and Nagoya University started in 1994 and was completed in 2000. Construction of three additional lines, including the 2-mi Kami-Iida segment, which links Line 2 and the Komaki terminal, is scheduled for completion in 2002.

Privately Operated Rail and Bus Systems

Tetsudo "Meitetsu" Railroad Company. Meitetsu operates extensive bus and rail networks in the Nagoya region, on both suburban and interurban routes. A city tramway and light rail system operates in Gifu, 19 mi from Nagoya. Rail accounts for 55.9 percent of the company's income, bus 15.6 percent, real estate 15.6 percent, and other commercial sources 12.9 percent.

Kinki Nippon "Kintetsu" Railway. Kintetsu's main line runs from Nagoya to Kuwana, Nakagawa, Yamatoyagi, and Osaka, with a branch to Toba and Kashikojima.

JR Tokai (JR Central). JR operations in Nagoya, which account for 17 percent of daily travel within the city, are not on the same scale as the major networks in Tokyo and Osaka. Six lines operate within the Nagoya region, of which three serve the city itself. Operating costs are financed entirely by fares. Since its formation in 1987, Tokai has increased ridership on all lines in the Nagoya area by introducing new air-conditioned cars, increasing the number of trains, and speeding up services. Between 1987 and 1990, passenger numbers on the Tokaido line increased by 50 percent and more than doubled on the Kansai line. Other developments include modernization of stations, elevation of tracks to eliminate level crossings, installation of closed-circuit television cameras, and high-quality reserved seat "Home Liner" commuter services on the Chuo and Tokaido lines.

Tokai Kotsu Jigyo (Tokai Transport Services Company). This 7-mi, largely elevated line provides an east-west suburban link between JR's Tokaido and Chuo lines. It was planned as part of a JR loop, connecting radial routes around Nagoya; however, the project was abandoned and the line is run as a self-contained operation with hourly local service provided by four diesel railcars.

Further investments in rail transit for completion by 2008 include

- A third east-west metro line and extensions to existing metro lines,
- Upgrading and extension of Meitetsu's Komaki line into central Nagoya via a new metro connection,
- Construction of a new West Nagoya Port line between central Nagoya and the waterfront area,
- Upgrading of several suburban lines, and
- Construction of two new lines.

Tokyo, Japan

Since the 1960s, Tokyo has lost central-city residents to the suburbs. This loss resulted from increases in housing, commercial, and service facilities in the outlying areas and from extension of transportation lines, both rail and highway. It is not uncommon for office workers in Tokyo to spend 2 h or more each day in overcrowded commuter trains. Some residents even commute as far as Nagoya, thanks to the superspeed bullet train Shinkansen connections. In many instances, employers help with the costs of such travel.

Japan is highly advanced in applying transit intelligent transportation systems to ameliorate congestion in urban centers. About 0.5 million in-car navigation units that receive and process traffic control center information are sold each year.

Metro Services

Teito Rapid Transit Authority (TRTA) operates 8 of the 12 subway lines, employs more than 10,000 workers, and moves about 6 million people daily over a network of 100 mi and 148 stations. Its rolling stock consists of 2,355 subway cars. TRTA farebox revenues cover 86 percent of operating costs, including debt service. Its FY 94 annual income totaled US$2.3 billion; expenses for the same year totaled US$2.8 billion. Personnel costs make up 35 percent of total expenditures.

The system's average daily revenue from ticket sales amounts to US$6.34 million. Sixty-four percent of its passengers use discounted commuter passes, and the entire system has used a magnetic prepaid fare card since March 1996. The new card has a fivefold increase in data-recording capacity, allowing TRTA to use automatic fare collection throughout its system.

The Rinkai new transit, a 7-mi, 12-station APM now being completed, is the centerpiece of the planned waterfront Teleport Town. The Tokyo Metropolitan Government (TMG) is promoting this mixed-use new town as a future subcenter to house 160,000 people. The computer-operated, driverless "Yurikamome" (Japanese for black-headed gull) APM will run on 2-min headways on a double-elevated guideway. It will have capacity for 17,000 passengers per hour and operate on rubber tires on a concrete track, incorporating heaters to prevent service interruption due to freezing.

The Rinkai new transit and the Tama monorail, now under construction, form part of the metropolitan government's plan to improve and further integrate public transit in the capital, whose daytime population now exceeds 12 million. More than 3 million people commute to the city center daily.

The concentration of business and government in the CBD has put a severe strain on the transportation network, which now operates at 200 percent of capacity. The two subway operators in Tokyo—TRTA and the Transportation Bureau of the Tokyo Metropolitan Government (TBTMG)—are both public agencies. Together, they operate 12 mass transit lines that move 7.5 million passengers daily with 3,000 subway cars over a combined network of 140 mi with 217 stations. Another 37 mi are currently under construction. Seven subway lines connect to partner networks and extend more than 30 mi from the city center. The network's combined track length is 395 mi.

Approximately 9.5 million people in the Tokyo metropolitan area commute by public transport—a 17-percent increase over the 1985 census. Almost one-third of this volume is concentrated in just 1 h during the morning peak commuting period. More than 15 billion passengers use public transit in the course of a year.

When completed, the high-tech Tokyo Number 12 automated linear subway line, which has been under construction since 1986, will be 26 mi long and have 38 stations. The first four station segments are in operation. The second phase, consisting of 18 mi and 26 stations, was completed in 1997. This low-slung, small-bore linear subway saves space and construction costs without affecting capacity. Tunnel diameter is only 14 ft, as opposed to the standard 20 ft.

Hong Kong

Hong Kong's five rail systems include a heavily used mass transit system, a busy suburban railway, a modern light railway, a traditional street tramway, and the Peak funicular railway. The first three rail systems are operated by public corporations and wholly owned by the government; private operators own the others. Public transit offerings also include ferries and road passenger transport, the latter made up of franchised buses, minibus fleets, taxis, and non-franchised buses.

In total, Hong Kong's public transportation systems carry 11 million passengers a day—nearly double its total

population. This use of public transportation is believed to be a record unmatched anywhere in the world. Hong Kong's transportation scene is further strained by the use of 320,000 private cars and 23,000 motorbikes in a 416-sq-mi region—an area smaller than Los Angeles (467 sq mi). About 14,000 high-fee parking meters are being turned into "smart" electronic parking devices.

Mass Transit Rail Services

The Mass Transit Railway Corporation (MTR) operates a three-line metro system comprising 27 mi with 38 stations. The network is served by 759 cars operating in eight-car trains. This profitable system was opened in stages between October 1979 and August 1989. By the end of 1998, MTR was carrying more than 2.38 million passengers every weekday. MTR's railway is one of the most efficient and busiest underground railways in the world. The 5 million contactless fare cards that are already in use have achieved the desired goal of fare integration among all modes and are doubling as phone and electronic purse cards.

The airport railway, which opened in 1998, has a dedicated express service linking the new airport at Chek Lap Kok and Central, with stations at the airport, Tsing Yi, Kowloon, and Central (Hong Kong station). Its commuter service between Lantau Island and Central operates stations at Tung Chung, Tsing Yi, Lai King, Tai Kok Tsui (Olympic station), Kowloon, and Central. The domestic service will interchange with the Tsuen Wan line of the existing MTR system at Lai King station and with the Island line at Hong Kong station, bringing relief to the MTR Nathan Road Corridor.

Suburban Rail Services

Kowloon-Canton Railway Corporation: East Rail. The Kowloon-Canton Railway Corporation (KCRC), which started operations in 1910, was double tracked and electrified in the early 1980s. Operation of the system, formerly run by the government, was vested in the KCRC in 1982.

The 21-mi railway provides suburban service to new towns in the northeastern new territories, a freight service to and from China, and passenger services to and from Changping/Guangzhou and Foshan/Zhaoqing. Suburban commuter service has grown substantially since electrification, and the railway, with 13 stations, handles 720,000 passenger trips daily. Passenger traffic is carried in 351 cars, operating in train formations of 12 cars.

Kowloon-Canton Railway Corporation: West Rail. In December 1996, the government proceeded with construction of Phase I of West Rail, a 19-mi commuter line linking West Kowloon with Tuen Mun via Tseun Wan, Kam Tin, Yuen Long, and Tin Shui Wai. Phase I is expected to be completed to Yuen Long by the end of 2002 and to Tuen Mun in 2003.

Light Rail Services

The KCRC also operates the light rail transit (LRT) system in the northwestern new territories in Tuen Mun, Yuen Long, and Tin Shui Wai. The LRT began operations in 1988. With the commissioning of the Tin Shui Wai Phase III extension in March 1995, system route length is now 20 mi, with 8 routes, 57 stops, and a fleet of 119 cars operating either singly or in pairs.

The LRT provides free transfer from one route to another within the same fare zone and with connecting feeder buses. Major public transport companies introduced a new fare structure in September 1997 following the launch of the Octopus smartcard. The LRT Octopus fare structure is distance based, with adult fares ranging from HK$3.70 to HK$5.80.

Octopus holders who travel regularly on the LRT enjoy frequent-user discounts ranging from 10 to 28 percent. Since September 1997, single-ride ticket fares for adults range from HK$4 to HK$5.80. The LRT and its feeder and auxiliary buses carry 364,000 passengers every weekday.

New World First Bus, Hong Kong's newest bus company, installed Octopus equipment in 50 of its buses in March 1999, and by the end of 2000, its entire fleet was fully operational with Octopus equipment. Seven transit operators are now participating in the Octopus system. (New World First Bus was established in early 1998 to bid for the franchise to operate public bus services in Hong Kong after the existing franchise, operated by China Motor Bus, expired in August 1998.)

Trams

Electric trams have operated in Hong Kong since 1904. Hong Kong Tramways, Ltd., has six overlapping services, using 8 mi of double track along the north shore of Hong Kong Island.

The company's 163 trams, including two open-balcony units for tourists and private hire, make up the only fully double-decker tram fleet in the world. The trams carry 280,000 passengers a day. Fares are HK$1.60 per adult and HK$0.80 for children and senior citizens.

Funicular Rail Services

Hong Kong's other "tramway" is a cable-hauled funicular railway operated by the Peak Tramways Company, Ltd., from Central to the Peak. The 0.86-mi line began operations more than a century ago; it was modernized in 1989. The rail line climbs 1,224 ft on gradients as steep as one-in-two. The line serves 11,500 passengers a day, mostly sightseers and some residents. One-way fares for adults and children are HK$18 and HK$5, respectively. The operation is extremely profitable, with a farebox recovery rate reportedly over 200 percent.

Ferries

Ferries are essential for traveling to Hong Kong's outlying islands and provide an important link to the new towns in the northwestern new territories. In the inner harbor, ferries are a supplementary mode of transport to cross-harbor buses and the MTR. Existing services are provided largely by two franchised private operators—Star Ferry Company, Ltd., and Hong Kong and Yaumati Ferry Company, Ltd. (HYF).

Star Ferry operates 12 vessels across the harbor and carries 89,000 passengers on its three routes daily during the year. Fares range from HK$1.70 to HK$2.70. Passengers 65 and older enjoy free travel on all Star Ferry services.

HYF owns 73 vessels and operates 24 ferry routes, including passenger and vehicular services and licensed services. The company carries 84,000 passengers and 1,300 vehicles daily. Adult fares are HK$32, with vehicles rates up to HK$480.

Thirteen additional ferry services, including service to Discovery Bay, are operated by eight licensed private firms. These operations are supplemented by *kaitos*, local village ferry services licensed to serve remote coastal settlements. Currently, 87 kaitos are in operation.

Road Passenger Transport

Road passenger transport accounts for two-thirds of all public transport journeys. More than half of public transport journeys made by road are on franchised buses, with the remainder on green minibuses, public light buses (PLBs), taxis, and nonfranchised buses.

Until recently, bus-only lanes in Hong Kong were mostly localized and did not facilitate the movement of buses between districts, regions, or both. As a result, buses still suffered significant delays because of traffic congestion in major interdistrict traffic corridors. The Transport Department commissioned a study in 1996 to investigate and design interdistrict bus-only lanes for six corridors covering major commuter traffic between homes and work and school places. As of mid-1998, new interdistrict bus lanes were implemented to shorten bus journey times, make services more reliable, and persuade more commuters to travel by buses instead of by private cars, in turn alleviating traffic congestion.

Franchised Buses. During the last few years, significant improvements in franchised bus service have been made feasible by opening the Western Harbor Crossing (WHC), the West Kowloon Highway, the Lantau line, and the North Lantau Highway. Fifty-three new bus routes were introduced (with six operating via the WHC) to provide direct bus services between the new territories, West Kowloon, and Hong Kong Island. In addition, four bus routes provide service to Tung Chung New Town and Chek Lap Kok Temporary Bus Terminus via the Lantau Link and the North Lantau Highway.

The largest operator is the Kowloon Motor Bus Company, Ltd. (KMB). It runs 312 bus routes in Kowloon and the new territories; 31 cross-harbor routes jointly with the China Motor Bus Company, Ltd. (CMB); 10 cross-harbor routes with Citybus, Ltd.; and 13 cross-harbor routes of its own. KMB also provides "airbus" service to and from the airport, operating three routes to Hong Kong Island and two within Kowloon.

At the end of 1998, the KMB fleet comprised 2,067 double-decker buses (with 1,494 air-conditioned double-decker buses), and 278 single-decker buses. Of these buses, 13 were super low-floor, single-decker buses with wheelchair accessibility.

KMB made 1.05 billion passenger trips and covered 186 million mi in 1998. It operates under a franchise granted through July 31, 2007. Fares range upwards from HK$1.20, depending on distance.

To relieve peak-hour congestion on the MTR along the Nathan Road Corridor, KMB operates 25 bus routes that provide service mainly during weekday morning peak hours from the new territories and North Kowloon to South Kowloon and Hong Kong Island. These services keep MTR passenger flows on Nathan Road at acceptable, safe levels.

