

TRANSIT COOPERATIVE RESEARCH PROGRAM

Sponsored by the Federal Transit Administration

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International Transit Studies Program
Report on the Fall 2010 Mission

PUBLIC TRANSPORTATION SYSTEMS AS THE FOUNDATION FOR ECONOMIC GROWTH

This TCRP digest summarizes the results of mission performed from October 29 through November 12, 2010, under TCRP Project J-03, "International Transit Studies Program." The digest examines how transit investments are linked to economic growth and recovery in several cities in Turkey, Egypt, and South Africa.

It was prepared by Harrington-Hughes & Associates, Inc., and is based on the reports filed by the mission participants.

INTERNATIONAL TRANSIT STUDIES PROGRAM

The International Transit Studies Program (ITSP) is a part of the Transit Cooperative Research Program (TCRP), authorized by the Intermodal Surface Transportation Efficiency Act of 1991 and reauthorized, in 2005, by the Safe, Accountable, Flexible, Efficient Transportation Equity Act: A Legacy for Users. TCRP is managed by the Transportation Research Board (TRB) of the National Academies and is funded annually by a grant from the Federal Transit Administration (FTA). ITSP is managed by Harrington-Hughes & Associates, Inc., under a contract with the National Academies.

The TCRP has sponsored the ITSP since 1994. The primary purpose of the program is to broaden the professional development of U.S. transit managers by providing them with opportunities to visit transit systems abroad; the managers return with insights and knowledge useful to their organizations, the transit industry, and their own transit careers. ITSP carries out its mandate by offering transportation professionals practi-

cal insight into global public transportation operations. The program affords the opportunity for them to visit and study exemplary transit operations outside the United States.

Two ITSP study missions are conducted each year, usually in the spring and fall, and are composed of up to 17 participants, including a senior official designated as the group spokesperson, a representative of the FTA, and a mission coordinator. Transit organizations across the nation are contacted directly and asked to nominate candidates for participation in the program. Nominees are screened by committee, and the TCRP Project J-03 Oversight Panel endorses all selections. Members are appointed to the study team based on their depth of knowledge and experience in transit operations, as well as for their demonstrated advancement potential to executive levels of the public transportation industry. Participation on a mission team is designed to complement and enhance professional development, helping to produce managers and leaders capable of dealing with a variety of problems inherent in managing transit activities in a complex environment. Travel expenses for

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ITSP participants are underwritten by TCRP Project J-03 funding.

Each mission abroad focuses on a theme that encompasses a topic of concern in public transportation. Cities are selected according to their ability to demonstrate leading-edge strategies and approaches to public transportation issues and challenges as reflected in the study mission's overarching theme.

The members of each study team are fully briefed prior to departure. The intensive, professionally challenging, 2-week mission has three objectives: to afford team members the opportunity to expand their network of domestic and international public transportation peers, to provide a forum for discussion of global initiatives and lessons learned in public transportation, and to facilitate idea-sharing and the possible import of strategies for application to transportation communities in the United States. Mission participants return home with ideas for possible application in their own communities. Participants are encouraged to share their international experience and findings with peers in the public transit community throughout the United States.

For additional information about the International Transit Studies Program, please contact Gwen Chisholm-Smith at TCRP (202-334-3246; gsmith@nas.edu) or Kathryn Harrington-Hughes at 443-385-0300 (khh@tcrpstudymissions.com).

ABOUT THIS DIGEST

The following digest is an overview of a mission that explored how public transportation systems can be effective drivers of economic growth. The study mission investigated how transit investments are linked to economic growth in the cities of Istanbul, Turkey; Cairo, Egypt; and Johannesburg and Cape Town, South Africa. The digest is based on individual reports provided by the mission team members, and it reflects the observations of the team members, who are responsible for the facts and accuracy of the data presented. The digest does not necessarily reflect the view of TCRP, TRB, the National Academies, the American Public Transportation Association (APTA), FTA, or Harrington-Hughes & Associates.

A list of the study team members is included in Appendix A. A list of the public transport agencies and organizations with which the team met is included in Appendix B.

INTRODUCTION

While each of the host cities has a unique story encompassing different opportunities and challenges, some common unifying themes also exist. In each city, improving individual mobility is a key policy goal for the public transportation service providers. The importance of reliable and affordable public transport to provide individuals with access to jobs and other destinations is one of the primary drivers of the investments that are being made in public transit in general and, particularly, in fixed-guideway transit systems in each of the cities. Implicitly or explicitly, access to employment is recognized as being tantamount to access to economic opportunity and growth.

The pressures of urban growth and the related challenges and opportunities of serving suburban development with public transit are also issues common to each city. Istanbul and Cairo are looking to improve public transport service to suburban communities to support suburban development and economic growth and to reduce densities and congestion in the urban core. Johannesburg and Cape Town seek to improve public transport service to neighborhoods that were established during apartheid and are home to blacks and disadvantaged populations that historically have been underserved by transit and have been denied economic opportunities.

All four cities are experiencing positive economic growth, and all are making substantive investments in public transit. In Johannesburg and Cape Town, investments in bus rapid transit (BRT) have been embraced as a driver of economic growth, which will provide the most cost-effective means to increase mobility, mitigate the growth in traffic congestion, and address the legacy of spatial dislocation of the low-income labor force from jobs. Similar to many lower-density urban areas in the United States, transit investment is seen as an essential element in creating a more sustainable urban form.

Istanbul's deployment of public transport as an economic development tool is primarily in response to tremendous economic and demographic forces. This is in sharp contrast to U.S. policies, which largely attempt to use public transportation as a means of shifting—or inducing new—travel behavior. In Istanbul, Cairo, and Johannesburg, public transport is being used as a tool to respond to and accommodate explosive demand for travel, thereby attempting to provide better access to jobs and services.

Transit investments also are being directed towards mitigating the negative by-products of

economic growth. Barriers to continued economic growth and livable communities include overpopulation, intense traffic congestion, and urban sprawl. In Istanbul and Cairo, transit investments are designed to reduce travel time and support self-contained communities on the urban fringe, thereby allowing each city to lower the density in the central city and to provide a viable regional transit network.

OVERVIEW OF PUBLIC TRANSPORT SYSTEMS

Istanbul

Istanbul is unique: it covers 2,063 square miles and is situated on two continents—Asia and Europe (see Figure 1). With a population of 12.9 million people, it is the largest city in Europe. Its residents are predominantly young, social, and active. It faces the problems of overpopulation in the core of the city and extreme overcrowding in the central business district (CBD). Istanbul Elektrik Tramvay ve Tünel (IETT) is responsible for public transport services in the city.

In Turkey, public transport services are the responsibility of the municipalities. Istanbul's jurisdiction is quite large, spreading across both sides of the Bosphorus. With a staff of 9,300 people, IETT is the primary public transport entity in the region, operating some services and contracting out others. The minibuss sector is regulated by IETT, and the bus service is operated by IETT. Most of the rail service



Figure 1 Istanbul is situated along both sides of the Bosphorus, which separates the continents of Europe and Asia.

is contracted to Istanbul Ulaşım (IU), which operates and maintains the metro, tram, and train system and is responsible for covering the operating costs, but not the cost of building and funding the infrastructure itself. The rolling stock, tunnels, and other capital infrastructure are owned by IETT.

IETT carries 3 million passengers per day on 4,900 buses operating on 515 routes. Its services include a metrobus and a BRT system, a light-rail/subway system, a funicular/tramway system, and an historic trolley on İstiklal Street. Its fare box recovery on the rail system is 130% and 70% on the bus system. IETT is funded exclusively with municipal funds—no assistance is provided by the central government.

IETT recently developed a very successful and effective BRT system by establishing dedicated bus lanes in the center of numerous urban highways. The decision to select this mode and alignment was based on the ease of construction and the desire to minimize the disruption to existing traffic. Within 2 years of opening, the BRT system reached its maximum capacity, and IETT officials are now contemplating putting some of the BRT system into tunnels to integrate it with light rail.

