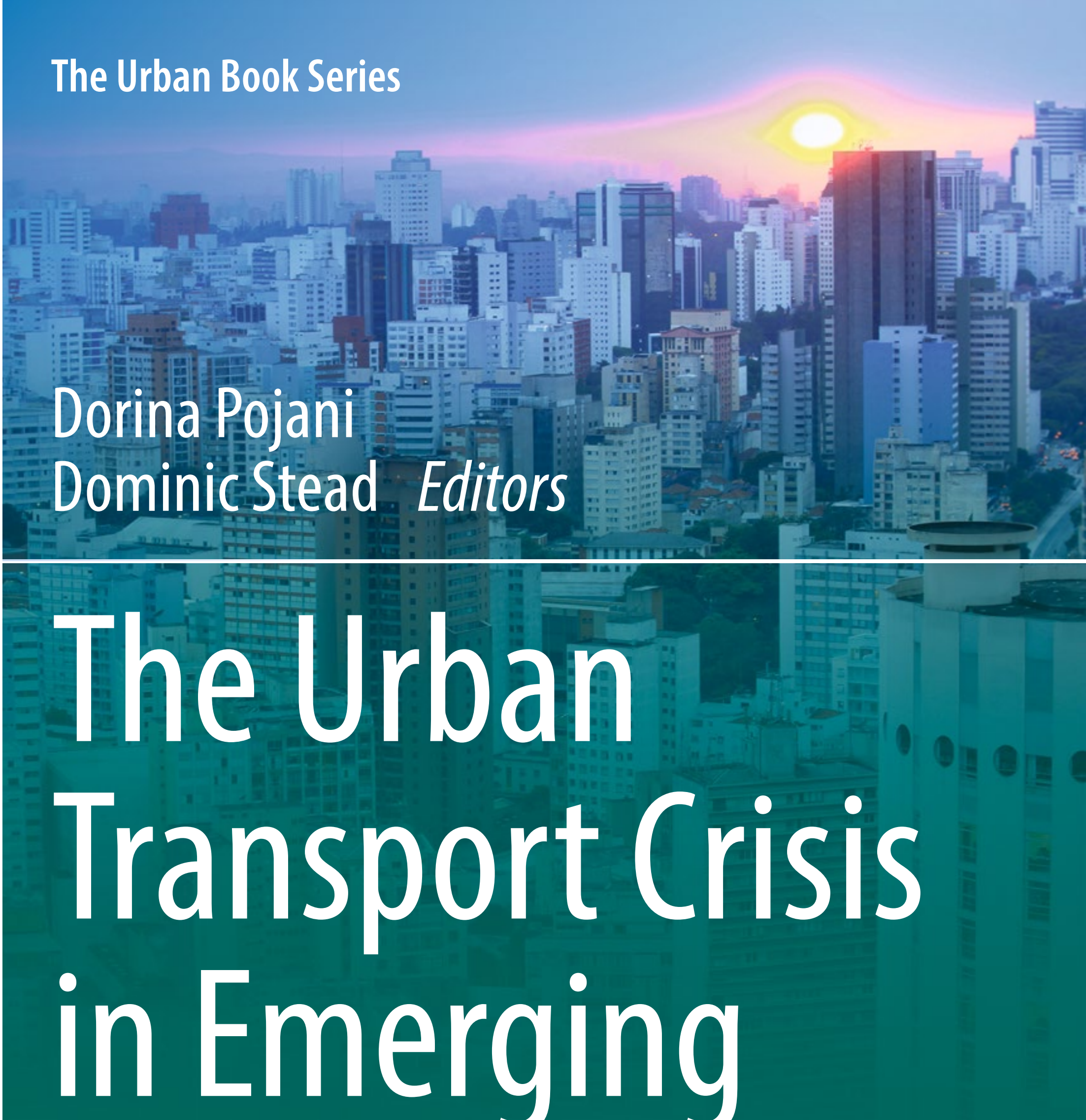

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Dorina Pojani
Dominic Stead *Editors*

The Urban Transport Crisis in Emerging Economies

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Editors

The Urban Transport Crisis in Emerging Economies

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Preface

This book was conceived and written to provide a contemporary view of critical urban transport issues, policies, and initiatives in 12 countries with emerging economies, each at somewhat different stages of development. With dedicated chapters on Brazil, China, Colombia, India, Indonesia, Iran, Mexico, Nigeria, Russia, South Africa, Turkey, and Vietnam, the book contains detailed, comparable information about the current urban transport situation in the major cities in these countries. Written by specialists in the field, the book draws on a wide range of information sources to provide up-to-date accounts of each of these countries. By assembling this information in one volume, it provides a valuable source for academics as well as policy-makers with an interest in the current and emerging urban transport needs of a large portion of the world's population.

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Delft, The Netherlands — Dominic Stead

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Contents

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Chapter 1
The Urban Transport Crisis in Emerging Economies: An Introduction

Dorina Pojani and Dominic Stead

Urban transport problems are perverse. While education or healthcare improves as societies grow wealthier, transport problems worsen. In the new millennium, congestion has come to be the defining feature of many cities worldwide. At the same time, transport is crucial to a more sustainable and more human urban future. This book discusses urban transport issues, policies, and initiatives in 12 of the world's major emerging economies—Brazil, China, Colombia, India, Indonesia, Iran, Mexico, Nigeria, Russia, South Africa, Turkey, and Vietnam—countries with large populations that have recently experienced large changes in urban structure, motorization, and all the associated social, economic, and environmental impacts in positive and negative senses (Fig. 1.1). It documents the worsening transport crisis and differences among these countries in their urban transport and land-use systems. The book contains in-depth chapters on each of these 12 countries, focusing on one or more major cities per country. Although various studies have analyzed transport issues in individual cities in these countries, no comparative account of the situation across all these countries has been compiled. This book aims to fill a gap in the transport literature that is crucial to understanding the needs of a large portion of the world's urban population, especially in view of the southward shift in economic power.

"Emerging economies" are grouped in various ways by think tanks, investment firms, and international organizations. Among the most well-known groupings are

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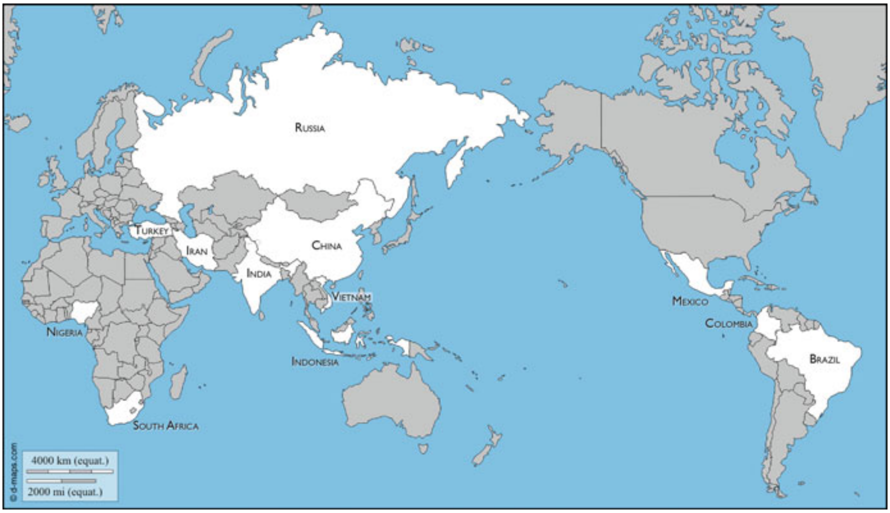

Fig. 1.1 Countries included in this volume. Map source: d-maps.com

BRICS, MINT, MIST, MIKTA, CIVETS, VISTA, G-20, and N-11.[1] The dozen countries included in this volume do not have a catchy acronym but they do share a range of characteristics (as well as representing the characteristics of their regions). They all have: (a) large and relatively young populations; (b) large cities (including megacities) and/or recent trends in rapid urbanization; (c) rapidly growing economies; and (d) high levels of transport-related externalities such as pollution, accidents, and congestion. Table 1.1 summarizes key data on the selected group of countries, compared to the European Union and the United States. In terms of urbanization, economic growth, and environmental outcomes, there is substantial variety within the group (see also McGranahan and Martine 2014 on the variety within the BRICS).

In the case of Brazil for example, the past three decades have seen the country become much more urban but, until recently, not necessarily much wealthier. The country has had a history of passive resistance to urbanization and urban population growth. However, overt attempts to curb the rapid growth of cities have failed, and the growth in the low income urban population (originating in rural areas) has largely been unplanned. Brazil's favelas and related inequalities have been a legacy of this. On the other hand, recent decades have seen important urban experimentation in

[1] BRICS = Brazil, Russia, India, China, South Africa; MINT = Mexico, Indonesia, Nigeria, Turkey; MIST = Mexico, Indonesia, South Korea, Turkey; MIKTA = Mexico, Indonesia, Korea, Turkey, Australia; CIVETS = Colombia, Indonesia, Vietnam, Egypt, Turkey, South Africa; VISTA = Vietnam, Indonesia, South Africa, Turkey, Argentina; G-20 = Argentina, Australia, Brazil, Canada, China, France, Germany, India, Indonesia, Italy, Japan, Mexico, Russia, Saudi Arabia, South Africa, South Korea, Turkey, UK, USA; N-11 (Next 11) = Bangladesh, Egypt, Indonesia, Iran, Mexico, Nigeria, Pakistan, the Philippines, Turkey, South Korea, Vietnam.

Table 1.1 Key characteristics of the case study countries

Country	Total population, 2013 (million)	Urban population, 2013 (million)	Urban population, 2013 (%)	Urban population growth 1990–2013 (%)	GDP per capita, 2013 (current $)	GDP per capita increase 2000–2013 (current $)	Passenger cars, 2011 (per 1000 people)	Passenger cars increase 2000–2011 (per 1000 people)	Road sector energy consumption, 2011 (% of total)	Air pollution, PM_{10} levels ($\mu g/m^3$)
Brazil	200	170	85	11	11.208	7.514	179[a]	45	25	36
China	1.400	720	53	27	6.807	5.858	54	47	6	82
Colombia	48	37	76	8	7.826	5.322	53[a]	7	25	53
India	1.300	401	32	6	1.499	1.042	11[a]	5	18	27
Indonesia	250	130	52	22	3.475	2.685	39	25	7	100
Iran	78	54	69	13	4.763	3.227	113[b]	95	17	47
Mexico	122	96	79	7	10.307	3.726	195	93	19	115
Nigeria	174	88	51	16	3.010	2.633	31[c]	21	27	46
Russia	144	107	74	1	14.612	12.840	233[a]	94	7	150
South Africa	53	33	63	11	6.618	3.598	112[d]	24	7	27
Turkey	75	55	73	14	10.946	6.726	110	41	11	40
Vietnam	90	29	32	12	1.911	1.477	14[c]	n/a	12	65
European Union	507	377	74	4	34.240	16.772	477	62	23	18
United States	316	262	83	8	53.143	16.676	403	–70	18	69

Source: World Bank, http://data.worldbank.org/indicator

[a]2009

[b]2008

[c]2007

[d]2010

participation and empowerment, which have begun to address some issues of inequality.

In Russia, the demise of communism and the liberalization of its markets were followed by a period of economic decline before starting to grow again in the late 1990s. Being a much more urban country than the others included in this volume (e.g., China and India), Russia was unable to use urbanization as a tool of economic transformation and has undergone wrenching political and social shocks. Other factors, including the unfavorable locations of many of its cities, have meant that the country's economic growth has not been as rapid as in other parts of the world where new, technology-based industries are stronger.

India has experienced "reluctant" urbanization. The country has aimed to emulate China's economic success through industrialization while trying to avoid rapid urbanization. As such, it has also put a brake on rapid economic growth to a degree. The restricted growth policy does not bode well for new urbanites who are trying to establish a secure place in India's cities.

In China, cities have been the main centers of economic growth. The country's leap has typically been ascribed to the liberalization of the economy, which began in late 1970s. However, another important factor is that China has also been one of the few countries to encourage urbanization, using cities as places of experimentation and change, albeit with high social and environmental costs.

South Africa's road to economic growth has been bumpy. The country has suffered socially as well as economically from its past racist anti-urbanization policy—apartheid. It is still searching for ways of transforming its cities from their overly fragmented forms.

As for the urban and transport developments in these countries, they have generally followed a similar path but they are far from identical. Shared trends include: (a) dynamic urban development processes, led mostly by the private sector, with high construction levels; (b) extensive urban sprawl, including peri-urban slums or decaying large housing estates and middle and upper class suburbanization; (c) increasing social segregation (e.g., gated communities for the rich and the middle classes); (d) rapidly growing motorization; (e) inadequate public transport systems; (f) chaotic traffic patterns, with high car and motorcycle use, and high environmental pollution; (g) poor pedestrian and cyclist infrastructure; and (h) informality, inefficiency, and/or corruption in the formal planning system.

In some ways, these trends are similar to those experienced earlier by "developed" countries. For example, mobility has greatly increased but cities have sprawled so much that accessibility has fallen for much of the population, especially the poor and most vulnerable portions. Similarly, gains in speed (through motorization) have been offset by deconcentration of the population and increased travel times. Congestion is an obvious corollary of excessive travel demand relative to travel supply. Excessive travel not only results in congested roads, it also leads to excessive emissions, traffic accidents, and energy use (Pucher and Lefèvre 1996).

These problems are magnified in emerging economies due to the large size of cities and the frequent lack of resources to tackle the problems. Most of the cities discussed in this book have experienced transformations toward increasing automobile dependence. Unpleasant conditions for pedestrians, high levels of pollution, treacherous road crossings, unsafe conditions for pedestrians and cyclists, inadequate public transport, and incessant traffic jams are standard.

While there is a high level of dissatisfaction over the maladies caused by urban traffic, local traditions of public action are still weak in many emerging economies—often the legacy of poverty, totalitarianism, or colonialism. On the other hand, emerging economies have the potential for overcoming the urban devastation of automobile domination (Pojani and Stead 2015). Their cities are often sufficiently dense that public transport and bicycle travel could serve much of the population. Furthermore, many emerging cities still have a pedestrian culture and a substantial portion of carless households, who thereby feel that they have nothing to lose by removing automobile traffic in cities to improve the urban environment.

These and other issues are explored with an in-depth case study approach, rather than a thematic or historical approach. A few words about why we have chosen this methodology are in order. We adopt Cervero's (1998) view that, like any methodological approach, transportation-related case studies have their advantages and disadvantages. On the positive side, cases are contextually rich. Cases can illuminate complex, underlying social patterns and political dimensions that are difficult to convey through other approaches. They often resonate with politicians and the general public, something that scholarly works in the transport and urban planning fields all too often have failed to do. Elected officials often rely on anecdotes while arguing certain points, and their voters and constituents are more receptive to hearing about cases. While scholars tend to think in terms of variables (e.g., how do land-use trends affect modal splits over time?), politicians and laypersons think more in terms of stories (e.g., what do experiences in several places tell us about a phenomenon?). On the other hand, a danger with cases is that they are unique. Sometimes they are the result of specific circumstances and particular contextual settings. Therefore, there is the risk of overgeneralization from a single story (i.e., assuming that processes and outcomes in one place can be easily exported to another). For these reasons, all case studies in this book need to be carefully weighed in terms of what is, and what is not, generalizable and relevant (see also Flyvbjerg 2006; Stead 2012).

Although the focus of the book is on urban transport characteristics and policies, attention is directed to the socioeconomic and ideological causes that underpin these characteristics. Transport problems are determined in relation to the distinctive spatial patterns and characteristics of the cities. Clearly, the unique economic, political, and cultural circumstances in emerging countries can have significant impacts on their urban transport planning institutions and outcomes.

In order to present the case studies in a more comparable way, all chapters follow a common format. Each chapter covers the following set of issues:

- Urban land-use patterns and spatial structure
- Trends in transport use and mobility
- Urban transport problems
- Urban transport governance, decision-making, and financing

- Proposed urban transport solutions and implementation issues
- Other country-specific issues

The object of this framework is to help identify new explanatory factors that may be overlooked in research limited to single cities or nations. The chapters contribute to a better understanding of urban transport problems and policies in nations where development levels are below those of richer countries (mainly in the northern hemisphere) but where the rate of economic growth is often increasing at a faster rate than the wealthiest nations. The results of the comparative analysis are presented in the concluding chapter. By including cities and countries across all continents, the aim is to identify useful lessons on how to achieve urban sustainability goals across the globe.