Bus services on Hong Kong Island are provided by CMB and Citybus. CMB operates 82 routes on Hong Kong Island, 31 cross-harbor routes jointly with KMB, and 2 cross-harbor routes of its own. CMB's registered fleet comprises 794 double-deckers and 29 single-deckers. Citybus, which was recently acquired by Stagecoach (the U.K.-based international bus-operating company), operates two franchised networks. The first franchise, which lasts until June 30, 2006, services 67 bus routes on Hong Kong Island. It also runs 10 cross-harbor routes jointly with KMB and 2 cross-harbor routes of its own.

Citybus was granted a second franchise in 1997 to operate a network of 13 franchised routes for North Lantau and the Chek Lap Kok Airport. At the end of 1998, Citybus had a registered fleet of 590 vehicles. Of these, 6 were super low-floor, single-decker buses with provisions for wheelchair passengers. The company's buses made 148 million passenger trips and traveled 23 million mi in 1998.

The fourth franchised bus operator is New Lantau Bus Company, Ltd. (NLB), which provides bus service on Lantau Island. NLB runs 13 routes with a registered fleet of 80 vehicles. It provides 6 million passenger trips, covering 2.2 million mi.

The Long Win Bus Company, Ltd., is the fifth and newest franchised bus company in Hong Kong. It was granted a franchise effective June 1997 to operate a network of 12 bus routes for North Lantau and Chek Lap Kok Airport.

Minibuses. Hong Kong's private minibuses are licensed to carry a maximum of 16 seated passengers. As of 1998, there were 6,742 minibuses in the region. About 4,350 are PLBs; of these PLBs, 2,392 are authorized to carry only group passengers and may not collect separate fares.

There are two types of PLBs: green and red minibuses. Their operation is regulated by a passenger service license. Green minibuses provide service according to specified schedules that define the routes, fares, vehicle allocation,

and timetables. There were 2,107 green minibuses operating on 287 routes and carrying 970,000 passengers daily in 1997. Red minibuses operate without specified schedules. They are not required to operate on fixed routes or timetables and are free to set fares. In 1997, 2,243 red minibuses carried 805,489 passengers daily.

Taxis. At the end of 1997, there were 15,000 urban (colored red), 2,700 new territories (green), and 50 Lantau (blue) taxis. These taxies carried a daily average of 1.1 million, 199,000, and 1,250 passengers, respectively.

Nonfranchised Buses. Residential bus service was introduced in 1982 to give commuters an additional choice of modes. Resident organizations invite nonfranchised operators to operate services under passenger service licenses issued by the Transport Department. These services operate mainly to and from housing estates during peak hours, supplementing services provided by franchised bus operators.

LESSONS LEARNED

This section focuses on the main strategies and technologies observed by study mission team members. Specific topics discussed are

- Public transportation and land development,
- Joint development of infrastructure,
- Integration of modes: Nagoya Central Station,
- Institutional and financial ideas,
- Joint trackage uses and other shared rights-of-way,
- Bus reliability and attractiveness,
- Private supply of public transit: The Kowloon Company,
- Fare collection technology, and
- Rapid transit control centers.

Public Transportation and Land Development

Japan and Hong Kong experience urban transportation problems associated with growth, much like the rest of the world does. Both countries use innovative technology and intensive land development when establishing public transportation systems. With strong emphasis on mass transit, each government advises and approves planning of urban transportation facilities. Setting central policies and providing guidance is key in creating the regional integrated public transportation systems in these two countries.

Japan

Japan has steadily expanded its transportation system to include high-speed rail, other rail, expressways, and airports. Automotive traffic has outpaced development of transportation facilities. Although public transportation is fairly established in large cities, congestion is still a problem because transportation facilities are beyond capacity. Increased congestion makes travel by buses unreliable. In turn, ridership has declined by 40 percent from its 1968 peak.

Large cities are developing transportation facilities to mitigate chronic traffic congestion and prevent disorderly urban sprawl. In small cities, car ownership is prevalent because public transportation is not as developed. Because of increased automobile usage, intermodal connections are important. The national government is attempting to revitalize bus transportation and divert automobile users to buses. These efforts are supported by subsidies to create exclusive bus lanes, improve bus stop facilities, and introduce new bus designs. Compared with large cities, small cities are struggling to develop public transportation systems that will ensure adequate mobility, establish growth centers, address sprawl, and revitalize center-city shopping areas.

The City Planning Law of 1968 establishes the framework for city planning and development in Japan. It defines geographic areas where development should be promoted and restricted, similar to the U.S. urban service boundary concept.

City planning in Japan consists of three key elements: land use, facility development, and urban development. Strong emphasis is placed on deliberate and rational formation of new urban areas. Urban development projects implement land-use plans and facility development. Integration of facilities and land development have been significant in addressing Japan's rapid growth. Land use and infrastructure are integrated much like the concurrency concept in Florida and other parts of the United States. Concurrency requires that infrastructure to support development be in place at the time of development or within a specified time following development.

In 1998, the Japanese government approved the New Comprehensive National Development Plan. This plan specifies initiatives to be implemented, including building self-reliant residential areas with increased green space, revitalizing overcrowded metropolitan areas with advanced infrastructure, forming regional corridors and areas that can share and maximize resources, and creating international transportation centers, such as airports and sea ports.

Regional planning has been emphasized in Japan for decades, and regional living areas have been established and implemented through coordination of land use and facility development. Prefecture, or regional, governments prepare large-scale, integrated plans similar to regional planning councils in the United States. Each prefecture must have a 10-year regional transportation plan consistent with and supportive of the national plan. Local governments prepare city plans, which include plans for specific geographic areas of the city.

Urban sprawl has created the need to use a variety of transit technologies to extend rail in suburban areas. To support the influx of new development, different types of new transit systems are being implemented. Infrastructure grants are provided from the road construction budget to fund up to 60 percent of the construction costs for new transit systems.

The strength of public transportation is attributed to the integration of housing and transit. For example, the Yurikamome new transit system serves a planned satellite urban waterfront development. It connects the waterfront city with Tokyo. This system is important because it provides residents living outside the congested city of Tokyo with an alternative means of travel.

Hong Kong

Hong Kong is one of the most densely populated places in the world. Its population grew from 4 million in the late 1960s to more than 5 million by 1980. Today, Hong Kong's 6.7 million people live within 421 sq mi, an area about half the size of Rhode Island. The rapid rate of population growth places a great demand on the government to provide adequate transportation facilities. This rapid increase creates the need to balance economic growth with additional infrastructure development.

Although public transportation is the preference for travel, Hong Kong is improving and expanding its roadway network. In order to provide access for residential and nonresidential uses in outlying areas, both roadway and transit improvements are necessary. Over the next 20 years, US$2.2 billion is earmarked for roadway construction and improvement.

Development is rapidly occurring in areas where transit infrastructure is in place. Many projects have been developed to further the goal of integrating rail and bus systems with new housing development and the airport.

Priority is given to railways because of the limited land needed and the ability to carry large numbers of people. Along with giving priority to rail, government is evaluating when to incorporate planning, design, and construction of projects. The amount of development needed to meet projected travel demands is currently being determined.

The government focuses on developing land uses adjacent to transit stations. Requirements for new projects include establishing mixed-land uses and coordinating public transportation. A zoning plan to control land development incorporates concepts similar to the livable cities agenda in the United States. The zoning plan is implemented in new towns and self-contained communities, allowing residents to live, work, and play in the same neighborhood. Two developments in Florida (Celebration and Seaside) illustrate the coordinated land use that Hong Kong is implementing.

MTR has built residential and nonresidential communities adjacent to transit stations. These commercial, residential, hotel, and recreational uses represent effective coordination of land use and transportation. MTR has developed communities adjacent to five main airport-railway stations. It is working on a comprehensive plan to integrate surrounding land uses with railway stations. The land uses will include 24,000 residential dwelling units and 35.5 million sq ft of office, hotel, and commercial space.

The Chek Lap Kok Airport is part of a major transportation improvement program. The Hong Kong airport authority is responsible for planning, building, and operating the airport. Its master plan is designed to meet demands until 2040. The plan provides the blueprint for advancing the facility from its current capacity of 35 million passengers to 85 million. Proposals call for development of airport-related land uses, including commercial, freight, hotel, and parking.

Plans for Chek Lap Kok are based on experiences with Kai Tak, the previous airport in Hong Kong. Kai Tak had 350,000 residents under its flight paths. The new airport on Lantau Island does not include plans for residential uses in the flight path. Officials realize that growth and viability of the airport depend on compatible land uses. Careful consideration was given to minimizing impacts on the surrounding area. A 1.5-mi strip of green space has been reserved on the island to act as a natural noise shield for residents north of the airport.

Development of multimodal connections is a significant part of long-range planning for Chek Lap Kok. The ground transportation center functions as an intermodal hub for all surface transportation to downtown. The center accommodates taxis, airport buses, tour coaches, short- and long-term parking, and the Airport Express train. The center is adjacent to the passenger terminal. The Airport Express connects to central Hong Kong from the ground transportation station center.

Hong Kong is experiencing an influx of immigrants from mainland China. This influx generates increased demand for bus service. In addition, the new territories continue to experience high growth resulting from land costs and the ability to have more green space.

The KCRC operates an LRT system and feeder buses that serve Hong Kong and China. To integrate surrounding land uses, the company is involved in extensive property development around transit stations. This development includes a mixture of residential, retail, and commercial uses. Expansion is anticipated along future rail corridors and in planned new towns. The government has identified locations for additional rail lines on the basis of expected growth.

Joint Development of Infrastructure

Many transit planners are familiar with examples of Japanese department stores built over and around subway stations and Hong Kong's high-rise towers providing significant real estate revenues for subsidizing new transit systems. These examples show how joint development can be successfully undertaken by coordinated effort of the public and private sectors.

This section focuses on transit systems visited by the study team. For purposes of this section, joint development is defined as public-private cooperative ventures that share the costs, profits, or both. Real estate development may play a role in such joint projects. (Conversion factors at the time this research was prepared were 119 Japanese yen = US$1 and HK$7.75 = US$1.)

Japan

In Japan, both transit and highway systems are covered under the same heading of "infrastructure" in the national budget. Unlike people in the United States, whose Federal Highway Administration and Federal Transit Administration are separate agencies with separate agendas, people in Japan view transit and highways as part of the same transportation network. National highways, bridges, and transit guideways are considered rights-of-way that are built and developed under a single national budget and set of laws.

As such, the national government maintains ownership and responsibility for the transportation rights-of-way, but privatizes the operation of highways and transit systems that use them. Up to 60 percent of the costs of new highways or transit systems are considered the responsibility of government, but the government undertakes virtually none of the operations. Maintenance and operation of highway and transit systems are a franchised function of the private sector. Private-sector entities are expected to operate on a profitable basis using commercial principals.

Tokyo Metropolitan Area Case Studies. The TRTA and Tokyo waterfront Yurikamome new transit line are two public-private joint developments observed by the study team.

Although the TRTA is fully owned and operated by the government, the transit system has struck an interesting bargain with other (largely private) operators to share trackage. TRTA subways were originally planned to replace the streetcar network. Passengers traveling into Tokyo center from the suburbs had to change from commuter to subway trains at points where the lines met near the city's edge. To eliminate the forced transfer between subway and commuter trains, six of the eight subway lines now connect directly to the suburban railways. TRTA drivers and conductors exit the trains at the subway terminal stations, where crews from the suburban lines take over. Passengers are not required to change trains, and through service now extends 30 mi from the city center.

Huge investments were required to build new subway lines in central Tokyo. The connection to suburban rail lines at either end helped to ensure the high ridership needed to amortize the costs of subway construction.

The Tokyo waterfront Yurikamome new transit line (see Figure 1) is perhaps the most successful example of new transit in Japan. The line carries 80,000 passengers daily and operates at a profit. Although real estate development of Rainbow Town has been slowed by the recession, ridership on the line has outpaced projections, generally because of recreational trips to the waterfront and parks that make up the development. Patronage has been particularly high on weekends, when many city dwellers use the line for excursions. The line generated US$68 million in revenues in FY 97, which was offset by US$60 million in operating costs, leaving an operating profit of US$8 million. The low operating costs are partially due to the line's being completely automated, thus having reduced labor costs.

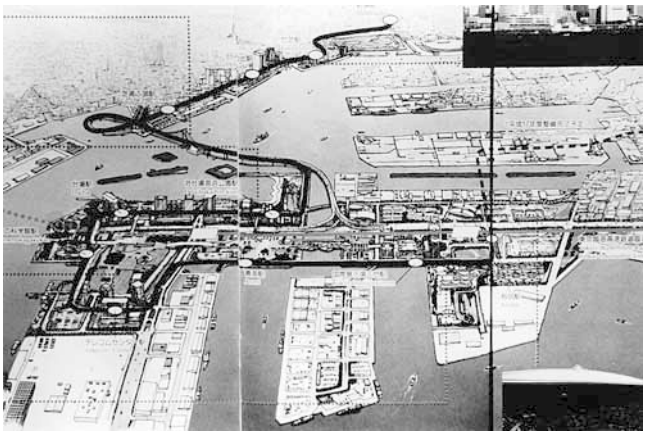

Figure 1. Tokyo waterfront Yurikamome new transit line (Japan).

Construction costs for the line were US$1.65 billion, or US$350 million per mi. Of the US$1.65 billion, US$1.1 billion was paid by the TMG and US$550 million was paid by the private sector through a consortium of 17 different banks. The high costs are attributed to the large footings required for portions of the guideway built above water or above mud flats in Tokyo Bay.

Because the redevelopment project is located on an island, the new transit line is the primary means of access to Rainbow Town. The project would not be feasible without the line; thus, the private sector was willing to take on the high costs of construction.

Osaka/Kobe Metropolitan Area Case Studies. Both Osaka and Kobe have developed new tram systems linking the central cities to waterfront redevelopment areas. These systems take advantage of national government subsidies for the construction of aerial guideway (i.e., infrastructure) components of these systems.