The extensive public transportation system is one of the keys to the economic vitality and livability of Istanbul. The city's burgeoning population has, however, resulted in congestion and sprawl. The city has developed a plan to shift some of the population away from the city center to new, self-contained communities that will provide both housing and employment and, thus, generate fewer trips. IETT estimates that there are 22 million trips made per day in Istanbul (including walking trips), of which IETT carries 3.2 million trips on its directly operated services. IU estimates that 9.5% of commuters use rail in Istanbul, and the number of trips in 2010 is expected to top 265 million—more than double the number of trips (107 million) carried in 2000.

The metro system, with 72 km of track, serves as the backbone of the transit system in Istanbul. By allowing metro service to continue from one side of the Bosphorus to the other, the Marmaray tunnel project will address congestion on the two existing highway bridges that cross the strait and will provide another transportation option for people traveling between the European and Asian sides of the city. When completed, the Marmaray tunnel project will increase the length of the metro by 77 kilometers.

The city's BRT system operates in exclusive bus lanes that primarily are located in the median

of freeways. Total travel time from end to end on the BRT line is 63 minutes. Riders pay before boarding, and the one-way fare is 1.65 Turkish lira (\$1.04). There are 33 stops, and headways are 15 seconds during peak periods and 45 seconds off peak, although off-peak schedules are adjusted based on demand and special events.

In addition to the publicly operated transit systems in Istanbul, there are also privately operated systems that help to reduce the amount of roadway congestion in the city. Minibuses play a large role in providing transit service to the outlying areas of Istanbul. Known as “dolmuses,” these buses sometimes run on the same routes served by the city buses, but they also serve areas with smaller populations as well as historic areas that are not easily served by traditional transit. There are more than 6,000 minibuses in service within Istanbul. Private shuttles are another option: carrying six to eight persons in each vehicle and licensed by the government, the shuttles are used to transport people to and from work. By carrying multiple people in one vehicle, these private shuttles are helping to achieve the municipality’s goals of reducing roadway congestion and travel times.

Cairo

Located on the banks of the Nile River, Cairo is a bustling city of 17 million people. It is Egypt’s capital city, and it the most populous city in Africa. Cairo’s efforts to use transit in the economic development context are aimed at keeping up with the crushing travel demands of this densely populated city. The Egyptian Company for Metro (ECM) and the Cairo Transportation Authority (CTA) carry a combined 1.7 billion riders per year, yet the streets of downtown Cairo are still heavily congested.

Approximately two-thirds of Egypt’s gross domestic product (GDP) is attributable to the Cairo metropolitan area. The annual growth rate of the Egyptian economy increased from 3.2% in 2003 to 8.8% in 2008. Nonetheless, the intense congestion resulting from high numbers of cars and people in the central city presents a barrier to continued economic growth and investment. The congestion is a by-product of the growth in population and increasing levels of car ownership, as well as a lack of sufficient off-street parking and sufficient capacity on the public transport system. A pedestrian environment is nearly nonexistent in the city, and traffic regulations appear to be little enforced.

ECM was formed in 1987 to build and operate the city’s two subway lines. Cairo is the only city in Africa with a subway system. In 1988, the system, which at that time had only a single line, carried 91 million passengers per year; since then, ridership on the Metro has grown 11% each year.

ECM’s first subway line—referred to as “Line 1”—uses 54 nine-car trains to make 522 trips per day, carrying 467 million passengers per year. Line 2, which was added in 1994, uses 35 eight-car trains to make 622 trips per day, carrying approximately 305 million passengers per year. Line 2 is fully accessible to persons with disabilities, and its more modern signal and train control equipment means it can also accommodate shorter headways over its 21 kilometers. Line 1 is currently being upgraded for wheelchair accessibility.

ECM’s current annual operating budget is approximately 300 million Egyptian pounds, but it is expected to grow to approximately 6 billion Egyptian pounds over the next 5 years. The increased budget will enable the agency to focus on four major initiatives:

1. Enhancing operational capacity,
2. Improving availability and reliability,
3. Upgrading assets, and
4. Expanding the metro network to more areas of the greater Cairo region.

CTA is Cairo’s primary public bus operator and also operates minibuses, ferries, metro trains, and trams (see Figure 2). These services, some of which are privately operated but supervised by CTA, carry 83% of the daily trips in Cairo. The CTA is an eco-



Figure 2 Cairo microbus transfer station.

conomic authority of Cairo's city government and employs 40,000 persons. It serves five primary cities in the Cairo metropolitan area: Cairo, Helwan, Giza, 6th of October, and Kalubia. Within these areas, CTA operates 20 bus garages, 5 workshops, and 883 routes.

CTA officials recognize that transportation is a crucial component of the city's development plans and the backbone of social life. The Egyptian government is undertaking efforts to modernize all of the country's infrastructure—including transportation—and is advocating an integrated system of transport.

Fares are subsidized by the government. The cost to ride a CTA bus is 1 Egyptian pound, but the actual cost per rider is 2.5 Egyptian pounds. Veterans and passengers with disabilities (and their escorts) ride at no cost; students qualify for a reduced fare. The total subsidy provided to CTA in 2010 was 690 million Egyptian pounds.

CTA has 3,000 buses in its fleet, which carry 3.5 million passengers per day. Another 6.5 million passengers are carried each day on unregulated minibuses. Management at both CTA and ECM indicated that it is likely that a new governing authority in Cairo will regulate the minibuses. In addition, CTA has service contracts with several entities such as the Greater Cairo Bus Company (an affiliate of CTA); school bus companies; and tour bus companies.

CTA is in the process of replacing many of its buses, 55% of which are more than 20 years old; the rest are less than 6 years old. The company's goal is to have a fleet in which no bus is more than 20 years old. The first 500 replacement buses have already been delivered by Mercedes, which won the bid to replace the fleet. Six hundred additional new buses will arrive in increments over the next 2 years (see Figure 3). The new buses cost approximately 650,000 Egyptian pounds each, and CTA plans to fund the purchase of the new buses through the sale of various surplus assets, primarily land and unused transit stations. The new buses will all be a bright red, making it easy for riders to distinguish between the new and old buses. CTA's goal is to provide a comfortable and attractive means of public transportation, which will attract riders from automobiles and help to solve the city's traffic problems.

To address its worsening air quality, Cairo has experimented with low-emission buses, with mixed results. In 1996, the Italian government donated six compressed natural gas (CNG) buses for use in Cairo. CNG vehicles are attractive, not only because of the low emissions, but also because of the very low price



Figure 3 CTA has already received 500 of the new Mercedes buses.

of CNG—approximately 45 piasters (\$0.08) per cubic meter. However, the extreme hot weather in Cairo has made it difficult to fill the buses' tanks to the required 300 bar (approximately 4,300 psi) and this has been further complicated by the need to refuel mid-day after the first 8-hour shift.

More recently, the U.S. Agency for International Development provided a grant to CTA for the acquisition of 50 new CNG buses. The chassis for those buses were built in the United States with a Cummins CNG engine and then shipped to Egypt, where the rest of the vehicle bodies were assembled locally. CTA is also experimenting with small hybrid-electric buses that use solar panels for start-up. These buses cost three times what a standard bus costs. CTA is also considering adding double-decker air-conditioned buses; a system of modern trams (streetcars); mono-rail; a BRT system with dedicated lanes; and a GPS-tracking system for the entire fleet.

At full build-out, the fleet will eventually number 3,000, and all buses will meet Euro 4 or 5 emissions standards. CTA is also making plans for uniform ticketing and electronic payment throughout its system.