Chapter 2, by Eduardo Vasconcellos, focuses on *Brazil*. The chapter discusses how public transport conditions have remained inadequate in most Brazilian cities while mobility policies clearly favor the use of the automobile through a series of subsidies and incentives. While the wealthy use cars, the urban poor are captive of an unreliable bus system, facing long travel times and discomfort on a daily basis. Negative transport externalities have escalated in larger cities. To provide more equitable, accessible, and sustainable urban transport, Brazil needs to overhaul its urban policies and practices. However, the outlook is discouraging for a number of reasons. The urban physical structure created in the last five decades, with substantial suburbanization, peri-urbanization, and sprawl, makes solutions unaffordable for many parts of society. Brazilian elites are strongly supportive of private transportation, whereas civil society organizations that advocate for change do not have yet sufficient political power to influence policy. The availability of cheap oil has reinforced Brazil's love of cars. Society's views on traffic safety are rather lenient. Inequity in urban transport is strongly related to the low level of "instrumental" and "political" education of the Brazilian people. The arena that offers the most opportunities for more immediate change is the support for environmental planning.

In Chapter 3 Yuan Gao and Jeffrey Kenworthy write about *China*. They show that the automobile has been a major shaping force in Chinese cities since the 1980s. Comparative data on Beijing, Shanghai, and Guangzhou provide a window into this process. The authors demonstrate how the nationally directed Chinese automobile industry provides a critical backdrop for why Chinese cities have become more oriented around the automobile. However, this motorization trend has been modified to some degree in recent years in favor of transit, walking, cycling, and electrically powered "lightly motorized" modes. The chapter concludes that Chinese cities, though undergoing major change towards the car (and motorcycle), have reached certain physical limits very rapidly whereby further motorization will be unsustainable, extremely polluting, and counterproductive economically and in many other ways. As such, Chinese cities are more likely to reverse their motorization trend through a major revival of high-quality transit, especially rail, and a rediscovery of their hitherto dominant nonmotorized modes, rather than capitulating further to the car.

The situation in *Colombia* is discussed by Darío Hidalgo and Juan Miguel Velásquez in Chapter 4. Their contribution shows that private motorization experienced a great surge following rapid economic growth. However, in the last few decades, the national government has been supporting large cities in developing transit in Bogotá. An internationally renowned Bus Rapid Transit (BRT) system, Transmilenio, has been created. This initiative and other transit projects have yielded major socioeconomic benefits, reducing costs, travel times, accidents, and emissions. However, key challenges remain, including the competition between paratransit and motorcycles with formal public transport and the financial solvency of public transport operators.

Chapter 5, by Sujaya Rathi, considers the case of *India*. Her chapter illustrates that poor transport conditions can thwart the country's economic development efforts and pose a serious threat to the sustainable growth of its urban areas. Indian cities are now facing severe congestion, deteriorating air quality, energy insecurity, and increasing incidence of road accidents. With the urban population projected to double in the next generation, the situation is likely to worsen substantially unless profound remedial measures are taken.

Chapter 6 on *Indonesia*, by Yusak Octavius Susilo and Tri Basuki Joewono, focuses on the Jakarta Metropolitan Area—a region which has "exploded" in terms of population, economy, and motorization. Its transport problems are staggering. While many plans and policies have been designed to alleviate these problems, they have not been implemented or, if implemented, they have met with very little success. Limited human and financial resources have constituted a major barrier. Other major obstacles have been: a capital-intensive road engineering approach focused on easing congestion for car drivers; a concern with short-term mitigation rather than future visioning; a lack of institutional coordination, which could lead to joint transport and land-use development; an ingrained passivity on part of local and regional administrators; an insufficient amount of research into the travel behavior and activities of local communities; and a low commitment to transport sustainability on part of politicians. On the positive side, the newly constructed bus rapid transit system, TransJakarta, serves a substantial number of users, and a new rail system is currently under construction. Internet-based and flexible travel sharing modes have appeared which are proving popular with users but have yet to be formalized and integrated into the existing transport system.

Chapter 7 focuses on *Iran* and is authored by Ali Soltani. His account highlights that the country's vast oil reserves pose a particular challenge to the development of cities in a more sustainable way. There is little order in the way different land uses are arranged across the Iranian urban landscape. Most big cities have vast tracts of informal, inadequate housing, their transport networks are filled to capacity, and road congestion from cars, motorcycles, and trucks is intolerable. Air pollution in larger cities such as Tehran, Isfahan, Shiraz, and Ahwaz presents a serious threat to public health. At the same time, a considerable share of people cannot afford a car and depend on public transport, walking, and cycling to reach their destinations. Most contemporary development, as opposed to traditional development, is very car-oriented because fuel is so cheap.

In Chapter 8, Priscilla Connolly writes about *Mexico*. Her chapter provides an overview of the transport systems available in Mexico City and the quality of mobility they provide. The chapter focuses on spatial injustices generated by a city increasingly geared towards car use by a minority. The author expresses profound skepticism regarding the effectiveness of recent mobility policies for either reducing automobile dependence or improving transport conditions for the masses. Certainly, there have been some advances in nonmotorized mobility infrastructure in central areas, but these have mostly benefitted the higher income residents and tourists. New bus rapid transit routes often offer safer and more comfortable journeys although these are both less flexible and more expensive than the paratransit they replace. The expansion of high-capacity transit towards the outskirts has been fraught with technical and financial difficulties, as well as leading to urban growth into areas that are vital environmental resources for the city. Meanwhile, the public sector is committed to building more and more urban highways, many with access restricted to those who can afford to pay. Above all, the government's capacity to change transport provision is limited by the interests vested in maintaining the status quo.

Chapter 9, by Roger Gorham, considers *Nigeria*. The chapter illustrates that urban transportation policy is a great challenge not least because local governments often lack technical capacity to manage noncompliant, atomized, yet politically powerful private-sector transport service providers. This struggle takes place amidst very high demand growth for services, limited capacity of riders to pay for services, rapid expansion at the urban fringe, and high rates of motorization often involving second-hand vehicles imported from elsewhere in the world. This chapter examines these common pressures as they affect Nigerian cities. It also tries to capture a range of further stresses on the urban transport situation that are uniquely Nigerian, including: the residual effects of a long-standing policy of petroleum subsidies; the policy choice in the 1970s to create a new greenfield political capital and the urban travel patterns that have resulted; inconsistent—and at times incoherent and ill-advised—efforts by the federal authorities to get involved in urban transport; the recent impacts of growing political divisions and tensions within the country—between oil-rich and oil-poor regions and between north and south; and the growing specter of terrorism across the country, particularly in the north.

Chapter 10, by Jen JungEun Oh, discusses the situation in *Russia*. This chapter assesses the current condition and performance of urban transport systems in large- and medium-sized Russian cities. Since the demise of communism, and the establishment of a uniquely Russian form of capitalism, the cities of Russia have undergone critical economic and social changes. These affect the performance and condition of their urban transport systems. While the population of most large cities in Russia has remained relatively stable, the number of private cars per capita has increased rapidly, generating a demand for urban mobility which is increasingly difficult to meet. The transition to a market economy has introduced new private actors in urban land development, an area which used to be the sole responsibility of local governments. The traditional static command-and-control type master plans are becoming increasingly unworkable. A similar transition has occurred in the provision of public transport services. Private bus operators have entered the market to fill the service shortage left by publicly owned bus companies but have been plagued with financial difficulties and operational inefficiency.

In Chapter 11 Fabio Todeschini and David Dewar write about *South Africa*. This chapter illustrates that there are strong similarities in the characteristics of transport systems in South African cities as well as a few notable differences. The case of Cape Town is used in this chapter to demonstrate the general characteristics and reference is made to other cities in order to highlight major differences where they exist. In Greater Cape Town, the disciplines of spatial planning and transportation planning continue to be pursued in virtual isolation from each other. Without serious change in the situation, the authors see little chance of achieving radical improvements in urban performance. Although it is now 20 years since the achievement of democracy and majority rule, South African cities remain as inequitable, unjust, inefficient, and unsustainable as ever. As levels of poverty and inequality increase with economic globalization and increasing structural unemployment, the cost imposed by the structure and form of the cities is biting deeply into household budgets and life opportunities.

In Chapter 12 on *Turkey*, Ela Babalık Sutcliffe shows that, while urban transport issues are high on the political agenda of all Turkish cities, regardless of size, policies do not always address the needs of the population. Growing urbanization and sprawl have resulted in much higher mobility demand. Responding to this demand requires major restructuring and modernization of public transport services, improvement and development of nonmotorized modes of transport, and effective control of motorization. Instead, the public sector tends to invest in costly urban rail systems while overlooking bus services and nonmotorized modes. Policymakers are reluctant to restrict or manage automobile use. On the contrary, in an effort to modernize the country and highlight its growing economic power, major investments in road projects have taken place, which propel more travel by automobile.

Chapter 13 is written by Du T. Huyn and José Gómez-Ibáñez and discusses *Vietnam*. Their account reveals that Vietnam's two major cities, Hanoi and Ho Chi Minh City, have been struggling with increasing congestion since the economic reforms of the early 1980s. One of the key causes has been massive rural-urban migration. As a consequence, many residents have adopted the motorcycle as the solution to their mobility problems. Virtually every adult now owns a motorcycle with significant impacts on congestion and health. Efforts to reduce motorcycle use by improving public bus service have not been very successful, in part because public officials have been reluctant to give buses priority in mixed traffic but also because the dispersed pattern of trips is difficult to serve with public transport. Both cities have begun to build rail transit systems but their high costs limit their coverage and ridership. The authors contend that urban transportation planners should seriously consider the prospect that car ownership will soon expand rapidly as incomes continue to grow and, in that context, motorcycles may be more attractive than conventional wisdom suggests.

In Chapter 14, the book's editors, Dominic Stead and Dorina Pojani, set out their *Conclusions*. This chapter presents a comparative overview of the case studies, and identifies some of the common issues, trends, and policy measures which emerge from the previous chapters. The chapter also considers what kind of lessons can be learned from these countries and to what extent they may be generalizable and applicable in other contexts across the world.

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Chapter 2
Brazil

Eduardo A. Vasconcellos

Capital city	Land area	Total population	Urban population	GDP per capita	Passenger cars
Brasilia	8,511,965 sq. km	200 million	85% (170 million)	$11,208	179 / 1,000 people

Data source: World Bank
Maps source: d-maps.com

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1 Introduction

Starting in the 1930s, the Brazilian economy and society embarked on a major transformation from agricultural to industrial. As a result, cities in the southern states, where most industries were located, began to expand at high rates. Between 1950 and 2000, the urban population ballooned from 19 million to 161 million (80 % of the total). Thus Brazil turned into a highly urbanized nation. The pace of urbanization was particularly fast between 1960 and 1980 and resulted in 48 million additional people in the nine largest metropolises (Table 2.1).

Due to low investments in education and large differences in the power to influence public policy, Brazilian society became highly unequal, with most people living in precarious conditions and a small elite living in affluence. Income gaps between social classes became wider, and important improvements in public services did not favor those who most needed them.

For a long time, Brazil faced economic turbulence, GDP fluctuations, and middle to high inflation rates. These had an enormous impact on the livelihood of the poor and on society as a whole. In the 1990s, for the first time in the modern history of country, the *Plano Real* (real plan) managed to bring inflation under control, which subsequently allowed for important changes in urban and transport policy to occur.

In the 2000s, when the political left wing won the presidential elections, a mix of new social policies and a highly favorable international economic environment allowed the national government to provide extra monthly assistance to those in dire living conditions (about 40 million people) and a significant and permanent increase of the minimum salaries received by most workers. These two changes produced a dramatic shift in the internal market. Many people were now able to consume basic goods which were never available to them before. This also led to an increase in automobile use by the lower income portions of the population, as well as the advent of a new private transport mode: the motorcycle. Transportation-related negative externalities—pollution, congestion, traffic accidents, and urban disruption—escalated in larger cities. Due to Brazil's deep social, political, and economic disparities, the negative impacts of urbanization and motorization were unequally distributed, with the poor carrying a disproportionate burden. Their burden was made heavier by policies that supported the use of cars and motorcycles and neglected nonmotorized and public transport modes.

Table 2.1 Population increase in the nine largest Brazilian metropolitan areas (1950–2010)

	1950	1960	1970	1980	1990	2000	2010
Population (millions)	7.9	15.3	23.8	34.1	42.2	49.5	56.3
Increase index	100	194	302	432	535	627	714
Annual rate of increase (%)	n/a	n/a	6.6	4.4	3.0	2.4	1.6
Increase in population since 1950 (millions)	n/a	7.4	15.9	26.2	34.2	41.6	48.5

Note: Metropolitan areas São Paulo, Rio de Janeiro, Recife, Belo Horizonte, Porto Alegre, Salvador, Fortaleza, Curitiba, Belém. *Source*: IBGE (2009)

2 Urban Land Use Patterns and Spatial Structure

Brazil's intense period of urban growth led to the formation of several megacities and metropolitan areas. Urbanization and land availability brought about a large amount of sprawl. On average, the (virtual) geometric radius of the main cities grew by 2–5 times (Vasconcellos 2013). Due to inadequate land use regulations and enforcement, urban expansion was uncontrolled in most cases. Poor rural migrants could not find alternative accommodations other than (legal or illegal) fringe housing thus having to travel long distances on a daily basis.

For the most part, urban road systems expanded radially. Typically, new radial roads had four to six lanes and bus services were organized along them to transport peripheral workers. In wealthy areas, some freeways and expressways were also built to accommodate an increasing number of automobiles. New residential areas were laid out according to a standard grid pattern, with roads wide enough to support ever-growing automobile use. Excess road capacity was temporarily used as free parking space for car owners (still a small portion of the population). In the 533 Brazilian cities with more than 60,000 inhabitants, building extra road capacity costs $100 billion (Vasconcellos 2013).

In most large urban agglomerations, employment remained heavily concentrated in the historical centers, generating large unidirectional travel flows. In few cases, such as São Paulo and Rio de Janeiro, new financial or industrial employment hubs were established. In São Paulo, the role of the historical center began changing in the 1970s when a new financial district (along Paulista Avenue) managed to attract the most important business activities. In the 1990s, a third center located in the wealthiest part of the city (Berrini Avenue) housed the largest multinational companies, reflecting the ongoing globalization of the Brazilian economy. In Rio de Janeiro, while the historical center remains the largest employer, a distant high-income beachside district (Barra da Tijuca) has also become an important employment hub.

In several cities, new middle-class districts developed, with both large houses and new apartment buildings, and equipped with services appealing to this income group and its motorized lifestyle (e.g., supermarkets, international fast food chains). In some cases gated communities were built, especially in the southwestern part of the São Paulo Metropolitan Region (Alphaville) and in the Barra da Tijuca district in Rio de Janeiro (dubbed "Rio Miami"). Even the capitals of the most impoverished northwestern states, including Pernambuco, Ceará, and Alagoas, developed gated communities to accommodate an emerging middle class. In most cases, the residents of these communities became dependent on cars for transport. Typically, higher income groups lived in more central areas, which had much better provision of public services.

Meanwhile, the low-income settled in the urban peripheries, which had irregular sidewalks and roads, and poor water, sewage, and garbage collection systems. In some large cities, hilly areas were occupied, which were constantly under threat from severe landslides due to heavy summer rains. Thus the "favela" phenomenon—which had existed in Brazilian cities long before the urbanization process—reemerged. Favelas were characterized by substandard construction materials (i.e., cardboard or metal scraps). In some cases, such as in Rio de Janeiro, they were able to take over central areas, closer to work and service opportunities.

3 Trends in Transport Use and Mobility

3.1 Modal Share Trends

In Brazilian cities with more than 60,000 inhabitants, nonmotorized modes comprise 40 % of all trips while private and public transport account for around 30 % of the total trips each. Walking accounts for the most trips, followed by cars and buses. Bicycles, motorcycles, and rail have small shares of overall trips (Fig. 2.1).