The Osaka new tram was built by the public sector and is operated by the Osaka Municipal Transport Bureau. Although the subway and new tram are vital as infrastructure for sustaining people's activities and life in the urban setting, both services operated at a deficit in FY 96 (US$207 million). Such deficits are funded through traditional public revenue sources in a similar manner to most U.S. transit systems.

The Osaka new tram was one of the few instances found by the study team of new transit service that was not developed jointly with the private sector. The lack of private-sector participation was probably due to a determination that the Osaka new tram could not be operated on a profitable basis and, therefore, needed to be fully undertaken as a public project.

Kobe new tram (see Figure 2) operates as a public-private joint venture between the city and Kobe New Transit Company. Kobe New Transit was intended to inject private-sector energy into a project beneficial to the general public. In addition to the new trams, the company engages in the

Figure 2. Kobe new tram (Japan).

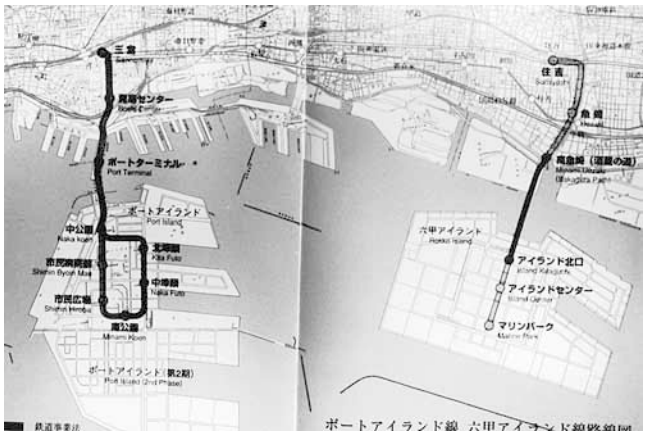

Figure 3. Port Island and Rokko Island developments (Japan).

sale, purchase, renting, and construction of land, buildings, and other facilities that make up Port Island and Rokko Island developments (see Figure 3). In 1997, Kobe New Transit reported new tram revenues of US$4.34 million and total expenses of US$4.53 million, resulting in an operating deficiency of US$184,000. The line is expected to become profitable as the economy recovers and as further real estate development activity occurs on the two islands.

Nagoya Metropolitan Area Case Studies. Public-private joint development of transit in Nagoya includes JR Central Towers and the Nagoya guideway bus system's Shidami line.

JR Central Towers offers the quintessential model for real estate joint development of air rights. Designed by the world famous New York architectural firm of Kohn Pederson Fox, the building is a "trophy property" that will generate significant profits for JR Central. Upward of 150,000 trips per day are expected through the Nagoya station, which already handles 1.1 million trips daily.

The JR Terminal Development Company is one of four wholly owned subsidiaries of JR Central Group that undertake real estate development and management. JR Terminal

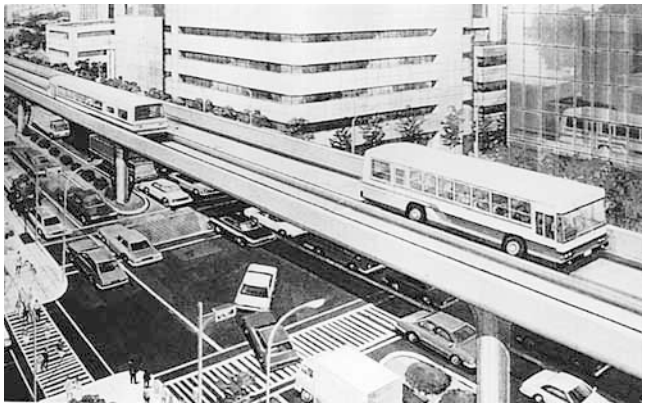

Figure 4. The Shidami guideway bus system (Japan).

employs 100 people. In total, approximately 25 percent of the revenues generated by the JR Central Group of companies come from real estate development.

Construction costs for the Shidami guideway bus system (see Figure 4) was estimated in 1992 as US$233.6 million. Of this total, 77 percent is the responsibility of the city government and 23 percent is the responsibility of the Nagoya Guideway Bus Company, which was formed to build and operate the project.

Basic infrastructure components paid for by the public sector include support columns, girders, floor slabs, bus stations, and traffic signal equipment. Noninfrastructure components paid for by Nagoya Guideway Bus include vehicles, bus station interior finishes, station equipment, administrative buildings, auxiliary facilities, communications equipment, safety equipment, and maintenance.

The line will be operated by Nagoya Guideway Bus on a for-profit basis. The company will engage in additional revenue-generating activities, including the operation of car parking, real estate development and management, and other commercial activities incidental to the operation of the line. In addition to the Toyota Motor Corporation, local private investors in the bus company include banks, the electric power company, the gas company, and railroads.

Hong Kong

The Hong Kong Transport Bureau is responsible for overall policy formulation, direction, and coordination of transport matters. One of its primary goals is contracting out as much of the transportation infrastructure as possible.

Three models in use in Hong Kong are (1) public corporations (i.e., government equity involvement), (2) franchised companies (i.e., no direct government equity, but some indirect subsidies), and (3) licensed companies (i.e., nonexclusive operating rights with less stringent government requirements than franchises). In all three cases, the goal is to operate transit service using sound business principles with a minimum of public support. In almost all instances, transit service is operated as a profitable venture that returns rev-

enues to investors. The system is cited as a model for reducing the growth of civil service, increasing innovation, and reducing regulation and bureaucracy.

Case Studies for Joint Development of Transit Services. Case studies of public-private joint development in Hong Kong include the MTR; the airport authority; KCRC; KMB; and the region's trams, water ferries, minibuses, taxis, and elevated walkway systems.

The MTR system cost US$7.8 billion to construct. Through mid-1998, more than US$516 million had been raised in profits from the joint development of 18 property complexes above and adjacent to stations along the transit lines.

MTR is undertaking some of the most extensive property development in the world along the five new stations of the Airport Express line. Total investment is projected to be US$25.8 billion. Under the terms of the development agreements executed by MTR, private developers are responsible for paying all costs, including land premium and construction. MTR derives revenues from these developments through up-front cash payments and sharing of profits and assets in kind.

The sheer size of the airport extension project dwarfs developments in most other parts of the world. Figure 5 shows a model of the planned Kowloon development. Comprising 18 residential towers, an 88-story office and hotel, and associated retail and public uses, the project will take more than 12 years to develop. Figure 6 shows a model of the planned Tsing Yi station, located midway between downtown and the new airport. This development will include twelve 40-story apartment towers, including 3,500 units, a major shopping center, and associated recreational and cultural facilities. Buildout of the project is anticipated to take 4 years.

MTR has recently been directed by the government to draw up plans for privatization. Assets would be sold to the private sector; however, government oversight of route operations and fares would presumably continue. Revenues generated by the government from privatization would fund additional infrastructure expansion projects.

The government envisions that, over time, the airport authority will be one of the region's largest commercial landlords. Under its land grant, the authority holds a 50-year interest over the entire island. The authority is developing this land through sublease agreements with the private sector. The new airport includes 90 hectares of commercial land, of which 42 acres have been leased and 180 acres remain available for future use. To date, developments include the world headquarters for Cathay Pacific Airlines, a Regal hotel, and airport-related commercial facilities. In addition, the area immediately adjacent to the new airport island includes a potential site for Hong Kong Disneyland and a new town development of the MTR Airport Express railway.

Half the world's population lives within a 5-h flight of Hong Kong, and half the world's airline business will soon be located in the Asian Pacific region. Ten new international airports are being built in East Asia, and travel to mainland China will rise from 65 million to almost 300 million passengers annually between 1995 and 2010. Similar to joint efforts for rail transit stations, airport planners are discussing the joint development of air traffic infrastructure.

The Kowloon-Canton Railway was operated by the government until 1982, when KCRC was created. Similar to the

Figure 5. Model of the planned Kowloon development (Japan).

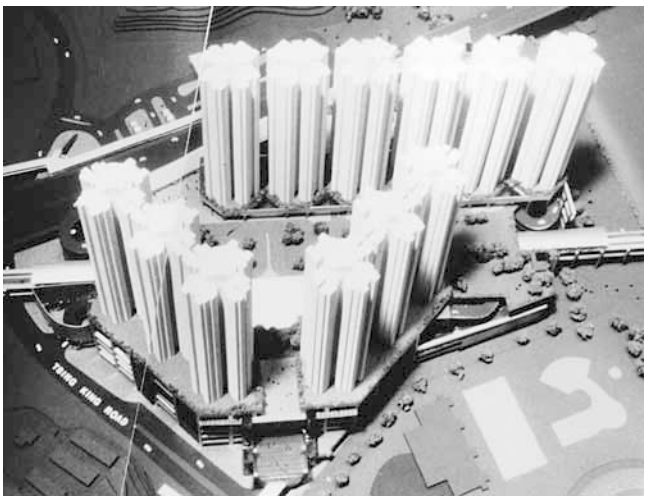

Figure 6. Model of the planned Tsing Yi station (Japan).

MTR, KCRC is completely owned by the government. It operates under prudent commercial principles and generates an operating profit. In 1998, KCRC generated an operating profit of US$227 million. In addition to passenger rail service, the corporation operates bus service and real estate development.

KMB operates as a private company with stock listed on the Hong Kong Stock Exchange. The company reported a bus-operating profit for shareholders of US$71 million in 1997.

The Hong Kong Special Administrative Region (SAR) government oversees operation of KMB through the award of a franchise. KMB was recently given a 10-year franchise; however, route changes and fare structures are subject to approval by the government. Unlike many cities that grant franchises, KMB must often compete with other operators on routes and does not enjoy exclusive operating rights. Exclusive rights are gradually being removed by the government to encourage competition.

KMB has been restructured recently to allow greater diversification. In addition to the provision of franchised bus service in Hong Kong, this diversification has created four additional divisions: property development, mainland China operations, nonfranchised transport operations, and internal financial services.

The private operation of trams, ferries, minibuses, taxis, and elevated walkways provides a critical connection, linking major fixed-guideway transit lines with other destinations within Hong Kong. Minibuses and taxis are highly profitable operations, and licenses for such services are very competitive. Other services, such as the historic trams and ferries, are not profitable. Nonetheless, the private sector operates these systems at a loss, under competitive franchise and license agreements with the government. Taxpayer subsidy is not required.

The parent company for the trams is Wharf Group, a well-established Hong Kong business that has taken responsibility for the trams out of a sense of civic pride. Wharf operates a chain of restaurants and other commercial ventures and sees the historic trams as a trophy to subsidize for good public relations.

The Peak tramway provides a similar sense of civic responsibility. The parent company also operates the world famous Peninsula Hotel, several restaurants, and tourist-serving attractions located at the top of the tramway route. The tram is subsidized to deliver customers to commercial businesses that are run by the parent company. In addition, operation of the tram brings a good civic image to the parent company.

Integration of Modes: Nagoya Central Station

A new station building, JR Central Towers, is being built for the Nagoya station. The station serves approximately 300,000 passengers per day with more than 1,000 train services, including the Tokaido Shinkansen, three JR Central and conventional subway lines, and other private railways. The station was last renovated in 1937. After more than a half-century of use, the existing station facility has become outdated.

The new station will greatly enhance the cityscape of Nagoya. Space and road access around the rail station will be expanded, making bus transport more convenient. Access roads for the exclusive use of automobiles are being constructed through the new station building, from the north and south sides to the west. In addition, the building has direct access to the station concourse, a station square, and an underground shopping mall, resulting in a smooth flow of people to each facility. A 262,465-sq-ft department store is planned for the lower floor. The south tower will have approximately 800 rooms and a large banquet hall. The north tower will provide high-quality office space.

Despite the commercialism, the project is a valuable lesson for transit professionals. The project brings together rail lines, bus lines, and pedestrian and automobile traffic in a very efficient manner. The project also shows how hard work and innovative ideas can benefit public and private concerns.

Institutional and Financial Ideas

Japan

Japan, with the second largest economy in the world, suffered a very difficult recession during the 1990s. Japan's economy is very tightly regulated and closed to foreign firms and exhibits favoritism to old and well-established companies. The recession and efforts to recover from it have brought about sharp changes in economic institutions, as regulations are reduced, innovation is rewarded, and markets are opened to newcomers.

Implications for public transit are readily apparent. Public-private partnerships that have driven expansion of rail services to new town developments almost all report financial difficulty. New technologies (e.g., magnetic levitation), which were being nurtured for introduction domestically and in the international market, have been placed on hold. Existing transit enterprises, struggling to maintain ridership in the face of the recession and a shorter work week, have turned intensively to customer service.

Japan has achieved a vital status as the lynchpin of Asian economies, with 70 cents of every dollar of output coming from Japan and with major investments by Japanese firms in Japan's neighbors' economies. Japan has provided US$43 billion of financial aid to its neighbors during the ongoing world financial crisis.

Trends Influencing Transit Markets. Several Japanese customs and lifestyle issues encourage the use of public transit. Among these customs and issues are emphasis on cleanliness and health (except widespread smoking), religious devotion to nature, extreme loyalty to jobs and employees, politeness, and conformity to the group.

The need for space and the corresponding high value of land dominates life. Living space is extremely small by U.S. standards, and workers generally have very lengthy commutes. Landfill projects are often economic given the enormous land values in urban centers. For instance, gas stations in urban centers have pumps suspended from the roof to allow more space for cars on the cramped main level. Golf driving ranges offer up to five levels to economize.

Viewed from the air, the landscapes of U.S. cities reveal vast expanses of black asphalt devoted to parking. Japan's cities contain many elevated freeways and interconnected corridors of passenger rail tracks, but very little space for parking.

Government Structure. Japanese citizens expect governments at all levels to care for them, even as they increasingly wish to be free of government encumbrances. There is a movement for deregulation and privatization, but also for intricate cross-subsidy schemes. Governments focus on effective coordination among firms offering competing service. Customers have choices and can match trip needs with mode characteristics.