CTA operates a ferry system and a light-rail transit (LRT) line called the "Heliopolis LRT." The ferry system carries 6,000 people per day. CTA staff indicated that the ferries are old (more than 25 years) and that there is a plan to engage the private sector in order to increase service to 60,000 trips per day as part of an effort to use the river to help lessen pressure on the downtown transportation network.

The Heliopolis LRT is a historic system constructed in the early part of the 20th century and

currently has a fleet of 30 vehicles, which provide 100,000 trips per day. CTA is in the process of upgrading the LRT rolling stock.

The institutional framework in Cairo appears to be in transition. In 2003, ECM transitioned to an independent board that reports to the Egyptian National Railways (ENR). ECM is responsible for operating and maintaining the system. Under the transition plan, employees of ECM have been borrowed from ENR until 2013. Staff positions, required qualifications, and training programs are now being defined. The ECM board members are now selected by the ministry of transport rather than by ENR. The tunnels and track for the existing lines are still owned by ENR. Tunnels and trackway for the new metro lines are being designed and constructed by the National Authority for Tunnels (NTA), which will also own the assets. ECM's stated vision is "to be the backbone of a safe, efficient, and exceptional transportation network in greater Cairo and the preferred mode for residents and visitors."

Johannesburg

Johannesburg is a relatively new major city, having been established in 1886 with the discovery of gold; it is the economic heartland of South Africa. Today the city encompasses 1,645 square kilometers (1,022 square miles) and has an official population of 3.9 million, but planners estimate that the actual population is about 5 million.

Johannesburg residents are young (65% are younger than 35), and unemployment is high. Of 3.5 million daily person trips, 47% are by public transport, including 72% by minibus taxi, 14% by rail, and 9% by bus. Two-thirds of the residents of this low-density city do not have access to cars.

Private minibus companies continue to provide the largest portion of trips in the city. The minibus industry grew in response to the apartheid government's policies, which failed to provide for the mobility needs of its workforce: the workforce was forced to live in segregated communities located far from employment and business centers, with inadequate public transportation services. Independent, private minibus companies thus sprang up to fill the demand. The minibus operators play a vital role in the city's transportation system, providing a means for residents of the townships to commute to employment centers. The minibus industry has, however, had its own set of challenges; the most pressing challenge has been

the difficulty in regulating the informal operators with generally poor safety and maintenance records. In addition, there is an oversupply of services, creating conflicts between operators competing for passengers. The movement of industry into political activity at the municipal, provincial, and national levels has also led to complications.

The Johannesburg Transportation Department is responsible for the development of policy, strategy, and programs for public transport, transport infrastructure, and transport safety. The department was responsible for developing and implementing services to transport the enormous crowds of spectators drawn to the city for the 2009 International Federation of Association Football (FIFA) Confederations Cup and 2010 FIFA World Cup.

Metrorail was formed under the banner of the South African Rail Commuter Corporation. This consolidation process and the development of a National Commuter Rail Plan have streamlined the institutional arrangements for commuter rail and provide the basis for decisions on recapitalizing the rail fleet. Ridership on commuter rail, measured as passenger trips per year, has been falling since the 1980s. This decline accelerated with the deregulation of taxi transport in 1989 and with the prolonged state of political protests and violence that ultimately led to the repeal of the apartheid laws in 1990 and to a new constitution in 1993.

The Metropolitan Bus Service (Metrobus) is owned solely by the city. The company operates about 532 buses on 80 scheduled routes and 130 school routes, transporting 90,000 passengers per day. Subsidies for bus services began under apartheid to ensure the provision of transportation that would bring workers from the outlying segregated townships to Johannesburg's industrial and commercial centers. The subsidies peaked in the 1990s, when the federal government was unable to meet the demands for subsidies. Competitive tendering to contract out the bus routes has replaced the former subsidy system; to keep transport affordable, however, the government makes up the difference between the cost of the tendered service and the fare revenue.

Cape Town

Cape Town is one of the oldest cities in South Africa, dating back to the 1600s, when it was a supply point for European ships rounding the Cape of Good Hope en route to India and Asia. The Mediterranean

climate and dramatically beautiful location on the southern tip of the African continent make Cape Town a popular tourist destination for Africans and Europeans. Cape Town is South Africa's biggest magnet for the information technology industry and other soft, clean industries such as banking and insurance.

Cape Town has a population of 3.5 million people over 948 square miles, making it the least dense of the host cities. The 2.5% annual population growth rate, in conjunction with a high level of unemployment, has focused the city on ensuring appropriate economic growth.

Cape Town boasts the best rail transportation in South Africa and has a well-developed transportation network of roads, but much of this network was established when the CBD was the focal point, which resulted in a radially oriented network (see Figure 4). The activity base has spread over the years, but this has not been matched by the development of a more grid-like system that would facilitate diverse travel patterns.

The public transport system in Cape Town currently consists of an existing bus service, minibus services, metrorail, and limited BRT service known as "MyCiTi." (In November 2010, MyCiTi was only operating express service between Civic Center Station and Cape Town International Airport Station.) According to the national household travel survey, 47.8% of trips are made by public transport in Cape Town, 44.6% are made by private vehicles, and 7.7% are made using nonmotorized forms of transportation. The public transport network is estimated to carry 1.1 million passenger trips daily, with 53% traveling by rail, 29% on minibuses, and 18% on scheduled bus services.

No capital investment in the Cape Town's commuter rail network has occurred in 40 years, and the network is operating considerably below its technical capacity due to a shortage of rolling stock. Although the rail network is capable of carrying more than 100 train sets, the city of Cape Town is currently served by 83 train sets. Future investment in the rail system will be focused on three priority corridors that have been defined in the Integrated Transport Plan.

The Cape Town integrated rapid transit (IRT) system is an initiative to transform public-sector transport. The term "integrated," rather than the more typical "bus," was adopted for this system to emphasize the system's integration with all other forms of transportation in the city. The IRT system serves as the

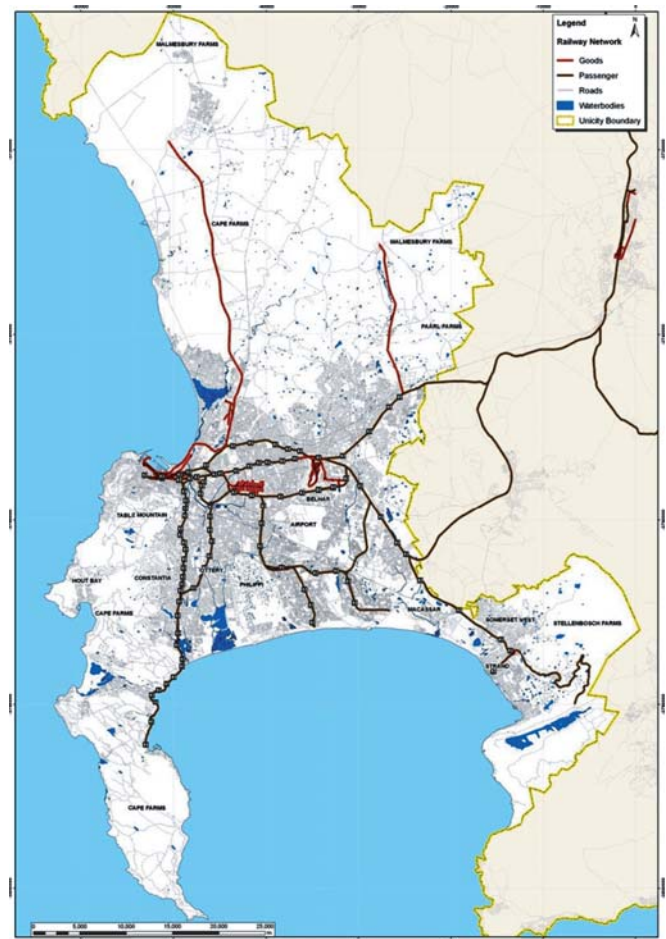


Figure 4 Cape Town railway network from Integrated Transport Plan.

key strategy for mitigating congestion, shaping metropolitan growth, and stimulating economic investment in neighborhoods adjacent to IRT stations.