Over recent decades, the modal share has been changing relatively slowly. However, automobile and motorcycle use have been experiencing increases. By 2005, the modal share of private motorized transport surpassed that of public transport. Meanwhile, nonmotorized modes, which have always served the largest part of the urban trips, have been decreasing in importance.

Going further back in time, data for the São Paulo Metropolitan Area between 1967 and 2007 show a clear pattern of decreasing public transport use and increasing private transport use (Fig. 2.2). The nonmotorized trip share increased in the 1970s and 1980s and then plateaued. A similar pattern was observed in other large Brazilian cities too.

The growth in motorization and car use is related to two parallel economic developments. First, in the 1950s, the political and economic elites decided to dismantle the rail networks and replace them with roads. The arrival of the first international automobile manufacturers in 1955 inaugurated a new era of support for the car. This mode began receiving a series of direct and indirect subsidies, including tax reductions, low licensing costs, free street parking, low gasoline prices, and pur-

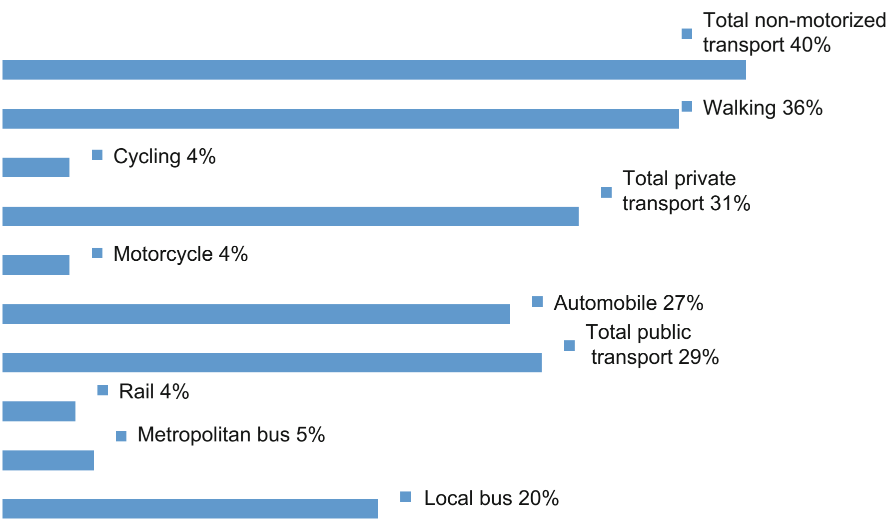

Fig. 2.1 Modal share (% of total trips), Brazilian cities with more than 60,000 inhabitants, 2012 data. *Source*: ANTP/SIMOB

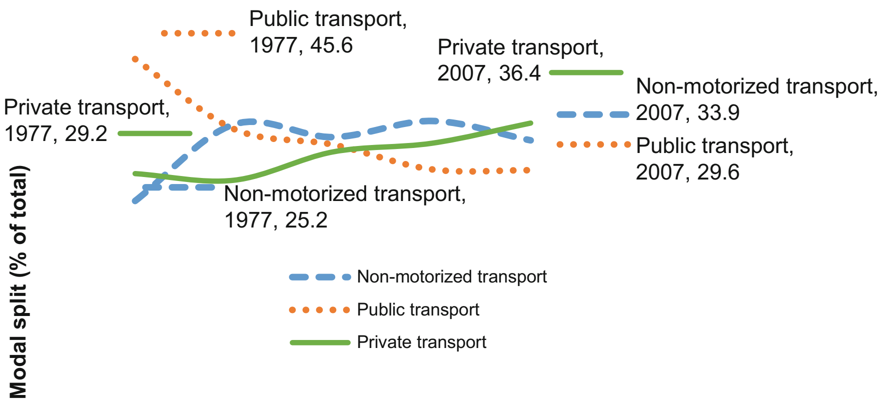

Fig. 2.2 Modal split trends in the São Paulo Metropolitan Region. *Source*: CMSP

chase credits (i.e., purchases in monthly installments for up to 7 years). Another key event was the manufacture of a low-cost compact car starting in 1993, which was sold with tax discounts and eventually took over the Brazilian market. Second, a conscious decision was made to favor the mass use of the motorcycle, which had only been a recreational vehicle for the very wealthy before the 1990s. Subsidies lowered its consumer price by 25 %. As a result, the motorcycle fleet grew from 1 million in 1992 to 20 million in 2013 (Vasconcellos 2013). The out-of-pocket cost for an urban trip of 9 km (the average in large Brazilian cities) became lower for car drivers and motorcyclists than for bus passengers. With such a bias in policies and investments, a shift to private transport was unsurprising.

The extreme variation in social and economic status translates into very different mobility patterns among population groups in Brazilian cities. Very low-income families are only able to make a few trips per day, mostly on foot or by bicycle and, when money is available, on public transport. Conversely, high-income families can make many trips to fulfill their needs. Among other factors, age influences mobility in a strong way: children and the elderly are less mobile than young- and middle-aged adults. Gender has an influence too, in the sense that men are more mobile than women in terms of motorized transport but the opposite occurs with walking. The São Paulo Metropolitan Area, the largest in the country, is a typical example of the relationship between modal share and income (Fig. 2.3).

3.2 Public Transport

The tram and train systems which operated in several Brazilian cities in the first decades of the twentieth century were dismantled or abandoned between the 1930s and the 1970s (Orrico 1999). The two large systems of São Paulo and Rio de Janeiro were among the few that survived. However, these only provided low-quality

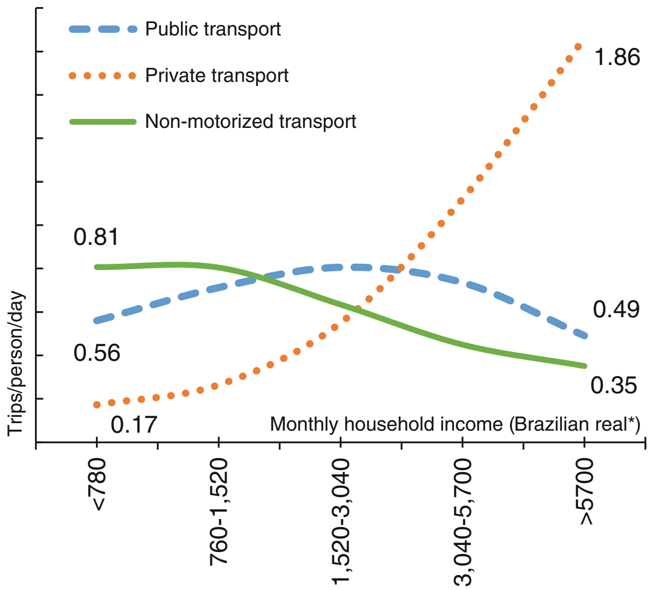

Fig. 2.3 Modal share vs. income, São Paulo Metropolitan Region, 2007. *Source*: CMSP. (*Asterisk*) 1 Brazilian Real equals $0.25 (2015)

services, which severely restricted the daily mobility of the poor living in peripheral areas. In Rio de Janeiro (the national capital until 1960), a number of massive demonstrations were organized to protest against the deplorable urban travel conditions, which were then suppressed by the military government.

Today, 14 Brazilian cities have rail networks in use (ANTP 2015). Only two of these networks, São Paulo's and Rio de Janeiro's, fulfill the technical definition of metro systems—with underground tracks and sophisticated operational controls. They were small relative to the size of the respective urbanized areas. The other metropolitan areas have low-quality railway systems built between the 1940s and 1950s. Exceptionally, the rail networks of Belo Horizonte, Recife, and Porto Alegre were upgraded in the 1990s.

Carless households avail themselves of bus services much more than rail service. Historically, the bus infrastructure has been limited to standard roads, where buses had to share space with automobiles and trucks. In the 1930s, when buses began to replace rail as a main urban transport mode, an assortment of vehicles was used. Bus services were mostly unregulated and provided haphazard services. In the 1950s—earlier than other Latin-American countries—Brazil started to regulate the bus industry. Individual operators of small vehicles came to be replaced by cooperatives and large formal enterprises—although minibuses still operate in favelas (Fig. 2.4). As a result, daily bus trips more than doubled in the largest cities between 1960 and 1990—from 14 to 38 million (Vasconcellos 2013). Bus fleets increased accordingly. In the 1970s, following the oil crisis, a few attempts were made to create exclusive

Fig. 2.4 Minibus service in a poor neighborhood in Belo Horizonte. Photo by author

bus lanes but most yielded poor results and were abandoned a few years later. Curitiba's high-profile Bus Rapid Transit system was an exception (see later).

Currently, all big cities have large, integrated bus systems. The high inflation rates of the 1960s and 1970s led to increasing bus fares, which affected most families. To aid bus patrons, an employer-sponsored transport voucher (*vale transporte* or *VT*) was introduced in the 1980s. Employees contribute with no more than 6 % of their salaries toward VT. However, informal workers, who constitute half of the Brazilian workforce, do not benefit from VT. Students receive fare discounts of 50–100 % in most cities and the elderly ride for free.

Despite these efforts, conventional bus patronage has declined since the late 2000s in the face of growing automobile and motorcycle use. As a result of ever-growing congestion and the travel demand generated by major sporting events (e.g., the FIFA World Cup in 2014 and the Olympic Games in 2016), several large cities are implementing a new generation of high-quality Bus Rapid Transit (BRT) systems, based on Curitiba's leading example. Rio de Janeiro and Belo Horizonte have made the most progress in this respect.

In Rio de Janeiro, two BRT lines have been inaugurated, the Transoeste and the Transcarioca, both of which cross large areas. Their introduction has considerably reduced passenger travel times (up to 60 %), as compared to regular bus services which run in mixed traffic (BRT Rio 2015). Daily demand on these corridors has surpassed expectations. In Belo Horizonte, the existing bus lanes in two major corridors have been transformed into high-standard BRTs lines (MOVE), with pre-board ticketing, digital information displays, elevated stations (level with the platform), and higher speeds.

3.3 Curitiba's Bus Rapid Transit System

Curitiba is capital of the state Paraná, 400 km southeast of São Paulo. Created in 1974, Curitiba's BRT system was a landmark not only in Brazil but also worldwide. It was seen as the first major transport innovation to emerge from a developing country, and it sparked a transport revolution. Many other cities were inspired to build their own BRT systems, including Bogotá in the 1990s. Curitiba's BRT now has 60 km of trunk lines, 300 km of feeder lines, 185 km of circular interdistrict routes (*interbarrios*), and 250 km of "direct" bus routes (*ligeirinhos*) which stop only at special "tube" stations—cylindrical structures made of steel and glass. Their futuristic design has done much to promote the system. The BRT is privately owned and operates without subsidies. It carries more than 1.5 million daily passengers—75 % of all weekday commuters (Fig. 2.5). This was achieved during a period of unprecedented population growth: from 300,000 inhabitants in the 1970s to 1.6 million in the city proper in 2000, and 2.3 million in the metropolitan region (Friberg 2000).

While remarkable, the BRT development in Curitiba had very little impact on other large Brazilian cities. Curitiba remained an isolated success story among several stories of failure to develop high-quality bus priority systems. For example, Porto Alegre, São Paulo, and Belo Horizonte built BRT corridors between 1977 and 1980. Campinas, Goiânia, Recife, and the São Paulo Metropolitan Region followed between 1985 and 1988. (The "ABD" corridor was built in the São Paulo Metropolitan Region, which crossed five cities.) After a long hiatus, Manaus, Fortaleza, and São Paulo implemented new bus priority schemes between 1999 and 2001. An additional corridor was created in Porto Alegre in 2004 and another one

Fig. 2.5 New, biarticulated buses in Curitiba. Photo by author

in Curitiba in 2009 (the “green corridor”). However, most of these corridors did not have fully segregated bus infrastructure and operation support. In most cases, they offered low-quality, irregular services, giving the BRT concept a negative image, which persisted for a long time.

A number of social, political, and economic factors explain the failures of other cities vis-à-vis Curitiba’s success. First, Curitiba’s civil society was active and had a long planning tradition, which was forged initially by European migrants who arrived in the twentieth century. The mayor at the time, Jaime Lerner, was not only a visionary architect but also a savvy politician. This prevailing culture was very different from other Brazilian cities. Second, Curitiba decided to build the BRT system while it was still a small city. As a consequence, the local traffic was mostly light and automobile users few. This helped avoid the sharp conflicts that arose in many other large Brazilian cities which attempted to prioritize buses by taking road space away from cars. Third, the strong linkages between local political forces and the dictatorial national government. This facilitated access to federal funds and ensured political support to the new system. However, current interest in high-standard BRTs has revived.

3.4 Nonmotorized Transport

Nonmotorized transport modes have never been taken very seriously in Brazilian transportation planning. No city can claim to have a high-quality sidewalk network and, while bicycles are heavily used in smaller cities (i.e., with up to 100,000 inhabitants), they have never received proper attention. Only a few cities, especially in the south, have invested in bicycle infrastructure—again due to the influence of European migrants. In the 1960s, pro-cycling movements spread to other parts of the country, gaining political support for the bicycle. However, cycling is still primarily seen as a weekend leisure activity for families rather than a daily commute mode. Nevertheless, several large cities now have bicycle lanes or bikeways, and these are expanding at a rapid pace (Fig. 2.6). At the same time, conflicts between cyclists and drivers and shopkeepers are increasing. The latter two groups oppose the creation of new bicycle facilities which take away parking lanes.

3.5 Automobile Use

Automobile fleets in urban areas became much larger during the economic boom of the 1970s. Purchases received another boost in the 1990s as a result of the federal actions in favor of cars, mentioned earlier. The motorization rate increased eightfold in just four decades: from 25 cars per 1000 inhabitants in 1970 to 200 cars per 1000 inhabitants in 2012. By 2009, more than half of the households had a car, a motorcycle, or both (IBGE 2009).

Fig. 2.6 Cycling lanes along major corridors in São Paulo. Photos by author

This motorization process was directly linked to the emergence of a new middle class with strong ties to the political dictatorship that ruled Brazil until the 1990s. Urban transport policies of this era (i.e., facilitating car purchases and building vehicular roads) were designed in such a way as to adapt Brazilian cities to the needs of the middle class. This process could be labeled as "the making of middle-class cities." Local elites were strongly supportive of other privatization reforms—in education, medical care, and leisure–adopted by the authorities, and a switch from public to private transport was the obvious next step.

Contrary to common beliefs, growing motorization in Brazil was not related to a need to establish social status but rather to a need to serve the numerous and diverse daily trips, which sustained the social and economic reproduction of the new middle class. A middle-class lifestyle would have been impossible using the existing low-quality and many unreliable bus services. Open and hidden subsidies for automobiles were obviously backed by the car industry, and encountered no major opposition by other social groups. Low levels of education and weak citizenship and political rights among the poor allowed the middle class to sway the public agenda in its own favor (Vasconcellos 1997a, b). However, public authorities were mistaken in their belief that road expansion would curb congestion and ensure free traffic flow. In São Paulo, the largest city, congestion worsened despite massive road investments: the length of congested roads in peak hours increased from 60 km in the 1990s to more than 300 km in 2010 (CET 2010).

3.6 Motorcycle Use

Throughout the 1980s, motorcycles were considered as an imported luxury good in Brazil. In the 1990s, new federal policies, including subsidies to build new motorcycle plants, facilitated the opening of a giant market for motorcycles in the country.

Fig. 2.7 Motorcycles along major corridors in São Paulo. Photo by author

Domestically produced motorcycles could be purchased at a quarter of the price of imported ones, and in up to 48 monthly installments. At such low cost, purchases skyrocketed. The fleet grew from less than 1 million vehicles in the 1970s to more than 20 million in 2013 (Fig. 2.7).

The support for the motorcycle industry grew due to three conditions. First, multinational companies perceived a large potential market in Brazil, which was untapped until the 1970s. Second, a wave of economic deregulation highlighted the role of free markets and small businesses in large cities. Third, given that a majority of the urban population could not afford automobiles, policies favoring motorcycles found strong support among the lower middle classes. Initially, motorcycles were used by poor urban youths looking for better-paid jobs. Eventually, the low-middle classes saw motorcycles as a way to escape their tiresome public transport commutes, or as a cheap delivery vehicle for their small businesses (the latter especially in São Paulo).