National transport policy calls for a balance of modes, with high-speed rail for lengthy trips, commuter rail for intermediate trips, subways for shorter trips, and new transit (i.e., automated guideway) for spot applications, usually in short, high-density corridors.

An interesting example of local government's regulatory power involves JR East, which had planned to carry advertising on the outside of urban electric trains as a way to halt the skid in advertising revenues. The TMG vetoed the idea, citing an ordinance against outdoor advertising. The ordinance even bans public service ads on the outside of trains. (The law, however, does not restrict advertising on buses and streetcars.) Elsewhere in Japan, ads on trains are allowed by many local governments.

Organizational Forms. Like the United States, Japan has a complex array of subsidy programs functioning at several levels. Of particular interest is Japan's unique practice of assembling land for parallel urban housing when urban expressways and railroads are being built.

Japanese transit systems, in general, recover a greater proportion of costs from the farebox than do U.S. systems. Among the reasons for this phenomenon are less significant competition from private automobiles, customer concentrations because of land use policies, and greater access to development revenues. Even so, not all transit systems cover all costs, and government subsidy programs are needed.

On average, the cost of auto ownership in Japan, as of 1993, includes a purchase price of US$13,000 (which includes US$1,000 consumption tax and car purchase tax). This purchase price makes up one-fifth of the average annual household income. Car and car weight taxes are US$470 annually; compulsory insurance is US$180. Vehicle inspections in the third, fifth, and seventh year cost US$600 each year. Operating 620 mi monthly, gas would cost US$120 (including a gas tax of US$46). Thus, the total cost of owning a car is US$230 monthly. In addition, private parking averages US$350 monthly in Tokyo, or US$5 to US$6 per h.

Figure 7. Integrated development of roads, railroads, and buildings in Hanshin (Japan).

The cost for commuting by feeder bus and then railway to reach central city offices averages US$350 to US$400 monthly. However, subsidies by employers are usually available.

Roads are built at all government levels (see Figure 7). The Ministry of Construction builds some roads directly through regional bureaus and also subsidizes up to 60 percent of the cost of other roads. National funds for roads come from gas and liquefied petroleum gas taxes, plus general revenues. These funds are transferred to the Road Improvement Special Account. The primary objective of highway tolls, which are widely used on urban expressways, is recovering cost, not regulating demand.

The national government influences financial aid for transit projects to local governments in three ways. It (1) appropriates general funds using an index of need versus ability to pay, (2) approves municipal bond issues on the basis of financial capacity, and (3) grants up to 50 percent of the cost of discretionary projects (higher in needy areas).

Tables 1–4 summarize Japan's various national, prefecture, and local subsidy programs for rail and bus services.

For small-scale improvements along existing railroads and rail expansions, parties that benefit are expected to pay. If benefits primarily accrue to private developers, they must pay the entire costs. Local governments share the cost where benefits are more diffuse. Decreasing land prices have sharply reduced private developer interest in these arrangements.

Until 1970, private bus companies in Japan were profitable, but road congestion, more private auto ownership, and expanded urban rail networks created hardships for this sector. Deregulation is designed to help bus operators survive.

National operating subsidies are available for certain rural routes, with 163 companies sharing in the program as of 1996. In addition, national subsidies are available for replacement of old buses, with 452 companies participating.

Japan's government has created a US$50 million annual fund for grants to railways for new escalators and elevators to serve the aging population. Localities may issue debt to finance transit system improvements. National agencies purchase the bonds at designated rates using postal savings and pension funds.

Through the process of *Kukaku-seiri*, land for road and rail projects promotes the simultaneous development of public facilities and private housing. The local government does this promoting by taking or purchasing extra right-of-way. Landowners are compensated by the increased value of their remaining holdings resulting from the project.

Daisan Sector and Related Enterprises. Within the context of well-established government financing and planning programs, together with extensive government regulation of entry, rates, and fares of transit service providers, lies an apparent paradox—the Daisan sector. These cooperative enterprises between various governments and private firms have contributed to significant expansion of transit services, often in conjunction with new town development. They fulfill the government's need for early cash flow to finance infrastructure investments and meet private-sector objectives of goodwill, influence, and inside knowledge of project procurements. While Daisan-sector projects are widespread and have served mutual objectives well, today almost all these projects are experiencing financial difficulties. However, given the very generous levels of depreciation charged to such projects and the need to repay government grants and

TABLE 1 Subsidy programs for subway services in Japan

	Item	Details
National	Subsidies for construction costs (under jurisdiction of the Ministry of Transport)	(1) Construction of new lines 1. For construction works undertaken prior to 1989 gross construction cost x 0.95 (exemption rate on gross cost) x 0.9 (exemption rate on capital investment) x 0.7 (rate of subsidy) x 1/2 (ratio of liability for national government) (Issued in 10-yr. installments from the year following construction) 2. For construction works undertaken after 1990 gross construction cost x 0.95 (exemption rate on gross cost) x 0.8 (exemption rate on capital investment) x 0.7 (rate of subsidy) x 1/2 (Ratio of liability for national government) (Issued in 10-yr. installments from the current year of construction) 3. For those instituted after 1991 (gross construction cost - gross cost - vehicle cost - construction interest) x 1.02 x 0.8 (exemption rate on capital investment) x 0.7 (rate of subsidy) x 1/2 (ratio of liability for national government) (Issued in a lump-sum in current year of construction ...Carried out from 1992, however, there is a 10% reduction for national level subsidy on construction costs) 4. For those instituted between 1994 - 1999 (Includes some of those adopted in 1993) Subway emergency preparation and improvement work : New line constructions will largely be categorized 1:1 between improvement range for national subsidy and improvement range for local independent work Range for national subsidy subjected improvement work: Rule 3. shall apply Range for local independent improvement work: Will be constructed as local independent work (construction cost x 0.8 (exemption rate on capital investment) ... Corporate bond (for special purpose) issued) (2/3 portion of prime interest returns of corporate bonds shall be subsidized by local autonomous organ) (2) Large-scale improvement works Reinforcement work on conveyance capacity of Midosuji Line ... 1/2 of new line construction subsidizing program (3) Emergency anti-seismic reinforcement works (from 1995) Emergency anti-seismic reinforcement works on existing routes (reinforcement of tunnel central columns, elevated bridge piers, etc.) ... new line construction subsidizing program
	Subsidies for Special Bond Interests (under jurisdiction of the Ministry of Home Affairs)	As annual 2% figured from the interest payments concerning the following special treatment bonds 1. Special bonds issued between 1983 and 1992 (Issued according to amount appropriated against the interest payments of each year for construction works bonds issued between 1972 and 1976) 2. Special bonds issued between 1993 and 2002 (Issued according to amount appropriated against the interest payment of each year for construction works bonds issued between 1977 and 1982)
	Subsidies for Model Works on improvement of public Tranportation Facilities (under jurisdiction of the Ministry of Home Affairs)	Subsidized for expenses needed for large-scale remodeling and improvement of existing terminals of public-owned transportation, with special concerns made toward the elderly and physically handicapped (escalator, elevator, installation of Braille blocks, remodeling of toilets, etc.) * Subsidy-subjected construction cost x 0.8 (exemption rate on capital investment) x 1/3 (rate of subsidy)

loans if profits are reported, the degree of financial hardship is open to question.

New Transit Technologies. Even with extensive national subsidies and regulation, most Japanese transit systems remain highly innovative, adorned with the latest technology and customer-service features. Not all rail systems are sleek and new. In Osaka, JR's older orange and green electric trains clatter along elevated guideways. But these trains are still clean, reliable, and frequent.

The January 1995 earthquake, with its epicenter under the Akashi Bridge, cost US$100 billion to repair, including US$70 billion in Kobe. The city paid US$30 billion; the national government paid the remainder. As a result, pillars for transit and highway projects have been made much sturdier, with concrete encased in steel. At transit stations, wells were dug for fire safety, with water also used for toilets. More independent fire-fighting stations have been established. Some redundancy of systems proved beneficial after

TABLE 1 continued

	Item	Details
Prefectural	Subsidies for construction cost	Same as national subsidies (amount appropriated for construction outside of municipal area). However, there is no 10% reduction for subjected construction costs. For those subway emergency improvement works in the range of local independent improvements (amount appropriated for construction outside of municipal area), the remaining 80% after deducting the capital investment shall be issued as corporate bonds, and 2/3 of that amount in prime interest return shall be subsidized.
	Subsidies for the improvement and promotion works on railway station building elevators	One-sixth of the costs needed to install an elevator shall be subsidized, up to a maximum of ¥25,000,000/unit. (excluding subway stations within Osaka City)
General Account Dept.	Construction expense subsidies	Same as national subsidies (amount appropriated for construction outside of municipal area). However, there is no 10% reduction for subjected construction costs.
	Subsidies for prime interest returns for special bonds	Subsidies against prime interest returns for special bonds
	Subsidies for Special Bond Interests	An annual 2% amount appropriated from interest payment required for special bonds
	Subsidies for Model Works on Improvement of Transportation Facilities	Same as national subsidy
	Subsidies for conveyance capacity reinforcement works	Subsidies against those costs required for reinforcing capacity of existing public subways, new installations and extensions of platforms, stairways, passages and so on in an effort to alleviate rush-hour congestion. * Subsidy-subjected construction cost x 0.8 (exemption rate on capital investment) x 0.35 (rate of subsidy)
	Subsidies for anti-seismic reinforcement works	In order to strengthen the anti-seismic structure of existing public subways, subsidies shall be granted against subway anti-seismic structure reinforcement measures under local independent works (excluding those works already subjected for subsidies against anti-seismic reinforcement and improvement works) * Subsidy-subjected construction cost x 0.8 (exemption rate on capital investment) x 0.35 (rate of subsidy)
	Subsidies for installation of escalators and elevators	1/2 of prime interest appropriated on the corporate bonds in relation to the installation of escalators and elevators
	Subsidies for installation of elevators, etc. (under the jurisdiction of the Public Welfare Bureau)	One-third of the costs needed to install an elevator shall be subsidized to a maximum of ¥50,000,000/unit.
	Subsidies for public liabilities in relation to basic annuity share	Amount appropriated for public liabilities in relation to basic annuity shares
	Investment	Gross construction cost x 0.2. However, for those construction works made between 1983 and 1989, an additional 10% investment to the final issuance year of the subsidy will be allotted in addition to the 10% investment for the current year of construction.

TABLE 2 Subsidy programs for bus services in Japan

	Item	Details
National	Subsidies to revitalize bus services (under jurisdiction of the Ministry of Transport)	Those services which stimulate demand for bus transport, alleviate traffic congestion, promote environmental protection or show any positive effects in revitalizing bus transportation are classified into six categories: advancement, modernization, human and environmental-friendly bus projects, education and investigation, pioneering projects and omnibus town improvement projects. Part of their expenses are subsidized.
	Subsidies to promote low-pollution vehicles (under jurisdiction of the Environment Agency)	Half of the differential value between normal buses as well as maintenance of refueling facilities are subsidized for the introduction of low-pollution vehicles (electric vehicles, natural-gas vehicles, methanol vehicles, hybrid vehicles) beyond a certain scale in specially designated areas under the Automobile NOx Law or in anti-pollution areas.
Prefectural	Subsidies to promote transportation services	Funds needed to improve such common facilities as bus terminals and bus stops are subsidized with half a revenue source increased by raising light oil transaction tax
General Account Dept.	Subsidies for capital investment	Capital costs needed to purchase vehicles are subsidized
	Subsidies to revitalize bus services	Those services which stimulate demand for bus transport, alleviate traffic congestion, promote environmental protection or show any positive effects in revitalizing bus transportation are classified into six categories: advancement, modernization, human and environmental-friendly bus projects, education and investigation, pioneering projects and omnibus town improvement projects. Part of their expenses are subsidized.
	Subsidies to purchase low-pollution vehicles, etc.	(1) Costs for promoting an early switch to models satisfying the latest emission control regulations are subsidized (2) Costs of the differential value between normal buses and low-pollution vehicles, buses with a wheelchair lift or super-low floored buses are subsidized (except for those covered by the national government subsidy).
	Subsidies for public liabilities in relation to basic annuity contributions	Public liabilities on basic annuity contribution are subsidized.

the quake, when buses, substituting for rail, carried 220,000 daily riders during the months necessary to restore full rail service.

A computer-controlled bus location system in Kobe, with real-time, solar-powered bus stop displays of approaching buses and travel times, has operated since 1995 (see Figure 8).

Nippon Otis Elevator is developing its linear induction, air-pad technology automated guideway transport on its own, without government or Daisan-sector assistance. The company is jointly owned by Otis Elevator Company in the United States and Matsushita Electric and Sumitomo Bank in Japan.

JR Central is working on a high-speed maglev project for its Yamamachi line that could trim the Tokadai corridor trip time from 4 h to 1 h, with speeds up to 325 mph. Other conventional Shinkansen services being tested (e.g., the 300 X series) could offer speeds of 275 mph.

The Kawasaki Railcar (KRC) Hyogo factory is strategically located in Kobe on a canal that allows railcars to be barged to the port for overseas shipment. The factory is set in the middle of the city and is surrounded by small businesses. The 2-million-sq-ft plant employs 8,500 people (about 5 percent of whom are female) and can produce 600 cars annually, in contrast to its Yonkers, New York, assembly plant, which can process about 60 cars a year. KRC has a 30-percent share of the Japanese domestic railcar market, with four principal competitors. In some cases, domestic orders are split by the entity (e.g., JR companies), with drawings shared and a common price. KRC's best technological innovation—friction-scouring welding—produces less noise and no grinding. The innovation's biggest problem is getting quality products from U.S. manufacturers on time.