Bus service is contracted out, but the facilities are owned and managed by the city. Daily ridership totals 270,000 on 1,530 routes. Service is subsidized by the national government. A dial-a-ride service utilizes 30 accessible vehicles to provide 400 scheduled trips each day to 5,000 registered users who have special needs.

An estimated 10,000 privately operated 15-seat minibus vehicles are in operation under single or multiple vehicle operators. There are 565 routes operated all day, providing service to 55,998 trips and 332,407 daily passengers, of which 120,922 are carried during the peak period. The services are unscheduled. Frequencies are between 1 and 2 minutes during the peak.

Metered taxis are chiefly sedans; riders are charged a fixed fare based on distance traveled. On

a typical day, 453 vehicles owned by 189 operators carry about 4,000 passengers.

TRANSIT SYSTEMS AND ECONOMIC DEVELOPMENT

Istanbul

In the divided city of Istanbul, 73% of employment is located on the European side, but only 65% of the population lives there. This results in more than 1.1 million daily trips over the Bosphorus as workers commute between the two continents, resulting in significant congestion on the two bridges that span the strait. As the population of Istanbul increases and as residential development expands on the Asian side of the city, the number of daily trips is expected to grow to 1.6 million by 2015. Reducing this congestion, decreasing the travel time for residents, and providing the population with additional transportation alternatives are the main goals of planned public transport projects.

To accommodate the demand for trips between the continents without exacerbating the burden on the road system, Istanbul is undertaking an ambitious rail development program—the Marmaray project. The 76.6-km commuter rail project will include 19.6 km of at-grade rail on the European side, 43.4 km of surface rail on the Asian side, 12.2 km of bored tunnels, and—the most technically demanding part of the project—a 1.4-km immersed tube twin tunnel beneath the Bosphorus (see Figure 5). The new line will include 40 stations and 7 transfer points to intercity trains and will be able to carry up to 75,000 passengers per direction per hour. Funded by the national government of Turkey, the \$4 billion project will reduce congestion and traffic impacts on the city, improve air quality, and decrease travel time for the millions who cross the Bosphorus each day. Perhaps most important, the tunnel will provide the first rail connection—for both passenger and freight trains—between Europe and Asia.

The project sponsors have tolerated lengthy delays in the construction of the project to ensure the protection of Istanbul's natural and historical resources. This illustrates a strong commitment on the part of the federal and municipal governments to preserving assets valuable to the culture and economy of the city. For example, out of concern about how changing levels of water turbidity and submarine noise might disrupt the migrating fish, in-channel work on the project is suspended every year during the two



Figure 5 Marmaray tunnel portal.

fish migration seasons: the spring migration from March 15 through June 15 and the autumn migration from September 5 through November 15. By suspending work during these key periods, the disturbance to the fish is minimized.

The project also has experienced numerous delays to accommodate archeological excavations. The project has uncovered 35 shipwrecks dating from A.D. 600–1,000, a tunnel dating back to A.D. 300, and skeletons dating back to 6,500 B.C. (making them 8,500 years old). Excavation and removal of submerged archeological finds is extraordinarily time-consuming as workers cannot operate at submarine depths for more than 20 minutes per day without absorbing toxic levels of nitrogen in their bloodstream. Furthermore, there are only eight experts in the world who specialize in the recovery of submerged ancient shipwrecks. The country's commitment to careful treatment of these finds has cost the project \$35 million for expenses related to archeological excavation and 4.5 years of delay at a cost of \$600 million.

The tunnel will cross the Bosphorus between Sarayburnu and Üsküdar, two points that have long been proposed as the best location for a tunnel. In addition to the delays imposed by fish migrations and archeological finds, the project faces daunting technological challenges. When complete, it will be the deepest immersed tunnel in the world at its maximum depth of 58 meters. (The current holder of that title is the San Francisco Bay Area Rapid Transit tunnel in San Francisco, which is at a depth of 46 meters.) The tunnel is being constructed in 135-meter, 19,000-ton segments in a nearby dry dock and is tested for watertightness before being placed on the floor of the strait. The placement of the segments occurs in waters with stratified currents up to 5 knots (5.75 mph) and with extensive shipping traffic. The tunnel is also being built in the world's most active earthquake zone, which has experienced hundreds of 1.0+ earthquakes in the last 10 years and dozens of earthquakes measuring 5.0 or higher in the last 500 years. The project is designed to withstand a 7.5-magnitude earthquake with no risk to life and minimal risk of losing its functionality, structural integrity, or watertightness.

Cairo

Transportation in the greater Cairo region is provided through public and private transportation systems. A total of 22 million passenger trips are made in the region each day, and almost 10 million of those trips occur on public transportation. In Cairo, the city center is the primary area where residents and visitors come to work and shop, and it also serves as the main transportation hub with connections to all modes of transportation. Because the majority of the jobs in Cairo are located in or near the city center, most transportation service is focused on connecting people from the outer areas to the CBD.

While the existing public transportation network provides some service to the outer districts, the government has a number of plans to expand the system to better serve these growing areas. The Cairo Metro's two existing subway lines provide service between the city center and several outer urban areas including Helwan, New El Marq, and El Mounib. Additional connections are provided to Shubra, a district within Cairo located on the north side of the city, which has a population of more than 5 million people. A third line, which will provide service between Imbaba to the northeast, the city center, and

the airport, is currently under construction and is scheduled to open in October 2011. When fully built out in 2022, the Cairo metro system will include six subway lines and will provide service throughout the greater Cairo region.

The city's extensive bus, minibus, and microbus (i.e., shared taxis) system provides service throughout Cairo and its suburbs and represents 83% of all public transportation trips. In addition, there are more than 1,180 minibuses operated in the Cairo region by the private sector. Because government officials recognize the important gap that these minibuses fill, they are currently working on a plan to organize and regulate the minibuses to make them a more formal and integrated part of the government system.

There are also plans to expand the transportation network in the Cairo region by constructing an addition to the light-rail system. The project will provide an additional 40 kilometers of light-rail transit in the Cairo region and includes the establishment of two new transit lines that will provide service between Cairo and New Cairo.

A railroad system also provides transportation service in Cairo and connects Cairo to Luxor, Alexandria, and other cities in Egypt. While the railroad is used by some to commute to and from work, it is traditionally used for longer trips between the major cities of Egypt.

The mode split in Cairo indicates that over half of all trips are by private shared taxis, or minibuses, which carry some 6.1 million people per day. Approximately 19% of trips, or 2.3 million passengers, are carried by metro trains; 18%, or 2.1 million riders, by CTA buses; 5% by the Greater Cairo Bus Company; and 6% in private cars. The private shared taxis that carry such a large share of the daily trips are considered to be unsafe, and they are entirely unregulated. The government is planning to create a new entity that will oversee all transportation services in Cairo, with the aim of improving safety and reliability of all modes.

Johannesburg

Recent investments in public transport are being used to help break down barriers between neighborhoods and to provide residents with improved access to jobs and education. One of the government's goals is to see that public transport is being provided equally throughout the city. Focus is also being placed on leveraging investment in public transport to increase

densification and more efficient urban forms, which will help to reduce transport costs for residents and to reduce the city's cost of transportation infrastructure.