The growth in motorcycle traffic has had unfortunate consequences in terms of safety. Between 1996 and 2012, some 222,000 motorcyclists died in crashes and 1.6 million suffered some form of lifetime injury. In fact, the advent of motorcycles has had the most dramatic public health impact ever seen in Brazil. Such high fatality and injury rates are partly due to the inherent vulnerability of motorcyclists travelling alongside larger and heavier vehicles but also due to a lack of safety awareness programs (Vasconcellos 2013). Recent plans in São Paulo to improve safety by creating dedicated motorcycle lanes have failed to materialize. The challenge persists.

4 Urban Transport Problems

Some of the main transport problems in Brazilian cities include low-quality infrastructure for nonmotorized transport, unreliable public transport services, environmental pollution, congestion, safety, and inequality in mobility and transportation access.

Clear and comprehensive policies on sidewalk construction and maintenance are lacking. In cities, the responsibilities are fragmented. Owners of lots or buildings are responsible for the maintenance of sidewalks in front of their properties. However, since policy enforcement is weak or null, sidewalks are of poor quality and in some peripheral areas they simply do not exist. As a consequence, walking is often unpleasant or unsafe. Not only does this detract from the enjoyment of the city, it also represents a barrier to public transport access. Cycling is often unsafe as the roads are poorly paved and have no dedicated infrastructure for bicycles. Cyclists try to overcome the problem by riding on sidewalks.

Public transport services are unreliable and the vehicles become overcrowded in peak hours (Fig. 2.8). In large metropolitan areas, the poor are often subject to long walking and waiting times. Economic access is also difficult for a large portion of the population. Bus fares are high relative to incomes. In 2014, the cost of a typical monthly bus pass was around 17 % of the minimum salary in the country ($300). High inflation rates at various times pushed fares up to exorbitant levels, generating massive political protests. Security in relation to public transport use is also a problem, affecting women and the elderly more than others, especially in buses which serve the less safe neighborhoods. Women tend to avoid using buses at night or if a long walk is required to reach a bus stop.

Fig. 2.8 Peripheral bus stop in São Paulo. Photo by author

Informal settlements, favelas, have their own specific mobility patterns and issues. Among Brazil's largest cities, Rio de Janeiro has the highest concentration of favelas, most of which occupy central locations. In the last decades, favelas have increasingly come under the control of armed groups comprising both drug traffic cartels and "private police" selling protection to local residents. By the 2000s, these groups had virtually replaced the state in providing basic services and security. Violence and fear increased as a result. At that point, the government decided to reclaim these areas through a series of actions, including ostensive police interventions and sociocultural activities to liaise with local communities (through a process called "pacification").

In a large mobility study of "pacified" favelas in Rio de Janeiro, it was found that vehicle ownership varies by income, gender, and age (Koch et al. 2013). Overall, bicycles are the most common vehicles, owned by only 20 % of the households, followed by cars and then by motorcycles. Vehicle ownership is predominantly male-based. Motorcycle owners are mostly youth. Local trips within the favelas are almost always on foot—only 10 % of trips are made with a vehicle. When travelling outside their favela, residents generally ride public transport. Men use more motorized modes than women while the opposite is true in case of nonmotorized modes. These gendered patterns are typical in Brazilian cities in general.

Providing transportation access to favelas situated on hillsides is a challenge since these areas have narrow and winding roads, and are typically served only by motor-taxis and small vans. Following the example of other Latin-American cities, such as Medellin and Caracas, Rio de Janeiro built in 2011 a 4-km funicular line to connect the "formal" city to "Complexo do Alemao," a large hill taken over by small favelas. The project was based on reliable technology and provided a safe and comfortable transport option for people. One trip per day was free. Stations could be reached walking or via a motor-taxi ride. However, after 4 years of successful operation, the system started losing patronage as a result of increasing local violence related to drug trafficking. Most tourists and residents began to avoid riding the funicular. Consequently, plans to extend the system to other favelas were postponed.

Environmental pollution has become a serious problem due to the growing car use and the use of low-quality diesel by buses (i.e., with high sulphur content and high emissions of particulate matter). In all cities, private transport is responsible for the largest part of emissions (Fig. 2.9). For example, CO_2 emissions from private vehicles are more than 80 % higher than emissions from buses. Emissions of greenhouse gases have also increased steadily, paralleling the increase in automobile and motorcycle use. In the São Paulo Metropolitan Region, the concentration of pollutants is particularly high and frequently exceeds the limits posed by the World Health Organization (Cetesb 2014). Epidemiological studies conducted by the University of São Paulo indicate that each year about 8000 people die prematurely in region due to transport-related pollution. This morbidity rate surpasses that of traffic crashes, AIDS, and breast cancer (Vormittag 2013).

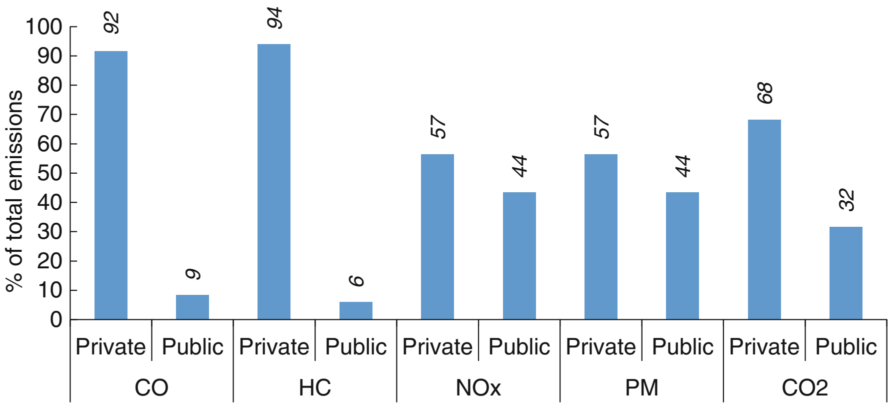

Fig. 2.9 Emissions and transport mode (São Paulo, Rio de Janeiro, Belo Horizonte, Curitiba, and Porto Alegre), 2007. *Source*: CAF (2010). *Note*: *CO* carbon monoxide, *HC* hydrocarbons, *NOx* nitrogen oxides, *PM* particulate matter, CO_2 carbon dioxide

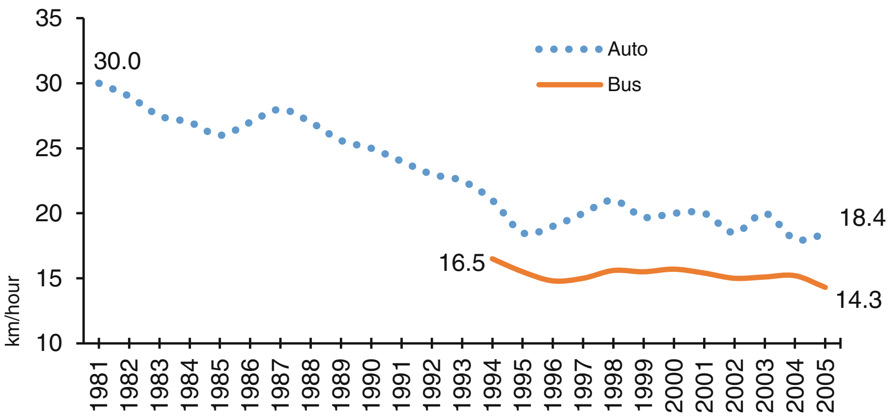

Fig. 2.10 Congestion on major arterial roads in São Paulo. *Source*: CET

Another major problem in large cities is traffic congestion. In São Paulo, the speeds of both automobiles and buses on main arterial roads have declined significantly in the past few decades (Fig. 2.10). It is estimated that São Paulo's congestion translates into 20–25 % higher bus fares (IPEA/ANTP 1998). Other large cities face a similar problem. The average bus speeds on arterial roads are now far below 20 km/h.

In terms of traffic safety, Brazil has experienced high fatality rates since the 1950s, when motorization began to grow rapidly. Currently, the number of fatalities

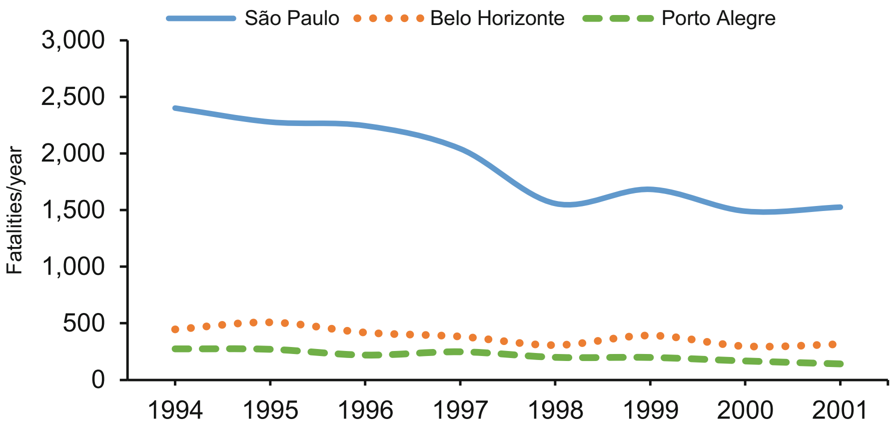

Fig. 2.11 Traffic fatalities in São Paulo, Belo Horizonte, and Porto Alegre, 1994–2001. *Source*: Vasconcellos (2013)

is around 30 per 100,000 inhabitants which is among the highest in the world. Between 1960 and 1990, a rate of 40,000 fatalities per year was reached, equaling the USA, a country where the level of motorization was ten times higher. In large cities the number of traffic deaths was exorbitant. In São Paulo, 3000 people died in traffic each year—the highest number among large cities internationally. Following the adoption of a new Traffic Code in 1997, fatalities abated only temporarily to increase again later with the upsurge in motorcycle use (Fig. 2.11).

In addition to a large numbers of vehicles on the roads, safety problems are exacerbated by poor and aggressive driving, low levels of fines for violators, unlicensed driving, weak enforcement of traffic rules, drink-driving, and poor road design. The chance that drivers at fault will be penalized is slim. Pedestrian deaths have become so commonplace that public opinion is often desensitized and dismisses the situation as "the inevitable cost of development," "fate," "God's wish," or just "caused by a few crazy drivers." Pedestrians have historically been the most vulnerable group, followed by motorcyclists, and automobile drivers and passengers. However, fatalities involving car users and, since the 1990s, motorcyclists have escalated while pedestrian fatalities have diminished (Fig. 2.12).

In addition, there is substantial inequality in transport and "mobility metabolism" between different income groups. For example, in São Paulo, high-income groups use eight times more road space and nine times more energy than low-income groups. Moreover, high-income groups emit 14 times more local pollutants and are responsible for 15 times more road accidents than low-income groups (Vasconcellos 2005).

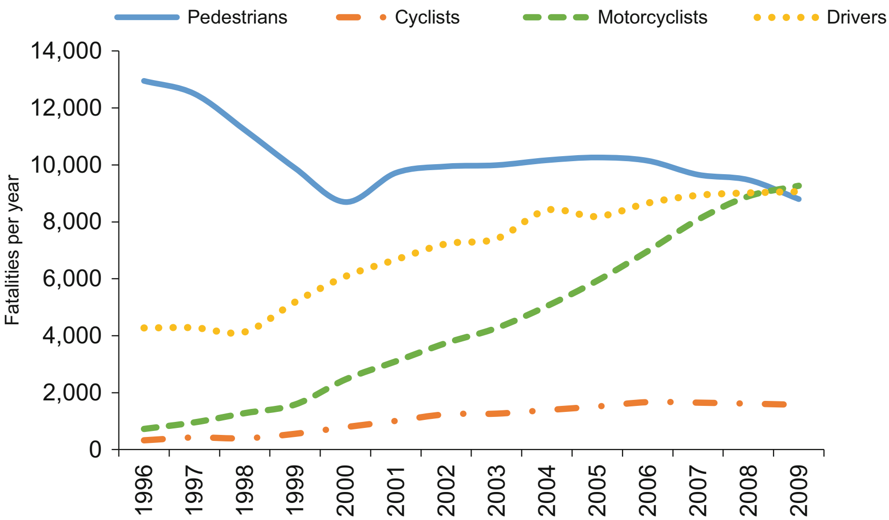

Fig. 2.12 Traffic fatalities in Brazil. *Source*: Vasconcellos (2013)

5 Urban Transport Governance, Decision-Making, and Financing

In Brazil, urban transport planning, public transport provision, and traffic management are primarily the legal responsibility of municipalities. Expenses are covered by the local budget. However, due to the enormous social and economic disparities in the country, many cities have minuscule budgets and cannot fulfill their transport-related tasks. Of Brazil's 5600 cities, only 500 have sufficient funds to provide an adequate urban transport system. As a result, they rely on financial help from the state and federal governments, which then leads to serious political implications. In the case of large capital investments (i.e., metros, suburban railways, and BRTs), all cities need financial support from upper levels of government. That is partly why mass transit infrastructure has developed quite slowly.

At the regional (metropolitan) level, political clashes are common. While metropolitan regions were formally created in the 1970s, the Brazilian Constitution does not confer them with decision-making powers. Only the federal, state, and municipal governments are empowered to make decisions and mayors have substantial authority within their cities. This means that metropolitan agencies, which are created by state governments, often face opposition from mayors who perceive them as encroaching on their jurisdictions. Under these circumstances, it is very difficult to reach long-term agreements on policy proposals.

In the 1990s, several legal instruments were introduced to support sustainable transport policies. However few of these had unequivocal positive effects. The most successful among these laws was a new and substantially revised Traffic Code which was adopted in 1997. The code reorganized all traffic-related administrative procedures and significantly raised the penalties for traffic violations. In addition, it transferred the power to manage local traffic from state governors to mayors, and paved the way for the creation of local traffic and transport departments. Nowadays, all large cities have their own human and technical resources to manage their daily traffic operations. Local inspectors are empowered to impose fines on violators. As a result of this code, traffic accidents declined sharply for a period but, as mentioned above, increased again later when motorcycles came onto the market.

In 2000, the City Statute, a new ambitious planning law, was adopted. For the first time cities were required to analyze the relationship and mutual impact of land use and transport while preparing master plans. However, only a few cities were able to achieve the political consensus, institutional coordination, and financing required to implement the law. Overall, the City Statute failed to generate real changes or act as a guide to urban development.

A year later in 2001, a new tax on the oil industry was introduced: CIDE (Contribuição *sobre a Intervenção no Domínio Econômico*). The idea was to use its revenues to reduce the environmental impacts of transport, subsidize fuel purchases, and build transport infrastructure. This tax generated a large amount of funds. However, funds were gradually diverted to the Department (Ministry) of Finance in order to cover debt payments to international financing agencies. CIDE was discontinued in 2012.

In 2011, a new Mobility Law was adopted, requiring all cities of more than 20,000 inhabitants to prepare mobility plans. The law defined how mobility plans should be designed and empowered cities to restrict excessive car use in their areas. It stipulated that all mobility plans must be prepared by 2014—a deadline which has now been extended. In the face of financial and technical constraints, few cities met this target. This experience revealed, once again, that this law, as with many others in Brazil, was based on unrealistic expectations.

6 Proposed Urban Transport Solutions and Implementation Issues

While the current travel conditions of most Brazilian urban residents are inadequate, several new developments might bring about some important improvements. For example, the historical neglect of pedestrians in transport planning has begun to change. Pedestrians are being formally identified as a key priority in new mobility plans. Brazilian society has begun to question why sidewalks and pedestrian signs and signals should be in such poor condition. Several nongovernmental organizations are campaigning for improvements. As a result, some new projects which normally would have ignored pedestrians now have considered their needs. Another important change is the public debate on who should pay for sidewalk construction and maintenance. Public opinion is increasingly in favor of assigning the public sector with the responsibility for building and maintaining sidewalks along main arterial roads and commercial streets.

Secondly, a country-wide movement in support of cycling has gained momentum. There have been hundreds of proposals in medium and large cities to introduce dedicated bicycle lanes (painted strips along the curb) or paths (physically separated from other vehicles). A number of nonprofit organizations have been very active in campaigning for change, organizing road safety training, and promoting collective events to gather public support. In both São Paulo and Rio de Janeiro, large cycling networks have been developed. It seems likely that they will soon expand in all major cities in the country. On the other hand, motorcycle use is still extremely problematic given the high incidence of fatalities.