Hong Kong

Hong Kong's takeover by mainland China and its new status as an SAR does not rank high on the list of significant disruptions to life there. At the time of the takeover, fears centered on loss of personal, political, and economic freedom, with hopes that the robust economy would cushion any hardship. Instead, loss of liberty has not occurred, while the economy has sunk into a deep recession.

Hong Kong may be returning to financial health. In 1999, Hong Kong's economy grew by 1.8 percent.

Trends Influencing Transit Markets. Although Hong Kong residents oppose more roads (believing that roads induce more congestion), spot improvements are favored to reduce congestion. Travel allowances for employees are not widespread in Hong Kong as they are in Japan.

Government Structure. The structure of Hong Kong's government is much less complex than in Japan or the

TABLE 3 Money spent on subsidy programs for subway services in Japan (in millions of yen)

(Unit: ¥million)

	Item \ FY	1990	1991	1992	1993	1994	1995	1996	1997 (Estimated Budget)
National	Subsidies for construction costs	6,192	9,750	13,392	12,101	15,239	19,404	16,619	5,739
	Subsidies for special bond interests	196	228	204	229	308	385	449	406
	Subsidies for Model Works on improvement of public transportation facilities							139	15
	Sub total	6,388	9,978	13,596	12,330	15,547	19,789	17,207	6,160
Prefectural	Subsidies for construction bonds	3,015	2,642	2,142	993	906	885	1,435	806
	Subsidies for improvement and promotion works on railway station building elevators			49	50		16	33	
	Subsidies for differential correction and improvement work on telecommunication				46				
	Sub total	3,015	2,642	2,191	1,089	906	901	1,468	806
General Accounting Dept.	Subsidies for construction costs	7,230	6,475	10,219	9,449	15,780	18,768	16,055	6,236
	Subsidies for prime interest returns for special bonds	7,080	7,711	14,883	14,736	14,295	12,283	10,400	10,423
	Subsidies for special bond interests	1,317	1,147	982	895	918	982	1,101	1,196
	Subsidies for Model Works on improvement of public transportation facilities						24	115	15
	Subsidies for conveyance capacity reinforcement works						153	234	213
	Subsidies for anti-seismic reinforcement works							81	332
	Subsidies for installation of escalators and elevators		21	68	133	252	425	628	883
	Subsidies for installation of elevators, etc. (Public Welfare Bureau)		171	175	199	337	342	200	
	Subsidies for public liabilities in relation to basic annuity shares	410	470	520	543	560	613	641	648
	Investment	7,296	10,655	12,207	17,707	21,216	28,108	26,928	15,757
	Sub-total	23,333	26,650	39,054	43,662	53,358	61,698	56,383	35,703
Total		32,736	39,270	54,841	57,081	69,811	82,388	75,058	42,669

(Note) Figures include New Tram.

TABLE 4 Money spent on subsidy programs for bus services in Japan (in millions of yen)

(Unit: ¥million)

	Item \ FY	1990	1991	1992	1993	1994	1995	1996	1997 (Estimated Budget)
National	Subsidies to revitalize bus services		5		40	36	81	25	
	Subsidies for the comprehensive development of urban and					29	19	201	18
	Subsidies to promote low-pollution vehicles							110	59
	Sub total		5		40	65	100	336	77
Prefectural	Subsidies to promote transportation services	17	16	14	13	14	15	14	14
	Subsidies to purchase vehicles	50	50	50	50	50	50	50	
	Sub total	67	66	64	63	64	65	64	14
General Accounts Dept.	Subsidies for capital investment	5,027	5,124	5,062	5,057	4,754	4,726	4,742	4,800
	Subsidies to revitalize bus services		6		40	36	81	25	
	Subsidies to purchase low-pollution vehicles, etc.					314	331	367	331
	Subsidies for public liabilities in relation to basic annuity contributions	121	134	148	150	152	159	164	168
	Sub total	5,148	5,264	5,210	5,247	5,256	5,297	5,298	5,299
Total		5,215	5,335	5,274	5,350	5,385	5,462	5,698	5,390

Figure 8. Computer-controlled bus location system in Kobe (Japan).

United States because Hong Kong's government has fewer layers. Hong Kong has long been recognized for favoring free enterprise. The region continues to rely on market forces with an enlightened system of bus franchises that emphasize competition and customer service achieved through vigorous government monitoring, but fewer economic regulations.

Within the Hong Kong government, the Transport Bureau focuses on policy, while the Transportation Department serves as the implementation body. The commissioner for transport heads the Transportation Department, which administers road traffic ordinances; plans and regulates transport operations (other than railways); and registers, licenses, and inspects autos. The Highway Department was established in 1986 to design, construct, and maintain public roads. It has an annual budget of US$680 million, about 80 percent of which is for construction.

Hong Kong policies emphasize mainland connections, upgrading buses (e.g., installing air-conditioning, fewer stops, and wheelchair access and studying more continuous exclusive lanes), examining electronic road pricing, seeking legislation to restrict use of mobile phones while driving, and favoring passengers over freight on KCRC joint-use tracks.

Several planning studies are underway, including one that emphasizes policy with mainland China connections

and environmental protection. Because there are no uniform standards for intelligent transportation systems, a unified plan is being developed to facilitate coordination of proprietary traffic control devices. An electronic road policy study is also underway.

Hong Kong uses franchises for bus routes. A package of routes is offered, including high and low density. Terms of 5–10 years are available. The quality of buses and proposed fare levels are considered when selecting franchisees. Bus franchises are nonexclusive, but exempt from license fees and rent on government terminals, and they receive rebated fuel taxes.

The Transportation Department does extensive daily monitoring of franchise performance, using passenger satisfaction surveys and performance data submitted by carriers. At issue is the extent to which the analyses should be made available to the media. Government inspectors recall 5 percent of buses from service for immediate safety and performance spot checks. CMB was providing poor service (and did not embrace the smartcard fare payment system), so it lost 23 routes in 1993 and was replaced entirely in 1998. Other penalties include fines, restrictions on expansion, and allowing more competition. Each year, franchisees must produce a 5-year plan and share it with the 19 local districts.

Organizational Forms. As in Japan, some gradations of government participation are found in Hong Kong's several transit enterprises, ranging from entirely government owned (e.g., MTR and airport authority), to government owned and privately managed (e.g., mid-level escalators), to entirely privately owned (e.g., Hong Kong trams, Star Ferry, and KMB). Although Daisan-sector (i.e., 51-percent government owned) enterprises are not apparent in Hong Kong, government-controlled enterprises display the same intense drive for profitability, with emphasis on joint development opportunities and customer service.

Over the next 5 years, US$30 billion will be spent on major rail, road, landfill, and port projects in Hong Kong.

The airport at Chep Lap Kok and its connections cost US$23 billion. About US$1 billion was spent on site preparation alone. The airport opened in 1998, only 9 years after it was first announced. The Hong Kong government has contributed US$4.7 billion and borrowed another US$1.5 billion. Private-sector investments in franchises and subleases stand at US$2.6 billion.

Among the borrowings is a US$1 billion loan from a consortium of 48 local and international banks at a rate 43 basis points over the Hong Kong interbank rate. This loan must be refinanced in 2001. In addition, the Hong Kong monetary authority has agreed to manage a US$640 million program to establish confidence in the airport's other borrowing programs.

Airport financing is one of the few examples of difficulties with mainland China. The People's Republic of China demanded a higher percentage of equity, and opening was delayed for a year as a result of negotiations. The People's Republic of China feared that the British were trying to divert resources through relatively heavy borrowing on the project.

In 1982, KCRC was created by ordinance and separated from the Hong Kong government. KCRC was charged US$128 million for the right-of-way, an amount regarded as well below market. By developing the land above its stations and depots, KCRC earns considerable income that is applied to its capital program. Figure 9 shows a KCRC rail stop.

MTR nets US$200 to US$300 million annually (US$358 million in FY 97), with profits returned to the Hong Kong general fund. MTR is being prepared for privatization to make the corporation even more market sensitive and to invite an influx of private equity. MTR and Hong Kong are now negotiating a franchise agreement, like those that apply to KMB and other bus companies, as a means to establish performance standards.

When MTR was formed in 1975, Hong Kong put in US$640 million out of US$1.4 billion of capital. Hong Kong adds more equity as needed for extensions. The deep recession ended plans to finance MTR's eastern expansion without further Hong Kong funds. Hong Kong has provided US$4.1 billion for MTR, including more than US$3.0 billion for the Airport Express.

MTR is expected to operate under "prudent financial principles" (i.e., maximize the rate of return on assets, cover operating costs, and establish reserves for future expansions). Hong Kong amended this understanding to demand a 40-percent return of profits, but then suspended the edict. Although the concept is poorly defined, MTR understands the concept to focus on service quality so that profits are put back in the enterprise.

For its station development deals, MTR requires private developers to take most of the risk and then shares in the profits. MTR is likely to manage the development, but if the development is not contiguous to a station (e.g., a shopping center), MTR may not actually manage the property. Most of MTR's profits are from property, as ridership has been flat since FY 95 (at about 2.4 million passengers per day).

Figure 9. KCRC rail stop.

MTR has earned more than US$512 million from its joint development projects, which include 31,366 residential flats, 823,490 sq ft of office space, and 951,440 sq ft of retail. In planning 21 mi of additional service by 2008, MTR is projecting an 11.5-percent rate of return on investment, primarily from development returns.

For the first 6 months of FY 98, KMB earned US$0.091 per share, after paying US$6 million in profit tax at the rate of 16 percent. KMB has three substantial owners, who are all property developers, totaling almost 60 percent. In late 1997, KMB created KMB Holdings, Ltd., whose shares trade on the Hong Kong exchange (known as Hang Seng). In September 1997, KMB proposed a fare increase of 9.2 percent, but only 7 percent was approved, illustrating the government's remaining direct regulatory, which may be eased in the near future.

New Transit Technologies. With hordes of "captive riders," transit providers in Hong Kong do not take their customers for granted. For example, KCRC has rigorous performance standards (e.g., no more than 2 min to buy a ticket and enter through fare gates, even during peaks).

The 21-mi Airport Express line, built and operated by MTR, shares tracks with the Lantau subway line. Travel time is 23 min. The new airport shuttle offers many customer amenities and high-tech features. The new touch-screen telephones, however, were intimidating to seniors, so some conventional telephones have been installed.

Although the Airport Express carries 30,000 passengers daily (out of 110,000 airport users), use of the airport and ridership on the shuttle have failed to meet early projections because of the recession.

Other practical innovations are the five sets of doors and the no-end doors on MTR's railcars. These features facilitate rapid, even loading. Platform doors are being retrofitted on railcars, and closed-circuit television surveillance equipment is being installed as safety measures and for temperature control in stations.

KMB is testing automatic vehicle location systems. Global positioning systems have not worked well in tests; distance-reckoning systems using microwaves offer greater promise.

New technology plays a key role even on Hong Kong's oldest surface mode, the double-decker trams (see Figures 10 and 11). Although ridership has declined (from 350,000 to 254,000 passengers per day) because of intense competition from buses, the 1-min peak headways and US$0.25 flat fare offer a reliable bargain to the tram's market. Newly installed technology includes electronic speed controls, closed-circuit television on rear stairs, on-board battery rechargers, adaptive braking, programmable logic controllers, and Austrix 3 scheduling software from Australia.

The tram has shown an admirable trend toward improved safety during the past few years. Among the programs that account for this success are defensive driving school certification with annual recertification, courtesy training, mandatory counseling after training with senior employees, a joint employee-employer consultative committee, a work improvement program, joint analysis of each accident, and focus groups with customers.

Figure 10. Double-decker tram in Hong Kong (a).

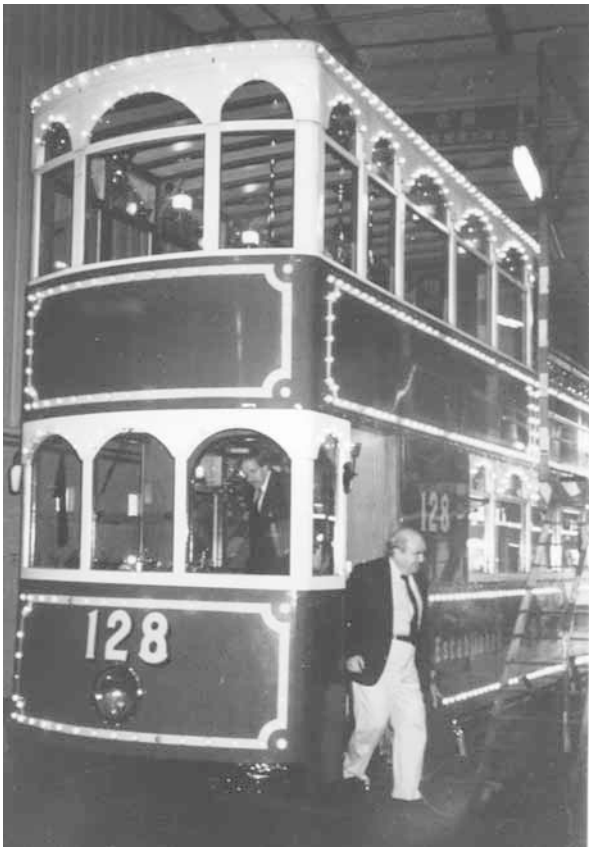

Figure 11. Double-decker tram in Hong Kong (b).

Joint Trackage Uses and Other Shared Rights-of-Way

The subject of shared rights-of-way in urban Japan and Hong Kong is particularly worthy of study because it focuses on one of the most densely populated regions of the world. Interestingly, the sharing of rail rights-of-way appears to be minimal. Controversies between passenger and freight service do not seem to be significant or growing. Future rail growth promises some extensions of trackage rights on commuter railroads in Japan to private competitors. Freight development appears focused on modes other than rail.