In the past 10 years, Johannesburg has seen the construction and successful initial operation of two new transit systems—Rea Vaya (which means “we are going”) and Gautrain. Rea Vaya is a BRT system that runs primarily in dedicated lanes to fixed raised station platforms. At completion, Phase 1 of the Rea Vaya network will include 122 kilometers of coverage, 150 stations, and 805 buses capable of carrying 434,000 passengers per day. The first segment completed, called “Phase 1A,” extends from Thokoza Park in Soweto to Ellis Park in downtown Johannesburg. This line is 30 kilometers long, includes 30 stations, and uses 143 buses. Forty-one of these buses are articulated, carry 56 seated passengers, and are designed to carry passengers between designated stations with raised boarding platforms. The other 102 buses, called “complementary,” are nonarticulated; carry 40 seated passengers; and provide for level boarding at regular curbside stops (doors on the left side of bus) and high boarding at the Rea Vaya stations, where the doors open on the right side of the bus. This arrangement enables these complementary buses to operate along the dedicated trunk line and then to branch out into neighboring areas to provide feeder service. A bus-operating company operates the system from 4:50 A.M. to 10:30 P.M. on weekdays and from 5:00 A.M. to 7:30 P.M. on weekends. The cost of this initial trunk line (i.e., Phase 1A) was 2.5 billion rand (\$360 million).

The next phase will add 43.5 kilometers of trunk line and 43 new stations served by 300 buses, of which 100 will be articulated and 200 will be nonarticulated. This phase will create a new bus-operating company and will cost approximately 3.5 billion rand (\$500 million) to complete. Officials expect this phase to be completed in 2012.

The business structure for operating the Rea Vaya system differs from the typical public transit model in which a public agency owns and operates the system. Instead, the city of Johannesburg owns all of the system assets, except the buses. This includes the stations, exclusive right-of-way, fare equipment, and maintenance depots. The ticketing, cash collection, station management, and bus ownership, operations, and maintenance are all contracted to private companies.

The key to Rea Vaya's success has been the formation of bus-operating companies to operate the system. One of Johannesburg's most vexing chal-

lenges was introducing a robust transit system to serve areas “claimed” by private taxi companies that had long provided the only service to those areas and had developed a profitable business providing the service. Naturally, the minibus taxi companies fiercely opposed the idea of a publicly subsidized system that would put them out of business or, at least, narrow their profit margins. However, the mayor and City Council of Johannesburg were convinced that achievement of their transport mandate required a comprehensive public system whose reliability and safety could be ensured and whose routes could serve not only the locals, but international visitors as well. With the FIFA World Cup coming to Johannesburg in 2010, officials knew this system had to be built quickly.

In 2006, the mayor of Johannesburg visited several transit systems in South America and quickly became convinced that a dedicated-lane BRT system could be effective in Johannesburg and could be implemented quickly. In November 2006, a 122-kilometer BRT system was approved in the city's Strategic Public Transportation Network, including the initial route to Soweto. In the year that followed, the city was involved in extensive and difficult negotiations with the taxi operators, who were fearful that the BRT would disrupt their livelihood. The negotiations were successful for three key reasons: (1) the mayor agreed, at the taxi operators' request, to pay for a technical advisor who would work with the taxi operators; (2) the mayor invited taxi operators to participate in study tours to South American systems so that they could meet with minibus operators in those communities to learn about their experiences with transitioning to a BRT system; and (3) the mayor directed that negotiations be conducted by an independent organization, thereby placing the taxi operators and the city on equal footing. The mayor's consistent inclusion of the taxi operators in the process and his genuine responsiveness to their concerns built credibility in a very short time. After lengthy negotiations, the mayor was able to convince a small group of the operators that their careers would be more prestigious as owners of a bus-operating company and that their drivers could earn more and have better advancement opportunities as highly trained bus operators than as taxi drivers.

Unfortunately, some political pressures and a lawsuit prevented the Rea Vaya system from opening in time for the 2009 FIFA Confederations Cup, but the city ultimately prevailed in the legal action and com-

pleted the system in time for the 2010 FIFA World Cup. One of FIFA's most stringent requirements was that the main stadium at Soccer City be capable of clearing the area of crowds within 2 hours after the end of a game. Without a high-capacity transit system in place, the spectators in the stadium's 94,700 seats had little chance of clearing within the allotted time. The Rea Vaya system, however, was up to the task—easily able to clear the area in less than 2 hours.

While the Rea Vaya system will have long-term economic development benefits during its many years of operation, the construction of the system was a substantial economic driver in and of itself. The city of Johannesburg was able to secure financing for the project through the Export Credit Agency, an international bank designed to promote exports in a home country. The bid for producing the buses was won by Sweden's Scania SA (an affiliate of Saab). With the aim of completing the order in time for the 2009 FIFA Confederations Cup (the original deadline for the system), Scania built the chassis in Sweden then airlifted them to Brazil for completion. Scania agreed to sell the buses to a "yet-to-be-named bus-operating company," as the taxi negotiations had not been completed at the time of the order; agreed to accept the buses themselves as collateral for the loan; and carried the financing for 12 years instead of the usual 5 years.

While the deal required a complex financing structure, in which the bus supplier bore significant risk, it provided a massive infusion of funds and technical skills into the Johannesburg economy. Some community members expressed concern about importing buses from another country, but Johannesburg officials knew South Africa did not have the domestic capacity—either in skills or manufacturing capacity—to complete the order on time. Nevertheless, Johannesburg officials do intend to enable some level of local production for the next phase. The city lacks the ability and mandate to stimulate local manufacturing capacity, but hopes that its initiative on the Rea Vaya project will motivate the national government to step into this role. Both the complexity of the financing and the speed of construction and completion—roughly 2.5 years from beginning of planning to revenue service—were remarkable.

Johannesburg's sequencing of future phases of the project will be based on a variety of factors including the importance of a corridor for city economic growth and development, the corridor's place in the

city's growth management strategy, and its potential for accelerating densification and transformation of the city's urban form. Thus, the Rea Vaya system is clearly seen by Johannesburg officials as having a close tie to, and dramatic impact on, the city's economic development efforts, as well as being an effective tool for reducing poverty. By providing a low-cost and reliable transportation option, it meets the mayor's desire to ensure that no one spends more than 10% of his or her income on transportation needs, and, with time, it will provide the opportunity for Johannesburg residents to reverse the spatial dispersal of communities through the development of higher-density neighborhoods surrounding the transit stations. One official was quite direct about the two primary reasons for building Rea Vaya: to satisfy the mobility demands of the World Cup and to improve social equity by delivering good transit service to underserved communities. The Rea Vaya system has been driven by a strong, principled mayor who recognized that effective, inexpensive transportation can be a wealth-building tool for the community's poorest residents. City officials noted that individual economic empowerment was a deliberate aim of the Rea Vaya project, while broader economic development benefits were unintentional.

Johannesburg officials are certainly not pausing to celebrate the success of the first Rea Vaya line. They point to a long list of crucial next steps including integration of ticketing, transfers, and multimodal facilities; station integration with surrounding land uses and local economic development; congestion reduction and continued behavioral changes regarding transportation choice; intensification of development in Rea Vaya corridors; and identification of sustainable revenue sources for public transportation.

The Gautrain project was launched by the Gauteng provincial government in 1997 to curb urban sprawl, relieve traffic congestion, and serve business travelers. It was seen from the outset as an economic development tool. The project also aimed to relieve traffic congestion along the highway between Johannesburg and Pretoria, which carries 300,000 cars per day. Other goals for the project include urban renewal along its route and creating a transit facility that is economically and environmentally sustainable.

Construction of the project sent 4.5 million rand to black-owned business entities, furthering the goal of black economic empowerment (BEE). The project spent approximately 3.2 million rand on South African materials, plants, and equipment.

Three lines are planned. The first, from the airport to Sandton, opened in June 2010 and carried its millionth passenger in September 2010, 3 months earlier than expected. The second line will be from Hatfield to Park, and the third will be from Sandton to Rhodesfield. The project will include 24 trains, with 4 coaches in each set, traveling at 160 km/h (100 mph) on standard gauge-rail (see Figure 6).