Over the last 5 years, there have also been several proposals to implement bus priority schemes in most large cities. The proposed systems vary from basic curbside lanes to full BRTs, with the former being more common. The largest bus priority scheme has been created in São Paulo (300 km as of 2015) while the largest BRT system is under construction in Rio de Janeiro as part of the public improvements to host the 2016 Olympic Games. The introduction of São Paulo's bus priority scheme led to an average speed increase of 25 %. Meanwhile, in Rio's BRTs speed increases have been even higher. However, the strong differences in bus priority schemes must be considered. Systems with basic curbside bus priority lanes implemented in suburban areas tend to be very unreliable due to irregular traffic conditions in a congested environment. On the other hand, these more sophisticated bus systems (BRTs) tend to concentrate services on major corridors, and exclude unprofitable peripheries, constituting an "elitization" of bus services, which only serve central locations.

In terms of public transport more generally, it is crucial to tend to the needs of workers in the informal sector who currently do not benefit from vale-transporte vouchers. At the same time, a review of fare policies must take place since over 20 % of passengers are allowed to travel for free and more than 80 % receive some form of discounted fare (NTU 2005). In terms of service provision, buses need to operate with greater regularity. This could be achieved by more segregation of traffic on the road network. These roads must be well paved, free from illegal parking and not obstructed by automobile traffic if desirable bus speeds of around 20 km/h are to be achieved. These public transport upgrades could be financed through modest parking fees. Free curbside parking is currently the norm in many large cities. It is estimated that, in São Paulo alone, one million drivers park daily at no cost on public streets. Given the high number of drivers, even a small parking fee could amount to substantial annual revenues.

In the case of favelas and other slum neighborhoods, funicular transport could be very useful for providing access, especially in hilly areas. Another important investment here could be the enlargement and standardization of the existing narrow access routes. However, this would require economic compensation and relocation of some families, and is therefore likely to be controversial.

Reversing historical trend in traffic mortality is paramount. While the Traffic Code of 1997 introduced important changes that increased safety, the road environment is still of poor quality. Motorcycles traffic is chaotic, and walking and cycling are treacherous in most places. Bold measures are urgently required to lower motorcycle speed limits and separate motorcyclists from larger vehicles on fast roads. Addressing the safety problem more fundamentally requires the reappropriation of the urban space that has been taken over by automobiles. Clearly, strong political will is required for this to happen. Newly formed progressive social movements must exert political pressure in order to overcome the obstacles created by conservative experts and politicians.

Another effective measure to improve urban transport conditions would be to charge automobile users the full cost of the social and environmental damage which they cause and to eliminate subsidies for automobile use. However, a climate prevails in Brazil where the automobile is idolized as a superior consumer good. Limiting its use is anathema to politicians, the media, and middle- and upper-income residents, an attitude rooted in low levels of education, poor citizenship, and political weakness of carless individuals and families, who are unable to speak up in defense of their own interests.

7 Conclusion

Urban transport policies in Brazil clearly favor automobile use and have done so for some time. Nonmotorized transport has long been neglected, thus ignoring the needs of millions of Brazilians. In most places, public transport remains very poor. The poor are captive riders of unreliable bus systems, facing long commutes and discomfort. Transport-related externalities, including pollution, congestion, traffic accidents, and urban disruption, have escalated in larger cities. As the Brazilian economy grows, the demand for private transport will grow too, thereby exacerbating current problems. To provide more equitable, accessible, and sustainable urban transport, Brazil will have to radically overhaul its urban policies and practices. However, the outlook is discouraging, for a number of reasons outlined below.

First, the legacy of the urban physical structure formed in the last five decades is problematic. Uncontrolled low-density sprawl has led to large travel distances, which are not conducive to modes such as walking and cycling. Bus passenger loads are unbalanced as service demand is higher in poor urban peripheries. This increases bus operation costs beyond a point where they cannot be recovered through affordable fares. Those with more complex mobility patterns (i.e., the middle classes and the wealthy) cannot efficiently fulfill their travel needs without a car. Sprawl is likely to continue in the future due to urban land availability, weak land- use planning and enforcement, and a mass of poor urbanites in need of shelter.

Second, Brazilian elites are strongly supportive of private transportation—both the car and the motorcycle. Even the left-wing federal government in power since 2003 has continued along the same lines as previous governments. The incentives for cars and motorcycles have increased much further, relegating public transport to a secondary role. Civil society organizations that advocate change do not have yet sufficient political power to influence policy. While they voice their ideas loudly and firmly, the political establishment strives to maintain the status quo. It is conceivable that intolerable congestion in major cities may prompt transport reform but this has not happened to date.

Third, the availability of oil has arguably been responsible for Brazil's love of cars. Since the 1930s and up to 2006, oil was imported. Thereafter, an enormous offshore oil field was discovered in the Atlantic Ocean and the country will be able to extract and use much of the oil it needs. With total oil reserves greater than 30 billion barrels, there is very little motivation to limit car use from an oil scarcity perspective.

Fourth, society's views on traffic safety are rather lenient. Unlike environmental pollution, traffic fatalities are not yet recognized as a major problem and/or an unacceptable phenomenon by all social groups and classes (Meny and Thoenig 1990). Traffic safety is often considered as an abstract concept imbued with emotional, psychological, and religious feelings rather than a concrete policy area, which requires analysis and practical solutions.

Fifth, inequity in urban transport is strongly related to the low level of "instrumental" and "political" education of the Brazilian nation. The poor have not fully acquired citizenship status, in the sense of knowing their rights and responsibilities in a democratic society, participating in politics, and voicing their needs and interests. In addition, the very unequal income distribution limits the poor from fulfilling basic needs, including the use of public transport to access work. Improving educational outcomes and household economies to a visible level may take at least two decades.

The arena that offers the most opportunities for more immediate change is environmental planning. The international environmental movement has already influenced some decisions on mobility in Brazil and the environment is continuously discussed by the media and local nonprofit organizations which have recently grown stronger. However, they still need to gain additional political leverage in order to have deeper impact on high-level policies.

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Chapter 3
China

Yuan Gao and Jeffrey Kenworthy

Capital city	Land area	Total population	Urban population	GDP per capita	Passenger cars
Beijing	9,596,960 sq. km	1,400 million	53% (720 million)	$6,807	54 / 1,000 people

Data source: World Bank
Maps source: d-maps.com

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1 Introduction

China has been undergoing a huge economic boom for several decades and by 2010 was the second major global economy (Barboza 2010). Between 1978 and 2013, the disposable income per capita in China skyrocketed, experiencing more than a 50-fold increase (NBSC 2014a). Besides the growing economy, a package of national and municipal incentives increased the prosperity of the Chinese car industry. In 2009, China overtook the United States as the giant of the global automobile market through three auto-encouragement policies[1] when the United States went through a precipitous tumble in 2008 due to the global financial crisis (Ferrazzi and Goldstein 2011). China's rise to ascendency in the global automobile market has seen the proportion of cars produced in China grow from 0.4 % in 1958 to 55 % in 2013.

As a powerful and relatively new automobile player in the global economy, China's expanding clout has attracted worldwide attention. However, it is simultaneously in the throes of negative impacts, both socially and environmentally, from having too many cars packed into urban areas that were not designed for them, but for nonmotorized modes instead (Figs. 3.1 and 3.2). This trend, combined with burgeoning urbanization, which has witnessed China's urban population increase from 26 % of the national population in 1990 to 55 % in 2014 (NBSC 2015a), creates major urban management and air quality problems for Chinese cities, especially its influential megacities such as Beijing, Shanghai, and Guangzhou.[2]

The cities of Beijing and Shanghai are directly controlled municipalities under the national government. Beijing, the capital, whose population has grown at a very rapid rate from 10.4 million in 1990 to 21.5 million in 2014 (Beijing Municipal Bureau of Statistics 2015), functions as the national center of politics, culture, and foreign relations. Shanghai serves as the national financial and economic hub and has also experienced massive population growth from 12.8 million in 1990 to 24.3 million in 2014 (Shanghai Municipal Bureau of Statistics 2015). Meanwhile, Guangzhou, the provincial capital of Guangdong and the most important port city for international trade, has undergone rapid growth from 6.8 million people in 1990 to 13.1 million people in 2014 (Guangzhou Municipal Bureau of Statistics 2015). In 2013, the cities of Shanghai, Beijing, and Guangzhou ranked as the top three in terms of Gross Regional Product across the whole of China (NBSC 2015b).

The trajectory of China's rapid urban growth, linked to an extraordinary rise in city expansion and urban motorization, has been accompanied by an equally severe rise in energy use, land consumption, and other problems. Specifically, China has overtaken the United States as the biggest energy consumer, accounting for more than 18 % of global energy consumption (Kennedy 2011). With regard to food security for a nation of nearly 1.4 billion people, much cultivated land has been

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[1] Plan for Automobile Industry Restructuring and Revitalization (2009) announced three auto-encouragement policies in response to the 2008 global financial crisis, including (1) Purchases Duty Preferential, (2) Bring Automobiles into Countryside, and (3) Car-Scrapping.

[2] See, for example, a new documentary entitled *Under the Dome*, concerning air pollution in China.

Fig. 3.1 Cars and motorcycles are difficult to accommodate in China's dense and space-constrained cities (Shanghai)

Fig. 3.2 Major public areas which were previously used for other functions such as footpaths, cycleways and social interaction are now taken over by cars, motorcycles and commercial vehicles (Zhengzhou)

developed for housing, roads, parking, and other urban uses as the pressure to accommodate China's soaring urban population and vehicle fleet has increased. Land around urban settlements is traditionally the most fertile and productive, and the long-term continuation of excessive land consumption for new urban areas (exacerbated by falling population densities) is not sustainable. From a global perspective, major increases in food import demands from a country of China's size would also be destabilizing for world food markets. The global competition for remaining conventional oil supplies has already shown potential for conflict. Global competition over food or water could have more severe consequences.

China has started making moves to face the challenges in meeting its responsibilities to weigh societal and environmental benefits against economic development in regard to the car industry and private motorization, particularly in megacities. This is not only beneficial for the inhabitants of the three megacities, but it also offers models of sustainable urban transport for other Chinese cities. Although China has been booming and continues to be the world's most vibrant economy, within the country, economic growth and urban expansion are by no means equal (Gao et al. 2013). More specifically, the coastal region including Beijing, Shanghai, and Guangzhou is much more developed than the western, northern, and middle areas due to a raft of national strategies adopted in the 1980s, which have privileged the coastal region.

As a result, the Chinese government is trying to foster more equitable development patterns across the country through its "West Region Development Strategies" (1999), "Revitalization of the Northeast Old Industrial Base" (2002), and "Central Rise" policy (2004)—strategies aiming to increase urban competitiveness based on enhanced economic, social, and environmental performance. There is the possibility that the early urban development and transportation lessons learned in the larger cities in the eastern parts of China during rampant motorization may be gradually applied when the other regions develop more.

2 Urban Land Use Patterns and Spatial Structure

Old Chinese cities featuring square or rectangular based dense urban forms, which generated the grid street network such as the *Hutong* in Beijing and *Longtang* in Shanghai, were traditionally built around walking, cycling, and other nonmotorized transport (Gao et al. 2015b) (Fig. 3.3). The employment system (referred to as *Dan Wei* in Chinese) in state-owned sectors provided employees with nearby housing as a part of work-related welfare and contributed to shorter commuting distances by foot and bike (Zhao et al. 2014). The typical "gated community" characteristic of such areas, with a mixture of residential, commercial, and recreational land use, also favored walking and bicycle trips for local residents to meet their daily demands.[3] From the beginning of the car industry up to as late as about the mid-1990s, Chinese

[3] As opposed to the typical western single-family detached housing model which consists almost exclusively of low density single story construction.

Fig. 3.3 The walking- and cycling-oriented Chinese city featured here rapidly gave way to motorcycles and cars (Kunming). Photo by Jeffrey Kenworthy

cities were the world's greatest walking and cycling environments and also had very high public transport use, mainly buses. The cities were extremely dense with intensively mixed land uses, and private cars were very uncommon. A vibrant and public urban culture prevailed.

In a very short space of time, particularly since the start of the twenty-first century, the automobile penetrated Chinese urban environments in a dramatic way, leading many Chinese megacities to develop substantial automobile-based land use. The resulting soaring housing costs and deteriorating air quality, along with the urbanization and motorization, pushed local residents to resettle in the suburbs, both voluntarily and involuntarily.

In this context it is remarkable that temporary residents migrate from rural areas or other cities to the urban center of megacities for more chances of jobs or better education for children, notwithstanding the worsening environmental conditions. Migrant workers tend to reside in migrant villages to avoid the unaffordable housing-related costs closer in.

Industrial suburbanization refers to the relocation of heavy-industry factories and newly constructed technology parks into the peri-urban areas. The cities sprawl outwards to the urban fringe along massive new roads. Congestion has dramatically increased as dependence on automobiles has grown, pushing travel times well beyond the typically accepted daily travel time limit (or Marchetti Constant) of about 65–70 min/person/day (Marchetti 1994).

In Beijing, the average traffic speed in core areas decreased from 45 km/h in 1994 to 12 km/h in 2003 (Peng 2004). The need to increase speeds has been a driving factor in the rapid development of Beijing's metro system. Five new subway lines have been built in Beijing's suburban areas since 2010. Meanwhile, Beijing continues a further outward expansion through the construction of highway loop roads. The Seventh Ring Road is currently under construction, while the Second Ring Road was completed in 1992 (Beijing Municipal Government 2015).

China is now looking towards urban public transport development to address its automobile-related problems. Its traditionally dense and linear form of urbanism has laid a good foundation for the growth of mass transit. The growth of rail transport with higher passenger carrying capacity and higher travel speeds has resulted in a slowing down of car use growth (see below). The future urban land use trends are likely to be based on a much stronger combination of nonmotorized modes and transit, which are the most sustainable for high-density Chinese cities.

3 Trends in Transport Use and Mobility

3.1 Bicycle-Led Urban Mobility (Late 1940s to Mid-1990s)

In the 1940s, when the population of China was 540 million, the total number of bicycles was around 0.5 million (Yang et al. 2014). Since the institutional transition from a command economy into a socialist market economy at the end of the 1970s, the Chinese bicycle industry entered a rapid period of growth, which peaked in the late 1980s (NBSC 2014b). China, which was widely acknowledged as the "bicycle kingdom" in the mid-1980s, experienced the prosperity of a bicycle-based society for many years. Over recent years, however, cycling has been on a dramatic downwards path. In the three megacities, there was a general decimation of bicycle trips from the mid-1990s onwards, and a continuous drop until 2012 (Fig. 3.4). In the 1980s, Beijing had a similar level of bicycle ridership to Shanghai, and higher than Guangzhou. In 1986, more than 60 % of daily non-pedestrian trips were made by bike in Beijing but this had plummeted to 14 % by 2012.

The relatively flat topography and agreeable northern Chinese climate in Beijing and Shanghai are part of the reason why bicycle trips are still favored by some local residents. Guangzhou, on the other hand, is mostly characterized by hilly terrain as well as a subtropical climate, which reduces the popularity of cycling.

Nationally, ill-advised attempts to tackle and alleviate the growing number of collisions between motorized and nonmotorized travelers have reduced the public willingness to ride bicycles. The lack of separation between cyclists and motorized vehicles has created potential threats to the safety of both cyclists and pedestrians. Unacceptable traffic behavior, in particular uncontrolled roadside parking, has damaged the connectivity of what were previously very good bicycle pathway systems in Chinese cities. The rights-of-way on the road for cyclists continue to be impaired because the designated bicycle lanes have gradually been eroded to cater for motorized transport (Fig. 3.5). The majority of Beijing's pedestrians regard walking environments as either unsafe or unsatisfactory (Pan et al. 2010).