Japan

The real sharing of rights-of-way occurs not on the rails, but on the roads: dedicated bus lanes and corridors are growing. In Japan, the new transit systems largely consist of simple elevated structures carrying rubber-tired trains and sometimes buses over existing roadways. These systems are viewed as a middle-of-the-road (literally and figuratively) approaches to addressing moderate demand that cannot be satisfied by buses on congested urban road networks. Yet, market densities do not justify the costs of heavy or light rail construction.

Rail Right-of-Way Sharing. Government literature alludes to extension of commuter railway lines into the subway. However, experience on the systems, for example in Tokyo, shows that this extension appears to be a sharing of tunnels, rather than of rights-of-way.

The seaside bus ride to the Akashi Bridge, the longest suspension bridge in the world, features an interesting view: a 70-ft embankment on which there are houses, a service road for residents, the Kobe subway, and the JR Central, all of which apparently share a common drainage system. The road is at the foot of the hill. This view is an interesting example of multiple uses of a shared right-of-way.

At Kawasaki's Hyogo factory, yard tracks accommodate different gauges because the bullet train operates on a wider-than-standard gauge, and no other service is permitted on its tracks. The bullet train has achieved what many U.S. freight and passenger railroads want: exclusive use of its right to use its own railroad. The necessity of serving enormous numbers of passengers efficiently has forced Japanese rail entities to operate services that make any other modal choices inferior. These services include construction of beautiful stations with attractive design features.

The imperative to attract and serve effectively the maximum ridership has resulted in a specialization of rail transit modes that precludes the kind of right-of-way sharing prevalent in the United States. Right-of-way acquisition costs and some operating costs are reduced when rights-of-way are shared among passenger modes and freight users. However, to the extent that operations become less uniform, there can be loss of efficiency. For example, a through freight provider has more flexibility in scheduling and in schedule recovery when rush-hour passenger trains are not a factor in track usage. Right-of-way sharing among modes requires an even stricter segregation of traffic and concomitant loss of flexibility and, therefore, capacity.

Japanese passenger rail transport cannot afford this loss of capacity. The trend of rail modes is toward exclusivity and specialization. Rail right-of-way sharing appears to be diminishing and will continue to be if freight carriers keep losing market share.

Nonrail Right-of-Way Sharing. The need to carry large volumes of people efficiently has lead to exclusive reliance on rail modes. The trend in nonrail modes is toward legally, financially, and structurally sharing other land uses with mass transportation.

Every precious *tatami*—the traditional measurement of land using the tatami floor mat—must be as productive as possible. Using roads as dual-mode facilities not only increases utility, but at least marginally acts as a disincentive to use the road for motor vehicle travel.

Although the image of numerous cyclists is commonly associated with Japan, the reality of facility sharing and intermodalism with bicycles is a little harsher. Vast numbers of illegally parked bicycles obstruct approaches to stations. Control mechanisms and bicycle parking facilities have been developed and implemented. Bicycles are not permitted on rail services. Again, specialization dictates streamlined usage.

The most common forms of right-of-way sharing involve the new transport systems (e.g., monorails and automated guideway systems). Guideway systems serve densities less than those required for subway and commuter rail development, especially where traffic congestion has reduced the attractiveness and effectiveness of bus operations. Guideways are usually built over existing roads, sometimes sharing highway bridges. With rubber tires and check-in/check-out train separations, these structures do not require track installation. Powered by high-voltage, low-profile linear motors, the cars are lower to the ground and much lighter. The net result is a system that allows for a lighter, less obtrusive elevated structure on which lighter, smaller, and quieter trains can operate. There is little negative impact on road use, even at station locations removed from the street. The systems operate on very short headways and have the potential to increase capacity as well by lengthening trains.

Dedicated Bus Rights-of-Way. Among the efforts to make buses become a less expensive transit alternative is implementation of exclusive bus lanes and bus priority lanes on urban roads. Peak-hour exclusive bus lanes grew from almost none in the early 1970s to more than 620 mi in 1990. This growth amounts to a more forceful type of right-of-way sharing whose outstanding national example is the key route bus system. The overall attractiveness of the key route system, with its stations, passenger accessibility, and comfortable buses, has produced some modal shifts.

Pedestrian traffic densities have made under- and aboveground pedestrian facilities essential parts of the urban road system. If the streams of pedestrians and cyclists using the

sidewalks were not diverted to air rights or the underground at major intersections and traffic generators, motor vehicle traffic would be paralyzed. Where pedestrians and cyclists use the same facilities at grade, additional safety measures are being implemented to separate them from motor vehicles.

Hong Kong

Transport densities and specialization of rail modes is even greater in Hong Kong than in Japan. Except for the quaint Hong Kong train, which runs in common with the traffic through Hong Kong Island, rail modes are segregated.

The KCRC schedules twelve 25-car freight trains daily from China to Hong Kong Island. (Study team members experienced one of the disadvantages of running freight in common with commuter rail service: riding in a tunnel behind 25 carloads of hogs.) The recession has reduced the number of freight trains operated to eight. However, as one of the largest containerports in the world, Hong Kong clearly does not rely on intermodal freight for its markets.

Even KMB and Hong Kong train systems maximize vehicle productivity by using double-decker buses and streetcars exclusively.

Bus Reliability and Attractiveness

Bus providers in Japan and Hong Kong place great emphasis on providing high-quality bus service and on implementing innovative programs to improve bus reliability and attractiveness.

For example, the canvas sunshade (see Figure 12) is ubiquitous throughout Japan and is far more prevalent than U.S.-style shelters, which are typically used only at stops with heavy patronage. The sunshade can be constructed with little sidewalk right-of-way, making it ideal where streets have been widened and where sidewalk space is minimal. Many Japanese stops have loading gates.

Figure 12. Canvas sunshade at a Japanese bus stop.

Some of the more elaborate and ornate shelters were seen in Hong Kong. All shelters are procured and installed by the franchised bus companies. Lighted advertising panels are located at heavy boarding locations. Regardless of how ornate a shelter is, its main objective is to efficiently load and unload passengers.

In addition, solar energy collectors on the tops of shelters (see Figure 13) provide power to illuminated information boards. Such installations are typical in front of Osaka station and other major bus stops.

About one-fourth of Osaka's 2,200 bus stops have electronic traveler information displays available. The network relies on a signpost bus detection system, and the stops are connected centrally through wireless circuitry. The simple display becomes active when the bus is about three stops away. The display tracks the bus's progress from this point and indicates when it is two or one stop away. When the bus is one stop away, the display flashes so that passengers who are not directly looking at it realize that bus arrival is imminent.

Almost all bus location systems in Japan are based on the signpost system (see Figure 14). At some shelters, there is also an audio message for the sight-impaired. The elec-

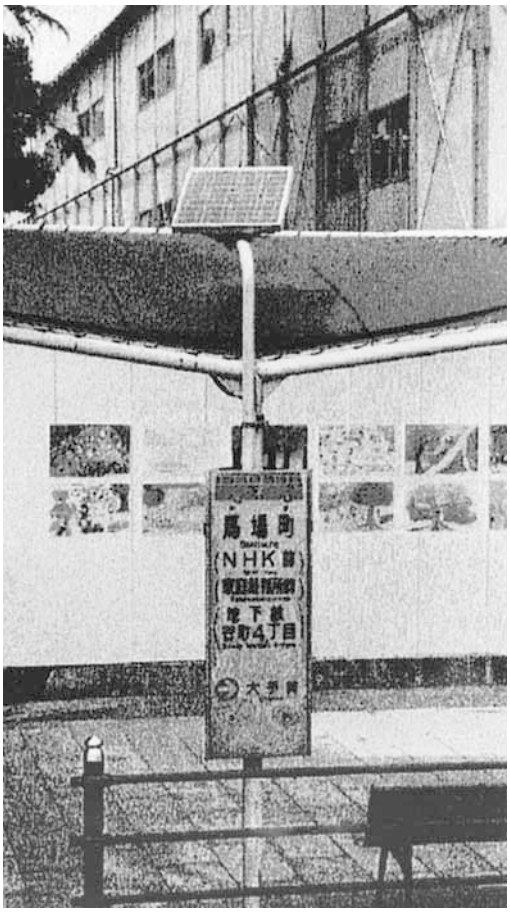

Figure 13. Solar energy collector on the top of Japanese bus stop.

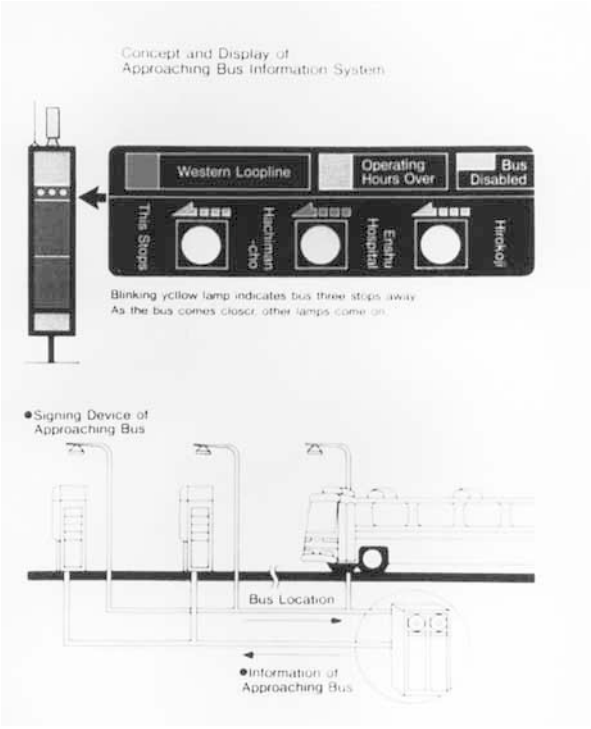

Figure 14. Japanese signpost system for bus location.

Figure 15. Key route operating on exclusive lanes in the center of the street (Nagoya, Japan).

tronic equipment is enclosed in an 11-in. by 48-in. rectangle. This enclosure is also used to mount passenger information, such as timetables and route graphics. Timetables are specific to each bus stop, and schedule adherence during the morning rush hour is uncanny—never more than 1 min from the scheduled arrival time.

In Nagoya's center city, key routes operate on exclusive lanes in the center of the street (see Figure 15). Lanes are marked in yellow and include center-of-street bus stations. This arrangement avoids the problems of left-turning vehicles, parked and stopped cars, driveways, right-turn access, and intrusion into the lane by unauthorized vehicles. Bus stations connect with well-developed pedestrian crossing areas. Nagoya's streets, unlike streets of most other Japanese cities, are wide enough for the key route system to be deployed.

The center-of-street lane concept, combined with center bus-loading stations, is virtually free of intruding traffic. The combination of distinctive lane markings and exclusive station areas is much more effective at keeping out intruding traffic than exclusive curb lanes are.

Bus stations are constructed in the center of the street. They are more complex than simple bus shelters, but far less costly than traditional LRT stations. Real-time information is provided. Front and rear loading areas require that buses have a standard location for front and rear doors.

Center-road landscaping has not been sacrificed for the key route bus system. In some areas, bicycle parking facilities are incorporated in the design. Some bus stations connect with Nagoya's five subway lines. This special treatment has resulted in a time saving of 23 min on two major routes.

Nagoya is constructing an elevated guideway bus system to connect the outlying Moriyama ward with Nagoya's subway system because the roadway system connecting the area to central Nagoya is too narrow to develop a key route system.

Innovation in Hong Kong bus operations is driven by heavy competition among private companies and among modes. Although the government rationalizes direct competition among bus companies by bundling routes together in the franchising system, it encourages competition on cross-harbor routes and between franchised buses and rail. It also encourages the use of PLBs and taxies.

Twelve-meter, double-decker buses are used extensively in Hong Kong. These vehicles provide increased carrying capacity within the same vehicle footprint as that of a 40-ft bus, but are slightly higher at 14 ft 5 in. The latest air-conditioned buses, featuring wide 2+2 seating configurations, are popular among riders. These buses offer loading times equivalent to single-level buses.

Hong Kong uses a significant number of double-decker buses to increase passenger carrying capacity per vehicle. This use results in a reduced impact on roadway capacity for the same number of transit vehicles. The impact of the second deck on loading times is minimal. Riders anticipate their

stops and move to the lower deck when nearing the time to exit. Boarding times are not affected because the bus is already in motion while passengers are moving to their selected deck.

Low-floor buses (see Figure 16) are becoming more common in Japan and Hong Kong as both countries strive to improve accessibility for all riders. In Hong Kong, new double-decker buses feature a super low-floor design. The front step, after kneeling, is just 10.4 in. from the ground. As configured in Hong Kong, these vehicles can only accommodate a single wheelchair. The wheelchair tie-down area, when not occupied by a mobility device, provides additional standing and circulation space by the front door.

Use of double-decker buses in the United States has been minimal with some applications in the tourism industry. Although such transit use might be practical in some U.S. cities for heavy-demand, express-level bus routes, a number of physical factors must also be considered, including roadway integrity and worthiness, infrastructure interference (e.g., height of existing overhead lines, bridges, tunnels, and signal mast-arms and heads), and transit facility infrastructure.

Figure 16. Low-floor buses in Hong Kong.

Private Supply of Public Transit: The Kowloon Company

A fascinating aspect of transportation services in Hong Kong is the privatization (and profitability) of mass transit. Government and private companies work together to plan and implement mass transit service that is customer oriented, socially responsible, and profitable for well-run private companies. This section explores how KMB, Hong Kong's largest private provider of bus services, can achieve and maintain profitability while most U.S. transit providers require significant government subsidies to survive. KMB's success is particularly interesting in light of the struggle Japan's bus service providers have had in sustaining ridership and mode share.

KMB began operations in Hong Kong in 1933 with 106 single-decker vehicles. The company grew despite difficulties arising from the Japanese occupation during WWII. Hong Kong's population increased rapidly during the 1940s, prompting the company to introduce its first double-decker bus in 1949.