Gautrain planners viewed the project as a catalyst for transit-oriented land development and a tool for accomplishing city goals for increasing overall development densities, particularly around transit stations (see Figure 7). Officials report that the private development community has responded eagerly with a great deal of interest in property around the Gautrain stations. Cities have changed their zoning to encourage this kind of development, and the market has responded well.

Cities feel, however, that they need to find a palatable way to recapture some of the value the train has created for private developers. This substantial public investment is yielding sizeable profits for private



Figure 7 Gautrain Station at the airport.

developers, and cities would like to recover some of that increased value to pay for the costs of public infrastructure and amenities. In order to stay more closely involved, the city of Sandton has provided city-owned land for a station through a lease (rather than a sale) to Gautrain and has worked directly with developers to make property adjacent to the transit stations available for higher-density developments. Officials have been successful in their efforts to promote higher-density residential buildings with 10 to 12 stories instead of the usual 2 stories.

Cape Town

As with Johannesburg, the National Land Transport Act requires Cape Town to develop an Integrated Transportation Plan (ITP) and update it every 5 years. Cape Town's current ITP is effective from 2006 to 2011. To prepare the plan, city officials conducted extensive international research in cities with progressive transportation policies, with the aim of identifying the most successful approaches and the most current trends. Officials studied Victoria, Canada; Portland, Oregon; and several cities in South America. Through this research, Cape Town identified and adopted as priorities a sustainable development agenda; an adherence to the triple bottom line of social, economic, and environmental prosperity; and a commitment to a global environmental agenda.

The foundation for Cape Town's recent efforts was laid by significant developments at the national level in the 1990s and early 2000s. The democratization of South Africa and the adoption of a national



Figure 6 Gautrain car in the depot.

constitution in 1993 created a mandate to treat all South African residents equally and to remedy the effects of the segregated communities and of the withholding of public services and infrastructure from nonwhite communities. Furthermore, the national government implemented new policy directives that require an integrated approach to development, planning, and transportation. New legislation further emphasized environmental sensitivity and sustainability, attention to the spatial component of land use planning, sustainable transportation approaches, and an emphasis on economic development. Cape Town officials noted that these national initiatives were key levers influencing local policy.

The vision of the adopted ITP is to provide “a world-class sustainable transport system that moves all its people and goods effectively, efficiently, safely, and affordably.” The key themes of the ITP are sustainability, universal design, economic development, and safety. Within these themes, the city has pursued a mobility strategy to transform and restructure public transit by focusing on people and quality of life.

Cape Town has focused on the development of an IRT system. The primary components of that system are a world-class BRT system, a network of pedestrian pathways and full-sized bicycle lanes, and close integration with other forms of public and private transport.

BRT was selected over other options, such as light rail, due to the flexibility that BRT offers. Growth in Cape Town continues to occur at a high rate, and these high-growth areas are occurring in various areas surrounding the city. BRT is more affordable than rail and offers the flexibility to serve today’s high-growth areas, as well as tomorrow’s new-growth areas.

There are a total of four phases for the implementation of the IRT system in Cape Town and at full build out, all of Cape Town and its surrounding towns will be included in the transportation network. Phase 1 of the IRT implementation includes providing service in the CBD and the areas north of the city and is anticipated to be completed in September 2013. Phase 2 will provide service to the south and southeast, including service to Somerset West. Phases 3 and 4 focus on the northeast and eastern portions of Cape Town and will bring service to Stellenbosch.

The MyCiTi BRT component of the IRT has been implemented throughout the CBD, to the airport, and to Table View. Table View and areas north of Cape Town have experienced rapid growth in recent years.

Growing at a rate of more than 1,000 households per year, this area houses more than 20,000 people who cross the river each day to access downtown Cape Town, and the area is anticipated to grow to more than 70,000 dwelling units. Providing public transportation to these high-growth areas will provide an important connection between the growing residential areas and the employment areas in downtown Cape Town.

The MyCiTi system includes a main trunk line with dedicated bus lanes, as well as feeder service serving residential areas (see Figure 8). The first phase of the MyCiTi feeder system is scheduled to be operational in late 2011. This system will provide greater connectivity for the whole community as buses will bring people who do not live adjacent to existing stations to the trunk line. Connecting MyCiTi with nonmotorized modes of transportation is also a priority to ensure a well-connected transportation network throughout the city. As a result, the entire system is being constructed to include a parallel bikeway along the route.

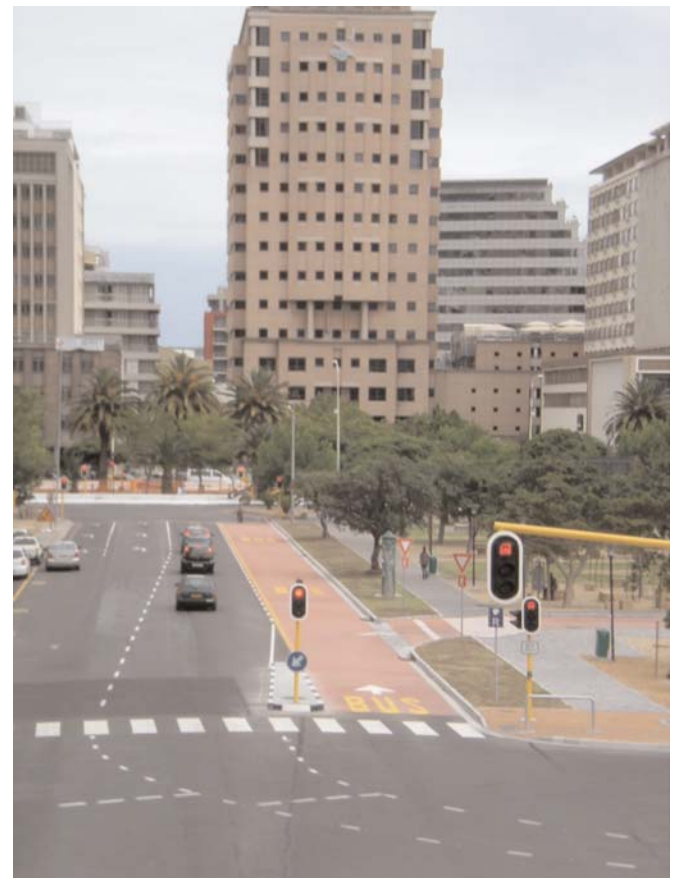


Figure 8 Cape Town bus lanes.

The next step in the installation of the IRT system will be to establish the innercity feeder routes. The innercity feeders are anticipated to begin operating in December 2011. The subsequent milestones of Phase 1 include the establishment of feeder routes in Table View, Montagu Gardens, and Century City by February 2012. Following the start of operation of those feeder routes, a connection to Atlantis will be made and will include both a trunk-line extension as well as feeder service. Service to Atlantis is anticipated to be operation by November 2012. The Du Noon trunk line installation will be the final part of the Phase 1 installation and is scheduled to be complete in September 2013.

The city is placing a high priority on development around the transit stations, but has yet to see substantial private investment. While transit investments have been the responsibility of the national and provincial governments in the past, this is the first time the city of Cape Town has led the effort to develop public transit. As a result, investor confidence has not yet risen to the desired level, and privately financed transit-oriented developments (TODs) are still some time away. City officials have begun changing the zoning around stations, but the process takes up to 18 months and has not been completed yet. Investors are cautious because of the clear lack of public investment in the existing urban rail system over the preceding 40 years. Cape Town officials know they will need to work hard to build investor confidence around the BRT system. To do so, they understand they will need to do whatever is necessary to ensure the BRT system works well from the outset. If they succeed, they are confident private investment dollars will flow to station-area developments.