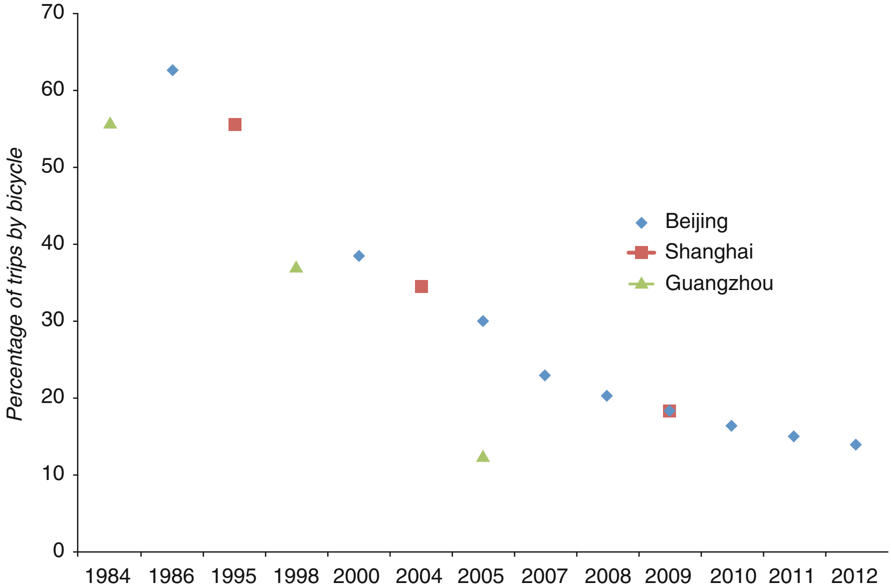

Fig. 3.4 Mode share of cycling (% trips by bicycle, excluding walking) in Beijing, Shanghai, and Guangzhou (1984–2012). *Sources*: Beijing Transportation Research Centre (2013), Deng and Xie (2000), and Lu and Gu (2011)

Fig. 3.5 Generous bicycle paths in Chinese cities have been rapidly eroded by expanded roads (Kunming). Photo by Jeffrey Kenworthy

The bicycle has experienced a dramatic change in fortunes in China, starting from the luxury status of bikes in 1897 when they were first officially imported into China (Esfehani 2003) and only available for the wealthy, to the cultural icon and must-have marriage property of the 1980s and 1990s. Towards the end of the twentieth century, however, bicycles and bicycling have been spiraling downwards in popularity across the nation, mostly since the mid-1990s. Bicycles have come to be seen as symbols of poverty and backwardness, as China has rapidly modernized and become an economic power. The situation has worsened dramatically since the start of the twenty-first century, when the era of private vehicles and private motorization radically accelerated. However, this position may be changing again under the weight of the severe problems generated by cars and traffic (see below).

3.2 Private Car-Led Urban Mobility (2000–2010)[4]

At the time that many developed cities stepped into the "peak car use" period (Puentes and Tomer 2009; Newman and Kenworthy 2011), there was a boom in the Chinese car industry with double-digit growth rates since the beginning of the twenty-first century (e.g., as high as 55 %). This was partly due to China's entering the World Trade Organization as the 143rd member in 2001 and the Tenth Five-Year Plan (2001–2005), which encouraged families to purchase cars (Gao et al. 2015a). In terms of private vehicle ownership per household (including cars, vans, and other private vehicles, but excluding motorcycles), there was a dramatic increase in the decade between 2002 and 2012, with an approximate growth rate of 37 % per annum. The three megacities have also experienced a continuous rise, in parallel with national development. Beijing has the highest level of private vehicle ownership, while Shanghai is lowest and closely reflects the national average (Fig. 3.6). Shanghai is the least private transport-oriented city in this sample, partly because of its long-standing and stricter restrictions on car ownership and use (see below).

With respect to private vehicle use, the proportion of daily trips by private motorized modes gradually increased along with the booming car industry and the decline of the bicycle culture. More recently, however, a few factors have helped somewhat mitigate automobile use at the municipal and national levels. These include the termination of three national auto-encouragement policies designed to help overcome the 2008 global financial crisis (MOF 2011a, b, c), the introduction of restrictions on private vehicle ownership and use (see below), and the preferential treatment in the national Five-Year Plans of urban public transport, especially urban rail transit since the Twelfth Five-Year Plan (2011–2015) (Peoples Congress of the People's Republic of China 2011).

[4] While vehicle ownership per hundred urban households has continued to grow beyond 2010 (Fig. 3.6), the more significant share of daily trips by private motorized vehicles (i.e., actual use of private vehicles) began to stabilize and decline around 2010 in Beijing, Shanghai, and Guangzhou (Fig. 3.7). It indicated an important change in orientation of urban transport in China, as developed in more detail later in the chapter.

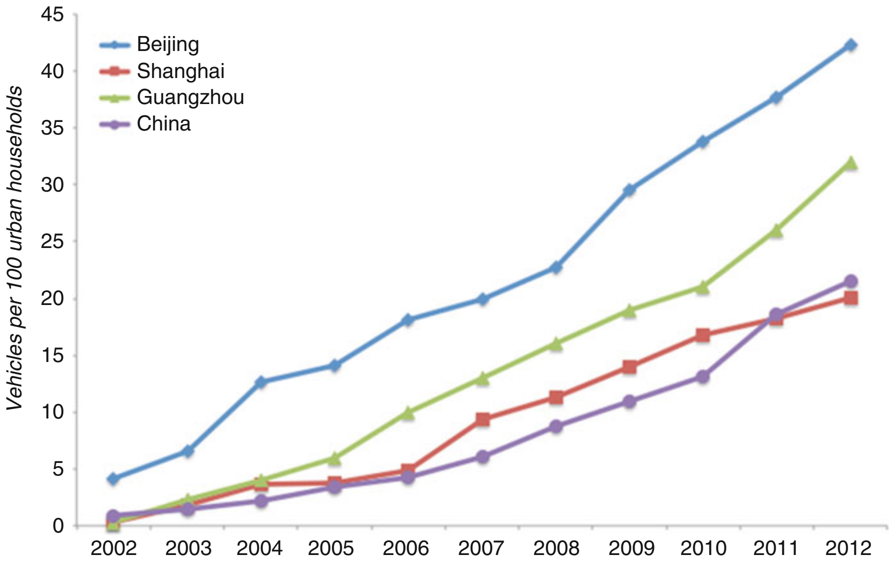

Fig. 3.6 Vehicle ownership (vehicles per 100 urban households) in 2002–2012. *Sources*: NBSC (2012) and Guangzhou Municipal Bureau of Statistics (2012)

The share of total daily motorized trips by private vehicles stabilized or experienced decline since around 2010 in Beijing, Shanghai, and Guangzhou (Fig. 3.7). Compared to automobile-dependent cities in the West, which generally have 80–95 % of total daily trips by private motorized transport (Kenworthy 2014; Newman and Kenworthy 2015), these Chinese cities actually had quite a low share of private motorized trips (40–45 % or even lower if walking and cycling trips are included). In other words, notwithstanding the prosperity of the Chinese car industry, major Chinese cities are far from what could be termed "car dependent," even though their road systems may be "saturated" with cars.

3.3 Rail Transit-Led Urban Mobility (2011–the Present)

The modal split changes in cycling and private vehicles have generated numerous problems such as traffic gridlock, atmospheric pollution, and unpleasant public space as most of the urban fabric was simply not designed around the car. The situation facing Chinese cities has become a major topic of local and global concern (Pucher et al. 2007). As a result, China is in a process of transition from unquestioned support for the car industry, towards prioritizing the development of urban public transport, especially metro systems within cities (Fig. 3.8) and high-speed rail lines between cities.

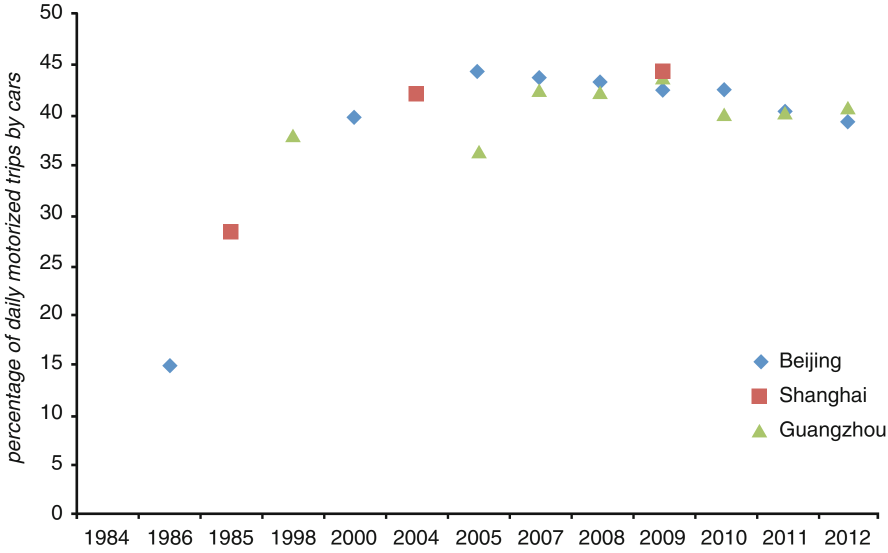

Fig. 3.7 Modal share of private vehicles (percentage of total daily motorized trips) in Beijing, Shanghai, and Guangzhou (1984–2012) (The data for Beijing and Shanghai have been recalculated to exclude walking and cycling in order to match the Guangzhou data. Therefore, the share of car trips appears artificially high). *Sources*: Beijing Transportation Research Centre (BTRC) (2013), Deng and Xie (2000), and Lu and Gu (2011)

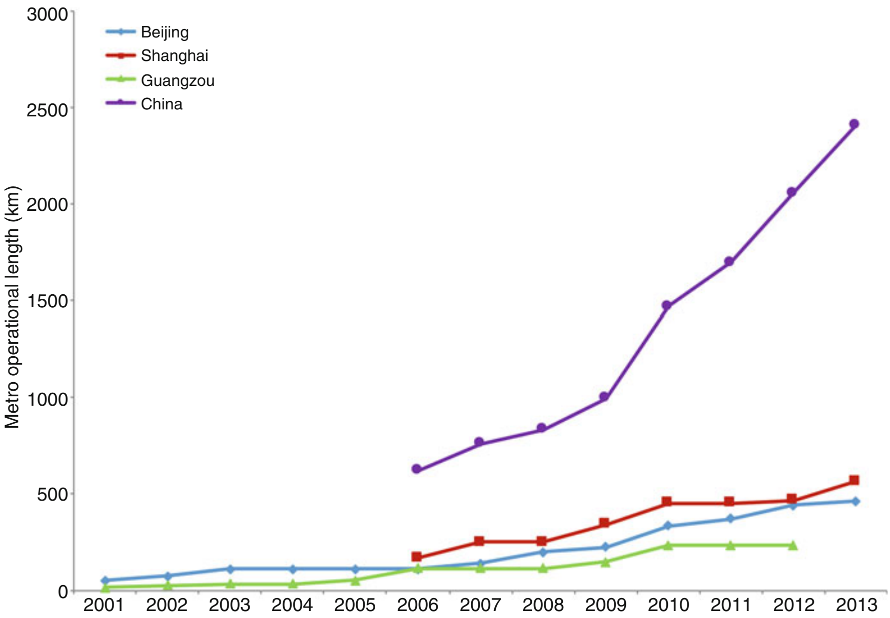

Fig. 3.8 Development of national and municipal metros systems (length in km). *Sources*: BTRC (2013), Guangzhou Transport Planning Research Institute (GTPRI) (2012), and NBSC (2013a)

Chinese urban rail transport started in 1969 in Beijing for military defense purposes (Strickfaden and Devlieger 2011). By 2014, 95 metro lines had come into service in 22 cities (China Association of Metros 2015). Beijing's rail transit commenced commercial operations in 1981 but developed slowly for some years because of political and technological constraints. In the early 2000s, its operational length and annual patronage rose steeply, particularly from around 2007. Beijing's subway is now the second longest in China after Shanghai.

Shanghai first opened a metro line in 1993 (the southern section of Line 1, only 4.4 km long). By 2014, the city had 15 metro lines (including the Transrapid or Maglev Train, a magnetic levitation train), totaling 578 km (643 km of urban rail transit in total). Shanghai now has the longest metro system in China and the third biggest metro system in the world, all developed in the space of two decades. The proportion of journeys by metro has risen from a mere 2 % to nearly 40 % over this period. In 1995, the new metro system catered for 230,000 trips per day which rose to a staggering 6,870,000 per day by 2013—a 30-fold increase. The bus is still the dominant public transport mode in Shanghai, but its share and daily patronage has shown a significant fall over the 18-year period as the metro has taken over (Fig. 3.9).

The city of Guangzhou launched its metro system in 1997 as the fourth Chinese city after Beijing, Tianjin, and Shanghai. By the end of 2014, its metro system ranked the third longest and busiest nationally. There were no newly built metro lines in Guangzhou from 2010 to 2012, but its patronage still increased 10 % compared to the 9 % decrease in regular bus transit during the same period (GTPRI 2012). Its urban rail transport operational length per 10,000 persons came last in comparison with its two other mainland rivals and was only about half of the Hong

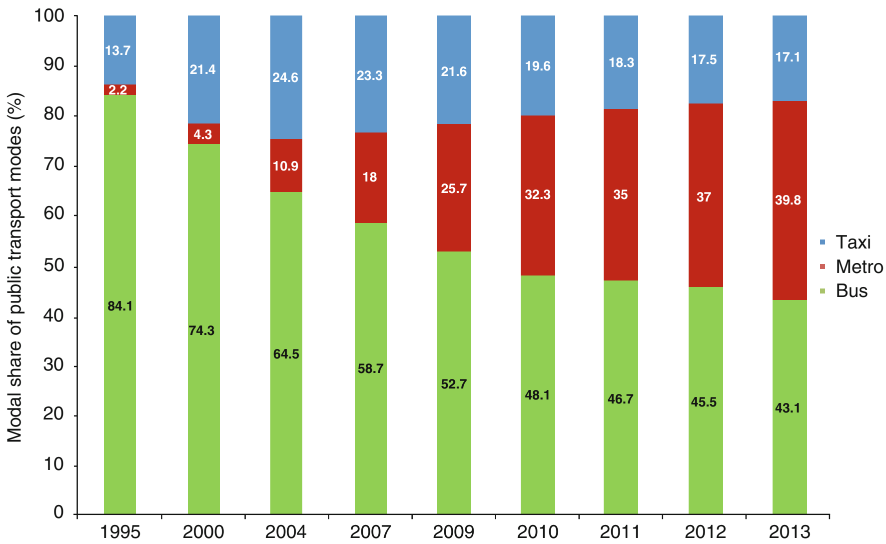

Fig. 3.9 Modal share of public transport modes in Shanghai (1995–2013). *Sources*: Shanghai Municipal Government (2010) and Shanghai City and Transportation Research Institute (2014)

Table 3.1 Density of network and intensity of usage of urban rail transport in five selected Asian-Chinese cities in 2012

City	Density of urban rail transport (km/10,000 persons)	Intensity of passengers by urban rail transport (10,000 persons/km/day)
Beijing	0.21	2.13
Shanghai	0.20	1.61
Guangzhou	0.18	2.15
Hong Kong	0.31	1.67
Singapore	0.23	1.23

Note: The density term refers to the ratio of metro and other urban rail transit operational length to local inhabitants. The intensity terms refers to the daily ridership by metro and other urban rail transit per unit of operational length
Source: GTPRI (2012). Data on intensity of utilization for Singapore and Hong Kong are for 2005 and 2006 (Newman and Kenworthy 2015)

Kong level and significantly below Singapore. However, it was the most intensively utilized of all five cities (Table 3.1).

China now also has the longest high-speed rail network in operation (11,132 km compared to the whole of Europe with 7,351 km), representing 48.5 % and 41.2 %, respectively, of the global totals as of 2014 (International Union of Railways (UIC) 2014).

4 Urban Transport Problems

4.1 Automobile-Related Accidents at the National Level

The introduction of such huge numbers of cars into Chinese cities in such a short space of time has generated high levels of traffic-related externalities (Fig. 3.10). Automobile-related accidents, deaths, injuries, and costs in China reached a peak around 2002–2005. Reasons for these patterns are numerous. Automotive technologies have improved safety performance, more regulation of traffic flows has been introduced, and driver skills and behavior have improved with greater familiarity with car driving and better education. A reduction in automobile-related accidents and deaths may be the result of growing public transport use and a declining modal split for walking and cycling, as people remove themselves from the danger of the road. However, this is a surprising result, which warrants deeper investigations.