Today, KMB has a fleet of 4,000 buses that run on 380 routes, serving more than 1 billion customers per year. KMB is the world's largest privately owned bus company operating in a single city. The operating network for KMB includes the Kowloon peninsula, the new territories, the Tsing Ma Bridge, the harbor tunnel, and Hong Kong Island, giving KMB the largest network of all transport providers in Hong Kong. Each day, KMB carries about 3 million passengers, considerably more than any other public transit provider in Hong Kong.

KMB has not been able to effectively tap into the market of serving customers with disabilities. Despite the operator's many efforts, including introduction of super low-floor coach for easy wheelchair access, few people with disabilities use the service. On its busiest routes, KMB has about 100 wheelchair activations per month and fewer than 10 per month on other routes. The numbers are much higher on U.S. transit systems. The lack of disabled customers may have more to do with Asian culture than with discrimination by businesses like KMB.

KMB is a major player in the economy—it employs one of Hong Kong's largest workforces (it has approximately 13,000 employees). Roughly 7,900 employees are bus drivers; only 6 percent of them are women. Most of its hourly employees, including the drivers, are unionized. However, the union does not wield much influence according to management. KMB staff believes that its union's lack of importance is due to the company's commitment to employee welfare and due to the overall weakness of unions in Hong Kong.

In 1997, the Transport Department awarded KMB a new 10-year franchise. KMB's stability is obviously enhanced by the award. This award is in stark contrast to the typical contractual arrangement between U.S. transit authorities and private contractors. Most U.S. states limit transit agencies' contractual agreements to 5 years or less.

Even with its success and stability, KMB went through a significant reorganization in 1997. The goal was to bring more transparency to individual operations and to make it easier for divisions to seek funding for future growth. The Kowloon Motor Bus Company (1933) became a wholly owned subsidiary of Kowloon Motor Bus Holdings, Ltd. It replaced KMB as the groups' flagship listed on the Hong Kong Stock Exchange.

The firm has five divisions: franchised bus operations, property holdings, mainland operations, nonfranchised transport operations, and internal financial services. Even with its diversification, the company prides itself on providing bus transport.

Management

The objective of KMB's management, as stated in KMB's mission statement, is "to make our buses the mode of public transport preferred by most public transport users most of the time; to maximize simultaneously the value for money given to our customers and the profit earned by the company; and to contribute to the economic and social development of Hong Kong."

KMB is managed by a 10-member board of directors. The board's 88-year-old chair has served in this office for 20 years. The managing director has held this position since 1993. U.S.-educated Winnie J. Ng is the only woman on the board. At 34, she is also the youngest member of the board. In addition to her role as a board member, Ng is the director of public relations and marketing. The average age of the board's members is 60. The average compensation of a director is less than US$200,000, with one person exceeding US$1 million.

KMB's management appears to be very stable. There has been very little turnover in recent years among top executives. Unlike with U.S. companies, Hong Kong's top executives do not switch from one private company to another. KMB also has several young women in executive-level positions who are possibly positioned to lead the company in future years.

Accidents

Over the last 9 years, KMB reports a significant reduction in accidents, from one every 136,400 mi traveled to one every 202,120 mi. KMB officials attribute the improvement to the company's commitment to upgrade maintenance standards and provide better training for bus operators. However, observers should not make assumptions regarding KMB's safety on the basis of the reduction in accidents. For KMB, an incident becomes an accident only when the police are called. Therefore, KMB's accident rate improvement could be the result of better maintenance and training, or it could simply be a matter of calling the police less often for minor incidents. A much better indicator of a company's accident record is the amount spent on repairs and claims resulting from accidents.

Maintenance

KMB boasts improvements in the reliability of its vehicles. To gauge mechanical reliability, KMB uses a method similar to the "miles per road call" measure used by many U.S. transit systems. KMB's "trip per mechanical breakdown" is the average number of trips operated before a bus experiences a mechanical breakdown. Using the trips per mechanical breakdown measure, KMB has experienced a 30-percent improvement in reliability over the last 6 years (from one breakdown in every 1,483 trips, to one in every 1,927 trips). This measurement, like the accident rate, can be misleading. KMB did not offer a definition of "mechanical breakdown." Similar to the situation in the United States, transit systems in Hong Kong have different definitions of what a breakdown is, and improvements could simply be a matter of changing the definition.

KMB does, however, have impressive maintenance shops. The shops visited during this mission were well organized and clean. All of KMB's maintenance and service facilities have received ISO 9002 certification—the international designation for excellence. Each bus is examined regularly and undergoes an annual inspection, as required by the Transport Department. In addition, a major overhaul is carried out every 4–6 years.

The Tuen Mun Overhaul and Maintenance Center, which covers 47,000 sq m of floor space, is listed in the *Guinness Book of Records* as the largest facility of its kind in the world. This facility, along with KMB's other depots, provides all aspects of vehicle service, from preventive maintenance to major body repair. KMB constructs its own vehicles, which arrive in kit form. The company stresses on-the-job training, as evidenced by its government-endorsed apprenticeship program. Mechanics, engineers, and other staff are encouraged to continually upgrade their skills by taking new courses and training programs.

Customer Service and Marketing

KMB prides itself on being a customer service–oriented company. It has established various communication channels for customers to voice their opinions. The most active is a 24-h hotline to give customers the opportunity to obtain bus route information and to comment about KMB services. The hotline is in Cantonese, Putonghua, and English, with 72 telephone lines providing callers with prerecorded messages. The hotline averages about 500,000 calls a month. Live operators are only available during office hours.

KMB's service center is located in a mall and operates like a typical U.S. transit system's customer service center. Representatives provide route information, fare tables, and collect customer opinions. KMB has a mobile information center that travels to different communities to solicit customer comments. The company also works with several focus groups to discuss new routes and services. KMB's website features press releases, route information, and sales items.

Very little of KMB's budget goes to customer service and marketing. Even medium-sized U.S. transit systems have more customer service representatives and service hours with live operators than KMB has. The company does not have a set budget for marketing, and the management views marketing as less important than other areas (e.g., training and preventive maintenance).

Financial Performance

KMB's financial performance for FY 97 was impressive, considering the recession plaguing the Hong Kong economy. The company's profit attributable to shareholders for 1997 was HK$550.8 million, compared with HK$527.7 million in 1996, an increase of 4.4 percent. Profit from the franchised bus operation for 1997 was HK$557.5 million, an increase of 6 percent over the previous year. Earnings per share were HK$1.36, a 3.8-percent increase over 1996. KMB made huge capital investments during 1997, with new buses and other equipment. The company's long-term debt increased by more than 200 percent to HK$1,115.8 million. This debt increase is questionable in light of Hong Kong's economic troubles.

Competition

Buses have been the major provider of transport services in Hong Kong for many years. The responsibility of providing adequate public transport fell on two major companies: KMB and CMB. Since 1992, the transport scene has changed significantly. Citybus, Ltd., started in 1993 and has expanded from 200 to 800 buses. Citybus's franchise award in 1992 signified the government's intention to introduce competition into the bus industry, which had previously been dominated by CMB and KMB. Since then, two other franchises have been awarded.

Including KMB, there are five franchised bus companies carrying almost 4 million passengers a day. None of the other companies offer any real competition to KMB. KMB enjoys a good relationship with the Transport Department, and its restructuring has better positioned it for continued success.

Fare Collection Technology

Study team members observed several items of note in the area of passenger fare conveniences.

Credit cards are very little used in Japan. JR West began accepting payment by credit card for the first time in April 1999. Cards are accepted at 314 of the company's stations (80 percent of the total). The new policy was prompted by tougher competition in the recessionary market. Competition from airlines for the Shinkansen operated by JR West and JR Central has picked up, with new reduced fares. A new discount airline, Skymark Airlines, charges 31.5 percent less on a parallel route, and other airlines are responding in kind.

The Japan Debit Card Association put off the start of its planned account-settlement information center until October 1999. Therefore, 860 financial institutions will not be able to start such services until March 2000. The reason for the delay is to further test Y2K capabilities. About 13 financial institutions and retailers offer debit card capabilities now.

In Kobe, ticket sale and fare collections systems are automated, with conveniently located ticket vending machines, as well as staffed ticket offices. Tickets are magnetically encoded for the specific system being used; however, intermodal transfers are not available. Gating systems are automatic and are equipped with magnetic readers for entering and exiting.

Osaka provides a daylong fare card that permits changes from bus, new tram, and subway anytime throughout the day of purchase. In an effort to move commuters from their automobiles, a reduced fare is available on the 20th day of the month. This ticket is also usable every Friday.

In March 1996, the Surutto-Kansai ticket system was implemented. This card can be used on the subway, the bus, the new tram, and the four private railways. A magnetic stripe on the card allows for both entrance and exit from the various systems. In Osaka, like in other cities in Japan, the method of ticket purchase is cash, at either ticket vending machines or ticket offices. Credit, debit, or smartcard technology is only now in experimental stages.

Tokyo is implementing many new customer conveniences. Its ticketing and fare collection systems have conveniently located ticket vending machines that dispense single-trip to monthly tickets. The gated turnstiles efficiently control entrances and exits from the system. The fare collection system is based on magnetic technology with cash payment. In Tokyo, like in other Japanese cities, the use of credit or debit cards or a smartcard program has not been implemented. A debit card program is planned for implementation in 2000.

Japan is not as advanced technologically in fare collection systems as Hong Kong or the United States is. Less effort is made in Japan to seek uniform payment mechanisms for multimodal trips and to provide transfer discounts. However, these innovations will probably be implemented in the near future given Japan's transit operators' quest for profitability through customer service and through the latest technology.

In contrast to Japan, Hong Kong is far advanced in electronic fare collection using smartcards. Hong Kong offers a striking example of how to organize a successful and profitable enterprise for multiagency fare collection using private-sector and government cooperation. The most impressive technology advancement in Hong Kong is the implementation and use of the contactless Octopus card.

Creative Star was formed by MTR and five (now six) partners in September 1997. There are now 6 million Octopus cards in circulation, with 3 million daily transactions. A US$5 deposit is assessed (the cards cost US$4). After initial tests, a steel plate was added to the card to prevent breaking.

The monetary authority limits the maximum amount that can be added to the cards to US$6.50 increments. Add-value terminals are located in many convenience stores (they are more secure than remote bus terminals). The system, which cost US$80 million to develop and install, was financed by loans from the transit systems at market rates.

More than 75 percent of KCRC customers now use Octopus. KMB is studying the potential use of Octopus to permit reduced-price transfers between systems. The reduced-price transfers could then be used to rationalize routes. KMB processes about 450,000 Octopus transactions daily; 70 percent of customers use the card on the 1,600 buses equipped to accommodate it. Even though KMB predicts 90-percent use by customers, it must still retain the fareboxes. Before Octopus, KMB processed 20 tons of coins each day.

MTR and KCRC use handheld verifiers with 12-h battery packs. The verifiers cost US$1,700. They are durable (passing 2-m drop tests) and provide an excellent example for U.S. transit systems that are barrier free and considering smartcards.

Octopus has a 70-percent reduction in faregate faults compared with magnetic cards. Throughput on MTR faregates has improved 10–20 percent using Octopus. The card offers frequent-user benefits. A tourist card, with special graphics to encourage saving as a souvenir, will soon be sold at the airport for a smaller deposit.

Advantages to the public for using the smartcard include usability across most public transport, no need to carry cash or coins, reliability, security, and flexible recharging methods. The Octopus card has some disadvantages, however. Hong Kong recently replaced 14,000 parking meters that accept only electronic cards (not Octopus). The feasibility of accepting Octopus is being explored. Also, the tram is resisting conversion to Octopus (even though Star Ferry, owned by the same company as the tram, is converting) because there is no room to install targets and because the transaction cost of a half cent (i.e., 2 percent of revenue) is deemed too great.

Several mission team members actually purchased an Octopus card while in Hong Kong and used it several times. They found it to be the most convenient transit fare paying method they had ever used.

Rapid Transit Control Centers

Much of the transportation industry's new technology initiatives are directed toward centralized management and control for safer and more efficient operation of transportation systems. Many of the most recent technological advancements have provided improved, cost-effective management of transportation operations. This trend is consistent with the commercial principles most often espoused by Japanese and Hong Kong transportation. In addition, modern control centers epitomize the efficiencies gained through technological advancements.

These technological advancements converge at the control centers, and they affect all involved—customer, operator, maintenance personnel, and outside agencies not directly involved in providing transportation. The primary objective of having control centers is to centralize management by upgrading service monitoring and control processes.

Rapid transit systems are complex, consisting of many components that require coordination. Components include right-of-way infrastructure, stations, rolling stock, signal system, pumping stations (for water removal) fan systems (for ventilation and smoke removal), and personnel. All components interact and must be coordinated through operating procedures and activities to provide service. This coordination is achieved through operating plans and procedures developed for the given conditions and service requirements. As such, control centers represent the "brain" of the transit system. Their basic goals are to provide continuous monitoring and control and to ensure safe, reliable, and efficient operation.

Because centralized service management is the primary objective of most rapid transit organizations, central control of critical functions tends to define the systems in most modern control centers. These functions consist of real-time monitoring of train movements; remote control of interlocking, switches, and signal equipment; command and control of supporting infrastructure and facilities (i.e., electrical power distribution system); control of plant equipment (e.g., elevators, escalators, and fire alarms); information transfer and personnel deployment for emergencies; communications with customers and with service personnel; data collection and analysis; and automated centralized train control.

These functions provide the basis for true centralized management, as opposed to command-center operations of the past, which basically "managed by exception."

Many transit functions, such as power control, train repair, and station operations, have their own command centers. The monitoring of signal equipment, traction power, public address systems, telephones, and in-service fleet operations is often done by separate command centers operating semiautonomously. Often, these command centers are linked by several communication desks that disseminate information throughout the system. This decentralized approach covers most functions vital to service and maintenance. Although effective, the approach has built-in inefficiencies that restrict levels of service reliability, labor productivity, and quality of service.