As an incentive to stimulate development around the BRT system, the city is considering property tax forgiveness for 3 to 5 years in targeted areas. While city finance officials worry about the revenue implications of such a program, the concept has support from the national government in the form of programs and authorizations adopted by the previous national finance minister, who saw the benefits of TOD and who passed a formal resolution to make such tools available to cities.

Cape Town also views cycling and walking as valuable strategies in its IRT System. The city has developed plans for dedicated cycling and walking paths in both the urban and suburban settings. Thus far, they have added 60 kilometers of bicycle trails,

most of which are separated. City officials report, however, that mustering support for bike facilities is difficult both with the public and within the city establishment. On the public side, Cape Town hosts a major bike race every summer and is home to a large population of cycling enthusiasts. Most of these, however, are more interested in racing and professional cycling and have little interest in facilities to support recreational or commuter cycling. Within city hall, transportation engineers still exhibit some intransigence regarding cycling and pedestrian facilities. Nevertheless, elected city leaders have seen the substantial and rapid benefits that can come from the relatively small investments required for cycling facilities and intend to continue the push for a robust network of bike trails in Cape Town.

TRANSIT PLANNING AND DECISION MAKING

Istanbul

In response to growth in population, traffic, and transit congestion, transport and land use plans for Istanbul focus on suburbanization. The goals are to relieve transit and roadway congestion in the dense urban core, which is stifling economic activity, and to support this suburban growth strategy by improving transit service to the suburbs. The plan for the new suburban growth is to encourage developments with higher densities and mixed uses. Concurrently, city planners are employing strategies to lessen densities in the urban core to help relieve congestion. Implementation of these strategies will lead to a multi-modal land use development pattern with multiple urban activity centers.

The goal is to establish smaller urban areas on the outskirts of the city that serve as complete cities, allowing residents to live and work without traveling to the city center. The municipality hopes that various programs will address the needs of the growing population without impacting the existing vibrancy of downtown Istanbul. This controlled growth is being achieved through several initiatives including municipal-built homes in the outlying areas, incentives to move manufacturing jobs outside of Istanbul, construction limitations that reduce densities in the city center, and pricing that encourages people to move to the new outer areas.

Reducing the demand on the transportation network is one of the main goals of these initiatives.

In order to successfully use these new urban areas to reduce pressure on the city center, these areas must meet people's basic needs and must also be served by roadways and public transportation. As a result, these new urban areas are being developed as complete cities and include schools, shopping, hospitals, and employment centers. As these new areas develop, one of the challenges facing the city is achieving a balance between expansion and creating areas dense enough to support transit. In addition, the city must use available resources to maintain the existing infrastructure and also to serve the newly expanded areas.

Building on the goal to reduce densities in the urban core, Istanbul has also moved to limit automobile traffic and the resulting gridlock. The city has implemented a strategy to close select streets to general-purpose automobile traffic in sections of the central city, making the streets pedestrian-only or pedestrian-and-transit-only zones. An example is Istiklal Avenue between Taksim and the Tünel funicular stop, which is a 1.6 kilometer stretch of street that was closed incrementally to general-purpose traffic and then had an electric tramway service added in 1990. By instituting these pedestrian and transit-only zones in the central city of Istanbul, the areas became more attractive, which adds to the central city's vibrancy, densities, and congestion levels.

Cairo

The urban core of Cairo is very dense and crowded, stressing the capacity of government to provide core services such as adequate roadway and public transportation capacities. As a result, traffic congestion is very high. In response, a key objective of investments in transit infrastructure is to move economic activity to suburban areas and to spur new growth in these areas. An example of this strategy to support suburbanization is 6th of October City, a rapidly growing suburban city and commercial area on the western side of Cairo. However, the rapid pace of suburban development has made it difficult for transit and transport investments in infrastructure to meet demand, and authorities are struggling to keep pace. Metro Line 4 will serve 6th of October City. The plan to move people out of the urban core and increase suburban growth is working, and plans for future metro lines do align with these plans.

Another example is New Cairo, which is located approximately 45 kilometers to the east of Cairo.

Established in 2001, New Cairo was developed when the government sold land to private developers at a discount to encourage its development. New Cairo is an example of the government's desire to reduce the density of downtown Cairo and to provide connections between the downtown and the new urban areas through expanded public transportation. Although currently served by some transit services, there are future plans to expand transit services to New Cairo through an expansion of the subway, light-rail, and bus systems.

The development of these new communities occurred prior to the establishment of a transportation network, so the city has implemented a plan to provide the sought-after transportation services in these newly established urban areas until the expansion of the existing systems is complete. Recognizing that the expansion of the public transportation systems would be a difficult and slow process, the CTA established a project that provides private transportation services to the new areas. The transportation needs are being met by several private companies. Currently, one main station acts as a hub to provide service to these new satellite areas, which allows people to stop at one station and easily transfer to another bus. As the government brings additional private companies on board, service will continue to be expanded.

The government has a national policy approach to subsidize all forms of transport—for example, CTA cites the cost per passenger on services as 2.5 Egyptian pounds (approximately \$0.43) per boarding, while the fare is 1 Egyptian pound (approximately \$0.18). The resultant annual subsidy is approximately 690 million Egyptian pounds (approximately \$118.5 million). Similarly, fuel prices for private automobiles at the pump are also very low and subsidized by the government. The cost per liter of gas is about 1.10 pounds (approximately \$0.19/liter or \$0.72 per U.S. gallon), while the real cost is about four times that amount. Subsidies of transit fares and fuel are set to help achieve societal goals by the national government, facilitating affordable transportation for Egyptian citizens and thereby improving access to employment and spurring economic opportunity and growth.

Johannesburg

Johannesburg's history of apartheid played a large role in how the city developed—it resulted in a disjointed city. As a result of apartheid spatial planning,

industrial areas were placed between the business and financial districts located in the center of the city and the outer residential areas or townships. Mixed uses were not promoted, which had a significant impact on transport costs and the quality of life for the residents. This spatial planning resulted in the workforce living on the outskirts of the city without sufficient transportation to jobs located in the city.

This access issue has been exacerbated since the job market has spurred suburban office centers north of the city, while many of the townships are located to the south and west. As a result, travel times have increased and frequently require a trip into the CBD for a transfer. New development has moved from the city center to the outer areas, particularly with businesses previously located in the CBD moving to the north side of the city. Traditionally, travel occurred between the outer residential areas to the city center; this new development is changing travel patterns and how future phases of public transport are being developed. Consideration is now being given to travel patterns that may not require a trip to the city center.

Soweto (i.e., South West Township) is the largest township in Johannesburg and is home to approximately 40% of Johannesburg's residents. Developed as a result of apartheid, Soweto is a residential area that lacks employment areas within its boundaries, which means that almost all of Soweto's residents must commute to other parts of the city for employment. Soweto has also traditionally been underserved by public transportation, and residents have had to rely heavily on minibus taxis as their primary means of transportation. When the city decided to bring metrobus service to Soweto in 2005, there was much resistance—summed up as “Get your metro buses out of Soweto or else.” However, once the minibus operators had participated in the study mission to Guayaquil and Bogotá, where they talked to peer companies that had successfully transitioned from minibus to BRT, the resistance lessened somewhat. As a result of the study mission, city leaders also decided to scale the planned metrobus system up to a full BRT system as they recognized that a BRT system would have beneficial ripple effects in the broader areas of land use and development, air quality, community development, and BEE. In November 2006, the city decided to build 122 kilometers of BRT north from Soweto.