4.2 Traffic-Related Air Pollution at the Municipal Level

The worsening nitrogen oxides (NO_X) and particulate matter (PM) concentrations in Chinese cities have displaced sulfur dioxide (SO_2) as the biggest pollutants, indicating that the rapid rate of motorization is playing a growing role in anthropogenic

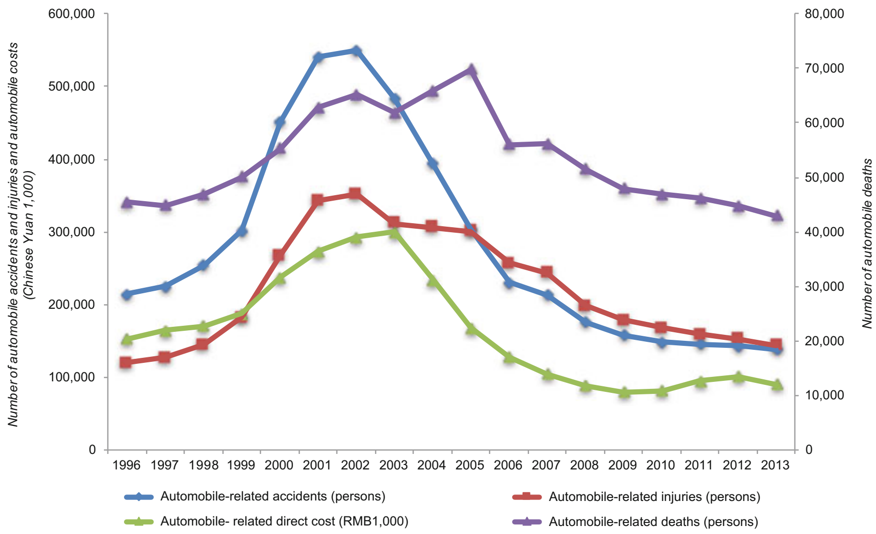

Fig. 3.10 Automobile-related accidents, deaths, injuries, and costs at the national level in China (1996–2013) (Missing data for 2004). *Source*: NBSC (2013b)

atmospheric pollution (Hao and Wang 2005). For example, nearly a third of the total $PM_{2.5}$ emissions are from vehicles (Beijing Municipal Environmental Protection 2015). According to statistics, the concentration of PM_{10} in major cities has been decreasing since 2002, which contradicts popular perceptions of what is happening in China with air pollution (Fig. 3.11).

Despite the falling trend, these three Chinese cities far exceed both the recommended European daily and yearly averages for PM_{10}—45 and 50 μg/m^3, respectively (European Commission 2015). In 2012, Beijing stood at 109 μg/m^3, or nearly threefold the healthy limit, while Shanghai and Guangzhou were around 70 μg/m^3, or nearly twice the limit. Clearly, Beijing is the most polluted of the three large cities, which coincides with its status as the city with the highest private car ownership in China.

5 Urban Transport Governance, Decision-Making, and Financing

5.1 Transition of National Policies on the Car Industry

The vigorous development of the national automotive industry was included in China's First Five-Year Plan (1953–1957), which favored a transition from an agrarian country to an industrial power. The First Automobile Works factory was

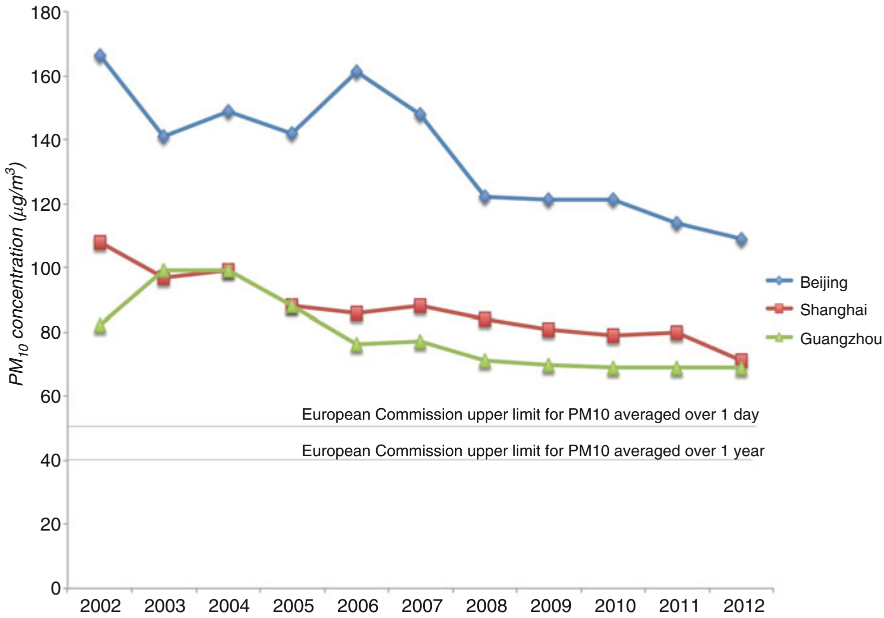

Fig. 3.11 Traffic-related particulate matter (PM_{10}) emissions (μg/m^3) in 2002–2012 (annual average for Beijing and Guangzhou and daily average for Shanghai) *Sources*: BTRC (2013), GTPRI (2012), and Shanghai Environmental Protection Bureau (2013)

listed as one of the first set of "156 Projects"[5] with a proposed annual output of 30,000 vehicles (Sit and Liu 2000). With its construction in 1956, the Chinese automotive industry was officially established and made concerted efforts in the field of heavy-duty vehicle production. This was designed to protect against possible foreign attack during the cold war and to help achieve the level of economic construction demanded from the establishment of New China (Gan 2003). However, it imposed restrictions on product diversification, especially passenger cars.

Along with Nanjing, Shanghai, and Jinan, Beijing founded the First Automobile Accessory Factory in 1954, principally to provide automotive components for the national First Automobile Works (Gan 2003). In contrast to the First (and later Second) Automobile Works focusing on heavy vehicles, Beijing's automotive industry came to specialize in the production of light-duty and passenger vehicles. Under Mao's Great Leap Forward (1958–1960), the Beijing factory successfully manufactured a passenger car named "Jinggangshan" (named after a mountain range) in 1958 and the factory was renamed Beijing Automobile Works. In the same year the "Red Flag" brand passenger car was produced in the First Automobile Works (Gao et al. 2015a). In 1960, Beijing developed a new car, the "Dongfanghong" (literally, "the East is red"). In 1983, the Beijing Automobile Works closed a deal

[5] There were 156 newly developed projects under technical support from the former Soviet Union during the First Five-Year Plan. They covered energy, machinery, and other heavy industries.

with the American Motors Corporation to build a Sino-foreign joint venture, the first of its kind in Chinese automotive history. These events facilitated the popularization of motor vehicles amongst Beijing residents.

The far-reaching 1978 “Reform and Opening-up” Policy gave more autonomy to Chinese industries, including the automobile sector. The change from adjunct to executive powers allowed individual car producers to become relatively independent through the “Separation of Enterprise from Administration” policy (Liu and Dicken 2006). There was an explicit countrywide move away from a solely military focus towards emphasis on the development of the civilian automobile industry, along with the evolution of China’s consecutive Five-Year Plans (Gao et al. 2015a).

Nevertheless, there were still limitations under the rigorous state controls in the beginning of economic restructuring. For example, passenger cars were first produced by the First Automobile Works in 1958. Later, between 1978 and 1985, the planned production fluctuated around 3000–6000 units annually. This accounted for less than 3 % of China’s whole vehicle production during that period. It would be more correct to say that this was the Chinese truck industry era rather than the Chinese automotive industry era.

The local underproduction resulted in the first import peak of passenger cars in 1985, soon after the private purchase of vehicles was legalized in 1984 (China Automotive Research Center 2010). The Automotive Industrial Policy of 1994 and the Tenth Five-Year Plan (2001–2005) provided official encouragement for individuals and families to purchase passenger vehicles. As a consequence, the industrial structure began to formally prioritize passenger cars over freight vehicles.

The decrease in import tariffs (reduced to 25 % by 2006) and the removal of restrictions on car import permits following World Trade Organization commitments in 2001 strongly stimulated the Chinese car industry, which experienced a period of boom. In 2002, the annual production had more than tripled compared to a year earlier. At the same time, Chinese megacities started rolling out Transportation Demand Management policies to ameliorate and tackle the traffic-based pressures. Besides these measures, which could only delay escalating private motorization, there were more effective actions, including prioritizing the development of urban public transport, especially rail transit. These actions have reduced the growth in private motorized modes since around 2011.

5.2 Municipal Restrictions on Private Vehicle Ownership and Use

Shanghai and Beijing were the first two cities in China to pioneer restrictions on private vehicle ownership by limiting the issue of license plates (Table 3.2). Shanghai adopted an even stricter stance towards the quotas on new car registration, with an average price of about $5,040 in 2008. Guangzhou is the fourth Chinese city (after Guiyang in 2011) to implement a similar policy through an integrated distribution system, with an emphasis on new energy vehicles.

Table 3.2 Comparison of municipal restrictions on private vehicle ownership

City	Year issued	Approach	Quotas
Shanghai	1994	Singapore-style auction system	Less than 10,000/month
Beijing	2010	Lottery system	20,000/month (2011); 15,000/month (2014)
Guangzhou	2012	60 % by lottery system (10 % for new energy vehicles) + 40 % by auction system	10,000/month

Sources: Beijing Municipal Commission of Transport (2010), Hao et al. (2011), and Guangzhou Transport Bureau (2012)

In terms of limiting private vehicle use, the Beijing and Guangzhou governments successively built on interventions for the 2008 Olympic and Paralympic Games (Beijing Traffic Management Bureau 2008) as well as the 2010 Asian Games (Guangzhou Municipal Government 2010) hosted by Beijing and Guangzhou, respectively. These two cities employed similar approaches for road space rationing to alleviate traffic. Privately owned vehicles with odd/even plate numbers are only allowed to drive during the odd/even dates of the year. During the implementation period from October 2008 to February 2009, arterial traffic flows increased by 4 % (BTRC 2009). Meanwhile congestion levels fell and vehicle emissions decreased. However, in the long run, the effect was offset by the ever-increasing vehicle population. The average arterial traffic speed in the morning peak (7–9 am) in Beijing stabilized to about 23 km/h between 2008 and 2012.

5.3 *Economic Growth*

Economic development (i.e., government investment in automobile facilities and rising individual purchasing power) is considered as one of the principal drivers of increased motorization in China (Mok 2000). For example, Beijing invested up to $7.6 billion in 2010 in road infrastructure, compared to $2.9 billion in 2001. Consequently, the length of freeways surged from 335 km to 903 km during the 9-year period between 2001 and 2010 (BTRC 2001, 2011). On the car supply-side, the Chinese car industry increased production, supported by state investment. The ownership of consumer goods such as cars is becoming progressively more affordable as personal incomes exceed subsistence levels (Riley 2002). In the wealthier national capital, for example, motorization reached 229 cars per 1000 persons in 2008—nearly fourfold the national average (China Association of Automobile Manufacturers (CAAM) 2011).

6 Proposed Urban Transport Solutions and Implementation Issues

6.1 Resurgence of Cycling

Until the mid-1990s, nonmotorized travel modes were the dominant form of urban mobility in China. Booming economic growth and a prosperous car industry promoted motorized transport, particularly the use of private vehicles, which encroached on the road space for cycling and consumed sidewalks for car parking (Figs. 3.12 and 3.13). However, given that even in megacities, shorter trips prevail, there may be signs of a return to cycling (in Beijing daily trips of less than 5 km accounted for 55 % of all trips in 2012; BTRC 2013).

Bicycle-sharing programs are helping revive the cycling tradition. The Public Bike scheme was introduced in Beijing in 2005 and developed rapidly around the time of the 2008 Olympic Games. In 2010, this system was officially brought under the direct management of the "Green Trip" program, overseen by the Beijing Municipal Government. It has an affordable "free+paid"[6] business model and the bikes are located near commercial, tourist, and residential areas, as well as railway stations.

By 2014, the total number of shared bicycle fleets and stations in China was 582,816 and 16,139, respectively. This makes China the largest bicycle-sharing country in the world (according to the Climate Environmental Service Group). Not only is cycling an environmentally-friendly mode for whole trips, but also the solution to the "last kilometer" connection problem faced by public transport users.

Today, cycling in China has an added dimension: electric bicycles. As many as 250 million electric bicycles (mostly e-bikes, or what are often referred to as pedelecs, as well as e-scooters) are used on Chinese streets nationwide. Besides government support, public awareness on environmental issues, as well as the influence of bicycle enthusiasts, is also encouraging more people to cycle.

6.2 Emerging Technologies

China has introduced a whole array of Transportation Demand Management policies to curb excessive private motorized travel demand. It has posed limits on conventionally powered private vehicles and has made commitments to develop alternatively fueled vehicles. As of 2014, many cities had already joined in efforts to curtail privately owned cars through limiting quotas on new car registrations (Shanghai 1994, Beijing 2010, Guiyang 2011, Guangzhou 2012, Shijiazhuang 2013, Tianjin 2013, and Hangzhou 2014).

[6] There are different fees in different districts of Beijing. In the six inner districts, the first hour is free and then a flat rate of 1 Yuan/h ($0.16) applies, with a maximum charge of 10 Yuan ($1.6) in 24 h.

Fig. 3.12 Sidewalks have been taken over in Chinese Cities for on-street parking (Dalian) Photo by Jeffrey Kenworthy

Fig. 3.13 People have to walk around cars or on the road as on and off-street parking has encroached upon pedestrian sidewalks (Dalian) Photo by Jeffrey Kenworthy

The idea of New Energy Vehicles was introduced in Chinese transportation planning in the 1990s when Battery Electric Vehicles were listed among the "National Key Science and Technology Industrialization Projects" detailed in the Ninth Five-Year Plan (1996–2000). Battery Electric Vehicles were listed again as one of seven national strategic emerging industries in the Twelfth Five-Year Plan (2011–2015).

The "Ten Cities, Thousand Vehicles" program launched by the central government in 2009 to great fanfare aimed to achieve a New Energy Vehicles sales target equaling 10 % of car sales by 2012 (Wan et al. 2015). The actual sales of New Energy Vehicles totaled about 66,000 by 2014, 82 % of which were being used in a public service capacity (Li 2014). No cities achieved these targets: Zhejiang, Hefei, and Shanghai came closest to reaching the targets, while Beijing and Guangzhou fell far short of their targets.

Other emerging technologies and social trends have affected urban transport in Chinese cities. Several smartphone apps allow for the customization of traditional public transport services and are extremely popular with younger travelers. Didi Taxi, a Chinese taxi service similar to America's Uber, entered operation in 2012 and offers a platform for planning taxi trips in real time through smartphones. This benefits both the drivers and the passengers as drivers can choose jobs closest to their location and passengers can decrease their waiting time. The convenience of this service can reduce the number of single-occupant private vehicles on the road, with benefits for pollution and congestion. The smartphone-supported car-sharing apps function similarly by matching trip origins and destinations between car service providers and consumers. However, current regulation means that Didi is caught in the dilemma of legality.

6.3 Prioritizing Rapid Mass Transit

The Twelfth Five-Year Plan (2011–2015) stressed the importance of developing public transport, especially rapid mass transit. This includes Bus Rapid Transit (BRT) and subway/metro within cities, as well as high-speed rail[7] between cities. BRT can potentially raise the operating speed of buses in urban China from around 10 to 20 km/h (Creutzig and He 2009), due to the application of fully dedicated rights-of-way (busway/bus lane).[8] While a median bus lane was built in Kunming in 1999, real BRT was not implemented in China until Beijing's BRT saw the light in 2005 (Fjellstrom 2011). Guangzhou opened its BRT in 2013 and, after Bogotá, is the world's busiest in terms of daily and peak-hour passenger trips (based on data from the Institute for Transportation and Development Policy). Qinhuangdao-Shenyang, the first high-speed rail line in China, was put into operation in 2003 (Fig. 3.14). By 2020 the total length of dedicated Chinese passenger lines is expected to be 12,000 km (based on the "Medium- and Long-Term Railway Network Planning" issued in 2004).

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[7] High speed rail or "bullet train" is defined as either an existing upgraded railway (operating speed ≥200 km/h) or an entirely new track system (operating speed ≥250 km/h) (Utah Foundation 2010).