Technology and operating method of transit systems have experienced revolutionary developments. Defining the state of the art for control centers is difficult because functions and operating methods vary from system to system. Several older systems have built modernized control centers for newer lines. These lines tend to be discrete, with no plans for integration with older, preexisting lines. Modernizing older systems in many ways presents difficult "custom-design" challenges that newer systems do not face. Off-the-shelf systems, which are often available for some of the most advanced control elements, tend to be well suited for

smaller, more recently built rapid transit systems. They lend themselves more readily to very high-technology features.

Larger, more heavily used older systems continue to have the least degree of automation in train control technology elements. Hong Kong is an example of an older, larger rail system, with the older portion having less automation and the new extensions having very advanced control systems.

Centralized train control presents itself in many forms in both Japan and Hong Kong. A philosophy of private-sector principles of system operators in both countries encourages the use of train control technologies and operating methods that provide cost-efficient, safe, and reliable operations.

In Japan, most cities built railway systems with government subsidies, which were established in the 1960s with the goal of expanding urban railway capacity. System expansion and system rebuilding projects took advantage of train control technologies that allowed for one-person-train operation, attendant-only operation (i.e., fully automated driving), and then fully automated operation (i.e., no crews on trains), such as the Port Liner system in Kobe. This system became the world's first fully automated transit operation in 1981. Automated transit-operation means full automation, not only with train driving, but also with door control and other functions. Automated functions bring considerable benefits. For example, rain control is optimized with respect to speed, acceleration, braking for passenger comfort, energy consumption, and vehicle wear and tear. Train operator errors are virtually eliminated, vastly improving safety margins.

Another form of centralized train control is automatic train supervision. Automatic train supervision provides automatic monitoring of trains, instructs each train to follow its schedule, and corrects deviations when they occur. Centralized monitoring performed at control centers is displayed on model boards, on cathode-ray tube (CRT) screens, or both. The displays show block occupancies, train presence, and identities. Automatic train supervision also provides for remote control of switches and interlockings. Field staff driving trains are directed by control center personnel about what actions to take, including train speeds. This reactive system is real time. The control center obtains information about train movements, automatically checks it against schedules, and relays information back to field personnel or to the automatic transit operations system.

In Nagaya, JR offers a slightly different example of centralized train control. Operating efficiencies brought about by investment in centralized train control and other improvements on JR-operated lines have helped increase ridership by more than 50 percent on the Tokaido and Kansai lines. Fares finance 100 percent of operating costs. Centralized management of the stations through control center closed-circuit television and public announcement systems provide for a safe, efficient, and cost-effective operation.

The most advanced centralized train control systems visited by the study team were operated by Hong Kong's MTR. As part of its ongoing effort to increase efficiency, MTR is replacing signaling and train control systems with SACEM, a state-of-the-art technology system. Through SACEM, MTR has increased peak-capacity train operations on its most heavily traveled lines (the Tsuen Wan and Island) by 6.3 percent. SACEM equips trains with vehicle on-board computers. Trains track their own positions and are aware of grades and curves. Speed limits and stopping profiles are programmed and performed by on-board computers. Centralized train control is performed at a center for each line. Although control functions are performed from decentralized control centers, MTR has realized the significant advantages of a single rapid transit control center, and consolidation of decentralized units is underway.

Advantages of a single control center include coordinating operation for the entire system, having one point of contact for all outside agencies (e.g., fire, police, and hospital), having economies of scale (e.g., reduced requirements for physical facilities equipment and personnel), improving communications, and reducing information and date transfer.

Centralization of control centers not only results in a significant increase in scope of control, but also redefines the roles of personnel working in the control center. Supervisory personnel now have a complete picture of system activities. Instead of reacting to problems, supervisors are expected to prevent them from developing.

Japan and Hong Kong have easily adapted to the new technology available to the rail transit industry. Smaller, more recently built systems have advantages in making the decision to invest in train control and control center technologies. The advantages of increased reliability, safety, and efficiency of operation that come with these investments have clearly benefited the riding public of these two countries.

SUMMARY OF POLICIES AND PRACTICES APPLICABLE TO THE UNITED STATES

Although one may apply some of the lessons learned during this study mission to the United States, many factors that contributed to the success of these applications in the Asian Pacific region are not present in the United States.

Public transportation is essential in Japan and Hong Kong because the countries' compact geographic areas have resulted in metropolitan areas with high densities. Also, the high costs of automobile ownership, particularly in metropolitan areas, increases reliance on public transportation and diminishes the desire to be automobile dependent. In addition, the systems visited were much younger than many in the United States, making issues of modernization somewhat easier to address and implement.

The countries' technological initiatives have focused on light rails, subways, people movers, fixed guideway systems, magnetic levitation, passenger communications, and point-of-sale fare collection systems. Some of these developments could have applications in various U.S. locations.

Many circumstances in Japan and Hong Kong are very different from those in the United States. First, the national,

regional, and local emphasis on transit as a priority over highway projects is not reflected in the United States. Second, the Asian Pacific region's level of private funding for transit is not present in the United States. Third, public consensus and support for transit instead of roads is not evidenced in U.S. cities. Finally, the United States does not have cities with densities like Hong Kong and Japan. Therefore, several public transportation policies in Japan and Hong Kong would not be practical in the United States. However, there are opportunities to reshape key policy direction and apply some implementation techniques in the United States.

Land Development

In Japan and Hong Kong, various agencies are responsible for developing transportation policies and strategies, as well as for providing limited funding for implementation. All levels of government agencies have strong transit-supportive policies. Government officials view public transportation as a priority and a mode of choice. There is strong public support for public transportation and consensus for increased services.

Planning for transportation facilities includes long-term thinking, projecting needs for 50 years in some instances. In the United States, plans are typically developed for a 20-year period. At the national level in Japan and Hong Kong, planning includes a regional perspective, resulting in a coordinated and comprehensive approach to public transportation.

Japan and Hong Kong have integrated land use and transportation. Land use patterns direct transportation planning. As land use plans are developed for areas, transportation facilities are incorporated. Transportation planning agencies coordinate with land-planning agencies in review and approval of the plans. Japan and Hong Kong have demonstrated that intense mixed-use development generates economically viable transit systems. Extensive development at transit stations is used as an economic development tool. This development at the stations, rather than user costs or farebox recovery, pays for transit.

In Japan, people deal with sprawl by developing transit infrastructure prior to or at the same time as the development of sprawl. In many cases, transit infrastructure is in place prior to sprawl development. In Hong Kong, the approach is to require new towns to be self-contained and to include intense mixed-use development. Both countries are considering policies that would allow development to lead transportation.

Both countries have established policies at the national level so that public transportation avoids congestion and air quality problems. Through educational outreach efforts, both countries have generated public acceptance of building transit systems instead of highways. In addition, private companies view public transit as a profitable venture and have provided long-term support for the systems. These models of transportation demonstrate that government policies on land use and transportation, along with public-private partnerships, are key components that must be fully integrated when implementing public transportation.

Joint Development of Infrastructure

One of the most impressive aspects of this mission was witnessing the degree to which East Asian operators had introduced a broad range of transit mode choices and delivered these services on a "for-profit" basis.

U.S. transportation is overwhelmingly weighted toward private automobiles and, to some extent, airplanes. Travel by all other modes (e.g., trains, buses, and boats) is marginal when viewed from a national perspective.

Japan and Hong Kong exhibit a multimodal balance in all levels of transportation. No single mode of transport dominates, and many different means of travel compete in the marketplace for ridership.

Highly subsidized, government-run transit systems are disappearing in Japan and Hong Kong. Large, highly diversified corporations are taking over the role of building and operating transit systems.

Transit systems in East Asia are built and operated according to sound business principles. The measure of success is generally the "profitability" to the private-sector entity that is charged with operating the service. High ridership is not necessarily an indicator of success if such ridership does not translate into the bottom line of the business.

In Japan, the government is responsible for constructing high-cost elements (e.g., subway tunnels and aerial guideways). Systems and operating elements are isolated from high-cost infrastructure components, and the private sector is asked to provide a profitable project using the installation of network components, vehicles, and the operation of the line.

U.S. transit systems seldom segregate the costs in such a manner. The entire U.S. system's cost-effectiveness is based on carrying the project's construction costs into the operations phase and on measuring the success against the ability of the farebox (and any other joint development) to retire the debt service. Under any such equation, even the most successful of the Asian systems would be deemed unprofitable.

Government agencies in Japan and Hong Kong no longer define their responsibilities to include the ownership or operation of public transit systems. Their role is limited to setting broad transportation policies, regulating the private sector, and subsidizing research and development and/or infrastructure when necessary. There is no longer any permanent role for government in the ownership or operation of transit.

The success of public-private joint transit development directly relates to how soon the public entity is able to transfer or privatize a transit project. Long-term public involvement with a project indicates that the project is a failure (i.e., the line is not profitable enough to generate private-sector interest).

Perhaps the most relevant example of the U.S. experience with deregulation would be the deregulation of the telecommunications industry. From the eyes of an Asian transit planner, this deregulation is a progressive move that has introduced innovation and competitiveness into the delivery of communications services. The experience of the Japanese and Hong Kong planners would suggest that deregulation and breaking up of the U.S. transit industry may be appropriate, as well.

Institutional and Financial Ideas

Japan and Hong Kong incorporate certain ideas that seem most applicable to the United States, despite many political, cultural, and economic differences. These ideas include

- Accelerated project planning and implementation,
- Regionwide electronic fare payment using smartcards,
- Platform screen doors for safety,
- Customer service emphasis to rejuvenate stagnant ridership,
- Aggressive joint development by transit agencies,
- Deregulation and competition among transit providers, and
- Emphasis on new technology.

The complexities of U.S., Japanese, and Hong Kong cultures and economies make reliance on the aforementioned ideas hazardous. One obvious reason is that each country changes constantly: trends at any given moment are simultaneously pulling and pushing at comparative constructs. Nonetheless, in the present-day United States, technological advances have raised expectations for improved government performance. U.S. national and local governments are having a hard time responding to these expectations, but seem newly devoted to more effective customer service.

Joint Trackage Uses and Other Shared Rights-of-Way

In densely populated cities of Japan and Hong Kong, rail right-of-way sharing is limited and declining as the need for highly efficient and productive rail systems increases. In Hong Kong, a transit-oriented streetcar and bus network maximize road productivity by using high-capacity vehicles. Structures over roads are not evident.

Track sharing and other joint uses of rights-of-way by commuter, freight, and intercity-passenger railroad companies have caused significant controversies across the United States when new and expanding passenger operations require using existing freight rights-of-way.

The dramatic growth of commuter rail in the United States during the last 20 years has increased cooperation with and controversy among the freight railroads that own most of the rail rights-of-way. The cooperation and controversy involve the need of commuter trains to share tracks or rights-of-way to initiate or expand service. The installation of rapid transit and light rail on rights-of-way adjacent to freight and passenger lines also has been a common method of addressing the costs and controversy that result from clearing new rights-of-way.

More recently, the sharing of tracks between light and rapid rail transit—maintaining train separation by temporal means (by segregating operations by time of day) rather than by signals—has increased the challenge in obtaining access to railroad right-of-way. This sharing of tracks has also increased the challenge of designing infrastructure that permits efficient and safe use of that infrastructure.

The bustling economy in the United States has caused the freight industry confusion and frustration regarding shared operations. The increase in proposed developments has led the Federal Railroad Administration to issue a policy on the safety of operations on adjacent and shared rights-of-way, in some cases limiting options previously planned.

Bus Reliability and Attractiveness

High automobile-related taxes (e.g., fuel, registration, and parking) have led to lower automobile ownership levels and greater transit ridership in Asia than in the United States despite the comparable high-income levels. In such Asian environments, fares do not need to be exceedingly low to attract ridership because the relative costs of automobile use are higher than U.S. levels. There is a greater balance among transportation modes in Asia than in the United States. This balance has led to less need to use general taxpayer resources for either autos or transit.

Several bus program features observed during this mission might have application in the United States. For example, the Nagoya key route bus system's design is worth reviewing by U.S. transit systems contemplating implementing bus rapid transit solutions. Also, the Hong Kong variety of three-axle, low-floor, accessible, air-conditioned double-decker buses may have application in specific U.S. transit situations. In addition, wireless networking of bus stops (as an alternative to hard wiring) is a cost-effective way to implement bus stop traveler information systems.

Although transit solutions must be well thought out, they can be kept simple. For example, Japanese-style sunshade bus stops facilitate comfortable waiting for buses and efficient loading and appear to be considerably less costly than U.S.-style shelters. For another example, the Hong Kong midlevel escalator system is practical, relatively low cost, and very well used.

Fare Collection Technology

A significant example of a technology advance that provides a substantial customer convenience and cost savings opportunity for the operator is the contactless smartcard. Of the developments studied during this mission, the smartcard operation was one of the most impressive. It exemplifies an advance that is beneficial to both the operator and the customer.

GLOSSARY OF ACRONYMS

APM: automated people mover
APTA: American Public Transportation Association
CBD: central business district
CMB: China Motor Bus Company, Ltd.
CRT: cathode-ray tube
FTA: Federal Transit Administration
HYF: Hong Kong and Yaumati Ferry Company, Ltd.
ITSP: International Transit Studies Program
JR: Japan Railways
KCRC: Kowloon-Canton Railway Corporation
KMB: Kowloon Motor Bus Company, Ltd.
KRC: Kawasaki Railcar
LRT: light rail transit
MTR: Mass Transit Railway Corporation
NLB: New Lantau Bus Company, Ltd.
PLB: public light bus
SACEM: a state-of-the-art technology system used by Hong Kong's MTR
SAR: Hong Kong Special Administrative Region
TBTMG: Transportation Bureau of the Tokyo Metropolitan Government
TCRP: Transit Cooperative Research Program
TMG: Tokyo Metropolitan Government
TRB: Transportation Research Board
TRTA: Teito Rapid Transit Authority
WHC: Western Harbor Crossing

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Note: titles and organizations are as of the time of the mission.

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