Another focus in Johannesburg is better regulation of the minibus taxi industry. One key step in this direction is the efforts made by Johannesburg

to negotiate with many of the minibus taxi associations regarding the introduction of Rea Vaya. Starting in the mid 2000s, Johannesburg sought to achieve support and buy-in from minibus taxi operators in the development of Rea Vaya. The minibus taxi industry was fractured and disorganized, resulting in slow negotiations and progress. As negotiations proceeded, Johannesburg's discussions focused on the larger operators in Johannesburg, leaving many operators out of the negotiations. Many minibus taxi operators opposed the Rea Vaya as it was seen as a publicly funded service competing with traditional minibus taxi markets and threatening their livelihoods. Overcoming legal challenges and this general industry opposition, Johannesburg was able eventually to reach a negotiated agreement with the largest of the minibus taxi operators, who formed an operating company that has taken on the management of the BRT, employing former minibus taxi drivers as employees of the operating company.

As a result of this transition from minibus taxi operations to Rea Vaya operations, 585 minibus taxis were removed from the roads when Phase 1A opened. These minibus taxi operators sold their old minibuses, raised shareholder equity, and migrated from minibus taxi operators to BRT bus operators under the auspices of the new operating company, with city support. This transition helped achieve the goals of both improved mobility for citizens through the Rea Vaya system improvements and BEE through the transition from individual minibus taxi operators to participation in the new operating company. Challenges do remain, however: 10 minibus taxi operating associations are involved in the current ownership group of the Rea Vaya operating company, but there are 90 others that are not involved in the project. Further economic impacts of Rea Vaya have been documented in terms of employment impacts for Phase 1A construction and operations, which generated about 3,500 temporary jobs during construction and 800 permanent jobs during operations.

Johannesburg, which does not now have adequate densities to support public transport, has developed a land use planning strategy to increase densities within 1 kilometer of existing rail lines, Gautrain service, and the Rea Vaya BRT. To support this goal, the city is making investments in infrastructure and development a priority in those areas that are well served by transit. Inncity regeneration is a goal of these land use strategies, as is TOD. There has been some success in TOD and implementation of these land use

strategies, more on the north side of town than on the south. All of these efforts have as their basis what have been identified as the key values of public transportation—to build a better quality of life, to build the economy, and to build society.

Cape Town

The layout of Cape Town includes a CBD in the center of the city, which is surrounded by an industrial district. Residential areas are found on the outskirts of the city, with higher-income residential housing located closer to the city center and lower-income residential areas typically located farthest from the city center. This layout presents a transportation challenge for the city as it looks to find sustainable ways to provide public transport between these residential areas and the employment center.

One such lower-income area is the city of Atlantis, which is located approximately 40 kilometers from Cape Town. At the time Atlantis was created, the government offered subsidies and incentives to encourage manufacturing and industrial companies to set up operations in Atlantis and, thus, to create local jobs for the residents. When the government subsidies ended, however, many of these companies left, causing unemployment rates to rise to 60%. Keeping with the government's mobility strategy, there are plans to expand the public transportation system and connect Atlantis to Cape Town, thereby improving residents' access to education and employment opportunities in Cape Town.

South Africa's Department of Transportation is supporting BRT investments in multiple cities throughout the country and is moving away from its primary investment strategy, which had been oriented largely toward roads. This national strategy in support of BRT development rather than rail development is based, in part, on the fact that the capital investment required for BRT construction is substantially lower (on a per-kilometer basis) than is that for rail. The national government subsidizes rail and publicly operated bus services provided in Cape Town in the amount of about 1 billion rand (approximately \$145 million) annually. A key intent of the BRT investment strategy is to make publicly operated transit services more efficient, reducing the need for subsidies. The national strategy is to provide more public transportation services nationwide, bringing better regulation and more structure than presently exists.

By bringing primarily African-owned minibus taxi operators in to operate their BRT services, both Cape Town and Johannesburg are striving to improve economic opportunities for the poor, in support of national and local policy goals supporting broad-based BEE, which is recognized as an important driver of economic growth and job creation (i.e., the Broad-Based Black Economic Empowerment Act of 2003). By designating BRT corridors that will connect spatially and racially segregated communities to centers of economic activity and commerce, the policy goals of providing inexpensive, reliable public transport services to the poor are also achieved, helping to improve economic opportunity.

LESSONS LEARNED

The following are the lessons learned from the ITSP Fall 2010 mission:

Corridor development is a fundamental element of the vision for each city: The Marmaray tunnel under the Bosphorus will achieve a 150-year-old goal for Istanbul to complete a rail corridor connecting the European and Asian sides of the city. Cairo's Transportation Master Plan 2022 (CREATS) calls for intensified residential and commercial land uses along public transport corridors and within urbanized area boundaries. Johannesburg's Integrated Development Plan (2010/2011) calls for initiating and implementing corridor development. The desired urban form for the city is delineated by two development corridors with focused infrastructure to support development and a series of goals and objectives for each corridor. Cape Town's city strategy for public transport is set out in the policies of its Integrated Transport Plan (2006–2011), which includes giving priority to public transport over private transport, directing investment in infrastructure, encouraging investment and growth in sustainable mobility corridors, and stimulating development on mobility corridors.

Major transit investments in each city include important roles for public-private partnerships: IU was established as a subsidiary of the Municipality of Istanbul to operate and maintain the railway system and undertake capital projects, the most prominent of which is the \$3.2 billion Marmaray tunnel project. Similarly Cairo Metro, the privatized Egyptian Company for Metro, was created for operation and maintenance, while the assets belong to the Egyptian National Railway. In Johannesburg and

Cape Town, the new BRT systems are creating operating companies in which displaced private taxi operators will be the shareholders.

Social equity considerations are embedded in transportation policy in the cities of Johannesburg and Cairo: Social equity considerations were most apparent in Johannesburg and Cairo. One of the key performance indicators for Cairo Metro is to “commercialize with social responsibility,” meaning that transit fares are set by the Egyptian government and the operating corporation has social responsibilities. To support mobility for its citizens, the Egyptian government subsidizes the cost of fuel, the cost of cars, transit fares, and parking fees. In Johannesburg, the Integrated Development Plan’s result will be a more equitable and spatially integrated city, and the BRT system will be integrated with other modes to address geographical segregation and facilitate region-wide mobility. The city’s motto in negotiations with the private taxi operators is “no operator should be worse off than they are now.”

The growth in car ownership and use is a serious threat to future livability and economic growth: Car ownership rates are currently low in each country, but increasing population and prosperity will exacerbate the already severe roadway congestion. Cape Town demonstrated a commitment to transportation demand management strategies to influence mode choice and travel behavior.

APPENDIX A—STUDY MISSION TEAM MEMBERS

(Affiliations listed were current at the time of the study mission.)

Peter Varga (*Team Leader*), Chief Executive Officer, The Rapid, Grand Rapids, MI
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APPENDIX B—STUDY MISSION HOST ORGANIZATIONS

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Cairo Transport Authority

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Sayed Kamal Aly, Head of Central Administration—
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Ashraf Hamed El-Sabbagh, General Manager of Central Requirement

Egyptian Company for Metro

Mohamed Shimy, Chairman and Managing Director

Abdalla Mohamed Fawzy, Head of Central Department for Operations—Line 1

Imbrahim Ramadan Ibrahim, Head of Central Department for Maintenance—Line 1

Aly Hussein Aly Metwally, Head of Central Department for Operations—Line 2

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Johannesburg, South Africa

City of Johannesburg Metropolitan Municipality
Rehana Moosajee, Member of the Mayoral Committee, Transportation
Donovan E. Williams, Office of the MMC: Transport
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Yolisa Mashilwane, Director: Management Support
Jacques van Zijl, Rea Vaya BRT Project Manager
Charles Blok, Director: Infrastructure BRT
Colleen McCaul, Consultant
Itumeleng Motsa, Marketing & Public Liaison Officer

Gautrain
Ingrid Jensen, Issue Management
Marcel Molina, Railway Operations Expert: System Acceptance

Bombardier Transportation
Sandy Motale, Public Relations and Communications Officer
Dawid Maree, Communications Officer

Top Six Taxi Management, Ltd.
Sicelo J. Mabaso, National Chairperson

Cape Town, South Africa

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