[8] This is a significant improvement, however, 20 km/h will generally not compete with cars travel speeds and is very much less than a typical metro average speed of 30 to 40 km/h.

Fig. 3.14 China has rapidly developed a vast network of high-speed rail (Xi'an). Photo by Yuan Gao

7 Other Country-Specific Issues

Rapid change is a key implementation strength in China. Although China has become more susceptible to severe transportation and motorization problems in recent years, it has demonstrated its capacity to adapt to rapid changes and even deal with some of the negative impacts constructively. This is due to a number of factors, not the least of which has been a booming economy which has helped China to accumulate the massive capital and investment required to enact meaningful and effective change, especially in transportation infrastructure. The stellar rise in the number of metro systems and the high-speed rail network serves as evidence of this ability. More evidence is found in the extraordinary rate of Chinese urbanization, such as the growth of Shenzhen from a fishing town with a population of about 0.3 million in the early 1980s, to a metropolis of 11 million people by 2014 (Shenzhen Municipal Bureau of Statistics 2015). China's potential for rapid change is therefore inextricably linked to its tremendous population momentum, despite the earlier one-child policy. China's dualistic centrally planned, yet successful market-based economy, also allows the country to implement its plans (in particular its Five-Year Plans) with greater authority and success than might occur in other nations. Employing both government regulation and control and market economics, China has shown a keen ability to rapidly change direction when needed.

8 Conclusion

Chinese cities adapted themselves to walking, cycling, and bus-based public transport for job accessibility and other social activities from the establishment of New China until the mid-1990s. These modes of urban transport are in accordance with the traditional dense and mixed-use Chinese urban settlement patterns. With economic growth, urban development, and the boom in the Chinese car industry, privately owned cars—the symbol of a modern economy—became more available and affordable from the beginning of the twenty-first century. Private cars became a major transportation mode, replacing bicycles on the streets of Chinese cities, which in turn resulted in many Chinese megacities drowning in traffic.

Chinese cities will become more livable again if their urban transport systems are integrated, with a better balance between nonmotorized transport, private vehicles, and public transport, especially rail-based modes. This will not only ensure that daily travel demand is met and traffic-related pressure is eased, but it will also help protect the integrity of urban public environments. Such an integrated system will need to include the following:

1. Cycling, walking, and public transport (BRT, light rail, and metro) will need to become the key modes for city centers and for linking subcenters. The old (and new) walking city and transit city fabrics within Chinese cities must be respected, protected, and extended (Newman et al. 2016) (Figs. 3.15 and 3.16).
2. Rail transport must become the main mode for commuting between centers and in connecting suburban areas. It can be supplemented by regular buses and paratransit feeder modes, as well as trams or light rail in certain cases.
3. High-speed rail can offer intercity transport services, which are quick, affordable, and sustainable. The growing network of high-speed rail is an important way of keeping intercity car and plane travel across China to a minimum, thereby helping to reduce fossil fuel use and CO_2 emissions.

Fig. 3.15 China is beginning to protect and expand its more traditional walking-based fabrics and vibrant strreet life and commerce (Dalian). Photo by Jeffrey Kenworthy

Fig. 3.16 An attractive and spacious pedestrian zone in central Shanghai. Photo by Yuan Gao

4. Economic development should be decoupled from coal and oil (Newman and Kenworthy 2015). Electric mobility based on renewable energy, both for public transit and for private modes, such as electric bicycles and electric cars, has been developing rapidly. China therefore has the chance to lead the world in transformations to transportation systems that dramatically lower dependence on fossil fuels and reduce CO_2 output.

These lessons and trends may offer a silver lining to the dark cloud that has caused prosperity up to now to largely bypass regions such as in central China. If and when these regions can also develop many larger cities, they may be able to build in a competitive advantage from the beginning through a more livable and ecologically sustainable approach to urban development and transportation, therefore offering more attractive lifestyles and opportunities.

In summary, a few small signs of a possible transition to more sustainable forms of transport can be detected in China. However, much more needs to be done to achieve socioeconomic development and environmental livability. A key to the future of the car in China revolves around a continued reduction in the built-in need to own and use cars, especially in cities, and a reformation of the nature of the cars that are produced.

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Chapter 4
Colombia

Juan Miguel Velásquez and Darío Hidalgo

Capital city	Land area	Country	Total population	Urban population	GDP per capita	Passenger cars
Bogotá	1,138,910 sq. km	Colombia	48 million	76% (37 million)	$7,826	53 / 1,000 people

Data source: World Bank
Maps source: d-maps.com

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1 Introduction

Located in the northwestern corner of South America, Colombia is the fifth largest country in the continent. Its geography ranges from flatlands on the Pacific Ocean and the Caribbean Sea, to high Andes mountains in the center, to rainforest in the southeast. With 48 million inhabitants, Colombia is the third most populated country in Latin America; it is growing at an annual rate of 1 %. It is also a highly urbanized country: 76 % of the population lives in cities compared to only 30 % in 1938. The majority of the population lives in the four largest cities: Bogotá, Medellín, Cali, and Barranquilla. These are the only cities with more than one million inhabitants, with Bogotá being a megacity of nearly seven million. In addition, Colombia has 41 urban settlements with 0.1–1 million inhabitants; the remainder are small towns (Cáceres et al. 2013). The urban population is projected to reach 85 % of the total by 2050 (Parra-Peña et al. 2013).

Colombia has seen rapid economic growth in the last few decades. Its GDP has grown at an annual average of 4.8 % over the past 15 years, and the portion of people living under the poverty line has substantially shrunk—from 49 % in 2000 to 29 % in 2014 (DANE 2015). Agriculture contributes only 6 % to the GDP, while urban economic activities including industry and services contribute 37 % and 57 %, respectively. Cities are the economic engine of the country: they currently generate 85 % of the national GDP.

Over recent decades, the country's economic growth has led to a surge in private motorization, particularly motorcycles. This has translated into higher levels of congestion, traffic accidents, and pollution emissions. However, Colombian cities still have a very large, though declining, public transport share. In the last two decades, cities have embarked on a major reform in public transport provision. Service provision has been transformed from a semi-regulated, dispersed ownership model to formalized private enterprises under stronger supervision by local governments. The process was sparked by the implementation of TransMilenio, Bogotá's renowned Bus Rapid Transit (BRT) system, which was emulated by several other cities with the support of the national government (Hidalgo and Díaz 2014). This support has been in the form of policy instruments, funding for infrastructure, and technical assistance. Consequently, the number of cities with mass transit systems has grown from two to eight. Colombian BRT systems now span a total length of 208 km and serve more than three million passengers daily (BRTData.org 2016). The national government has also supported smaller cities that do not require high capacity transit in implementing integrated public transport systems. These projects have reduced operational costs, travel times, air pollutant emissions, traffic fatalities, and injuries. The overall results of these efforts are nevertheless quite mixed. While positive transformation is evident—as reflected in increasing socioeconomic indicators—financial struggles are also prevalent. Most importantly, cities have been unable to curb motorization, especially the growth of motorcycles.

2 Urban Land Use Patterns and Spatial Structure

The relentless urbanization process throughout the twentieth century has resulted in rapid and unplanned urban growth, especially in the four largest cities. Older cities include pedestrian- and cycling-friendly districts inherited from the colonial era which are being gentrified (Fig. 4.1) and are increasingly popular with tourists. However, they constitute a relatively small area. A large portion of the urban housing stock has been gradually self-built at high densities but in a patchy manner in city fringes or other geographically inaccessible areas. While the urban outskirts have expanded, the city centers have been eroded. For example, in Bogotá between the mid-1970s and the mid-2000s, the city center population declined from 15 to 6 % of the total and the first ring of population declined from 55 to 29 % of the total. Meanwhile, the population in the external ring grew from 30 to 66 % of the total. Urban population growth has also meant that urban agglomerations are expanding beyond their original jurisdictions, spanning across several municipalities.

Self-built, informal settlements (*barrios bajos*) house at least 18 % of the national population (Fig. 4.2). Typically, they lack infrastructure and amenities, including water supply, sewage, electricity lines, public space, or adequate public transport—or these were provided years after the housing was in place. In larger cities, much formal housing for the wealthy is also built at high densities (Fig. 4.3). Overall, Colombian cities are some of the densest in the region (Table 4.1). Formal employment tends to be concentrated in city centers; however, much of the population is employed in the informal sector. Socio-spatial segregation is high in Colombian cities despite recent economic growth.

Fig. 4.1 Old town in Cartagena. Photo by jipe7 (Flickr)

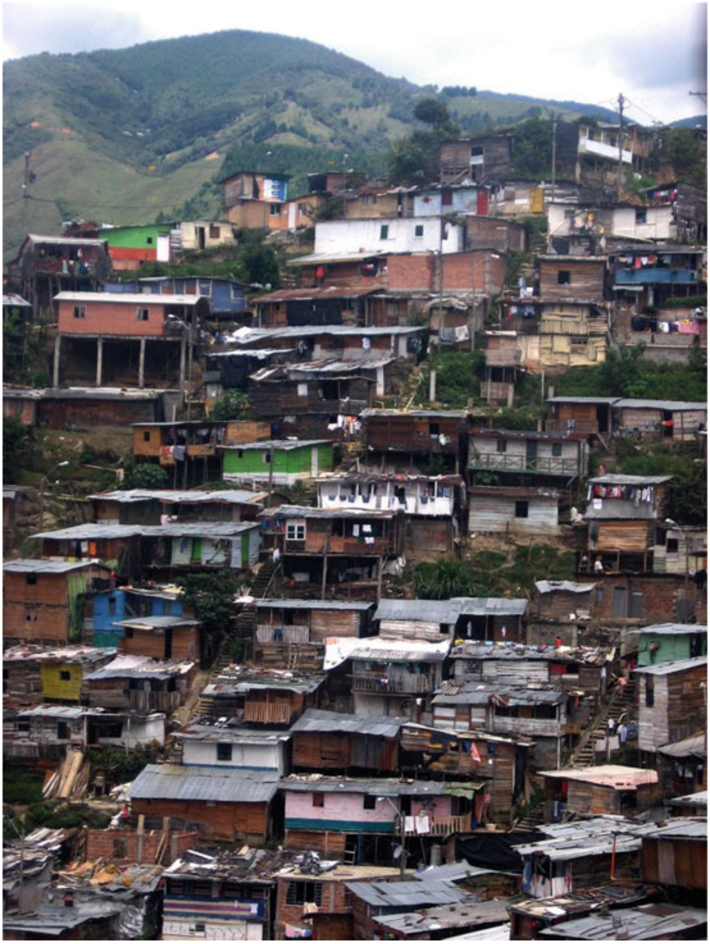


Fig. 4.2 An informal settlement in Medellin, Colombia. Photo by Lorna Phillips (Flickr)

Fig. 4.3 High-rise housing built in local red-brown stone in Bogotá, against the backdrop of the Andes. Photo Daniel-1-1 (Wikimedia)

Table 4.1 Population and density in selected Latin American cities

City	Population (million)	Density (inhabitants/km^2)
Bogotá, Colombia	8.9	18,300
Medellín, Colombia	3.5	15,700
Cali, Colombia	2.4	12,500
Lima, Peru	10.8	11,700
Mexico City, Mexico	20.0	9700
Sao Paulo, Brazil	20.3	7500
Santiago, Chile	6.2	6300
Buenos Aires, Argentina	14.1	5300

Source: Demographia (2015)

In theory, high urban densities are desirable in terms of sustainability since they can support shorter trips and render public transport services feasible. However, for the most part, Colombian cities have failed to take the advantage of opportunities afforded by high levels of density. On the contrary, inadequate urban planning has resulted in low quality, cramped urban spaces in which amenities are few and/or inaccessible from a physical and financial point of view (see later).

Municipal governments have a high degree of autonomy and are responsible for designing and implementing their own urban development policies and land-use and transport master plans. While positive in many ways, this autonomy is a barrier to coordination across jurisdictions, preventing metropolitan areas from effectively planning and implementing shared solutions to cross-border problems. This situation has led to fragmented land use planning, disjoined transport networks, and, ultimately, a reduced quality of life for citizens. Some cities have regional coordinating bodies ("Metropolitan Areas") with legal authority over environmental and transportation issues but their capacity is generally weak (Bustamante Pérez 2014).

In terms of land use planning, the case of Bogotá has special status as capital and megacity. Since the beginning of the twentieth century, several master plans have been proposed to guide its development, including one by Le Corbusier in the 1950s, but most have been theoretical rather than operational. In the 1970s, the idea of a polycentric city was promoted in order to deconcentrate the employment from the CBD (which contained 70 % of jobs at the time). An Urban Development Study, one of the most important plans for Bogotá and its region, was prepared in 1972. Although not officially adopted, the concepts that it proposed, including urban densification, decentralization of activities into five secondary centers, urban expansion toward the southwest, and ample road space allocation in the North American style, became the basis for most future development projects (Bocarejo and Tafur 2011).

The first specific transportation master plan for Bogotá was prepared in 1996 by the Japanese International Cooperation Agency. However, in the absence of a clear urban vision, this plan was only tentative. It proposed the construction of a metro line in the northern part of the city, which never materialized. In 1997, a National Land Use Law was adopted that made it mandatory for municipalities to adopt long-term master plans. Bogotá's first official master plan was not prepared until 2000, in the course of Mayor Enrique Peñalosa's administration and in conjunction with TransMilenio's development (Bocarejo and Tafur 2011).

3 Trends in Transport Use and Mobility

3.1 Growing Motorization

The predominant travel modes in Colombian cities have traditionally been walking and buses, partly as a result of high population densities (Fig. 4.4). Private motorization levels are still low, even relative to countries with similar income levels (World Bank 2015). However, with the steady rise in incomes, private vehicle ownership is increasing at an average annual rate of 4 % for cars and 6 % for motorcycles (Acevedo et al. 2009). Over the next 30 years, this may result in more than three times as many private cars and more than five times as many motorcycles on the roads (Table 4.2). Motorization is already replacing some walking and public transport trips.

Notwithstanding higher access to motorized vehicles, travel times have not shortened. Due to burgeoning congestion and a relatively slow pace of mass transit development, the same trips now take longer, including those by public transport. In Bogotá, Cali, and Medellín, bus journey times have increased by more than 10 % in a decade. The average travel time in Cali is 29 min while in Bogotá it is 56 min. Furthermore, travel times vary significantly depending on income levels. The poor travel spends much longer than average to travel in the city due to their peripheral housing location and their use of slower transport modes. In Bogotá, their mobility is half of that of higher income groups and spends on average nearly one-fifth of their income on transportation (Bocarejo and Tafur 2011).

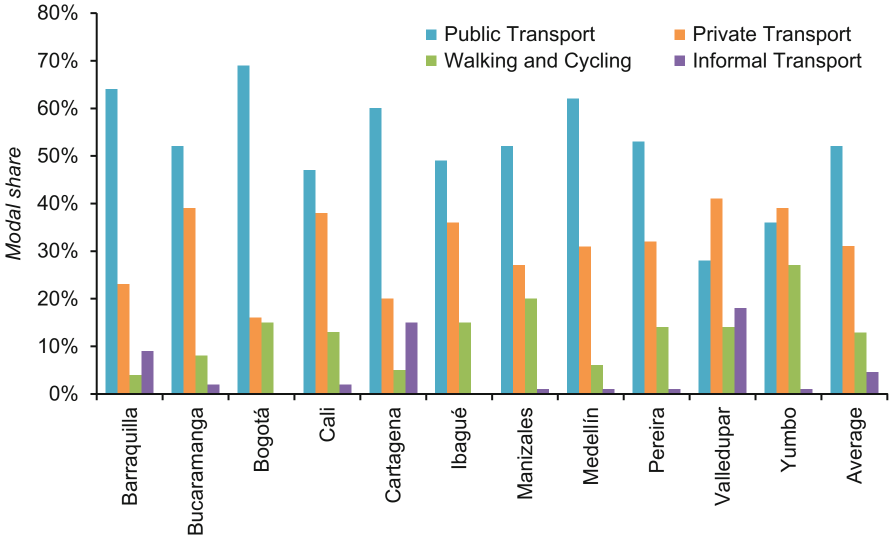


Fig. 4.4 Modal share in larger Colombian cities. *Note*: "Informal transport" includes unauthorized buses, mototaxis, and pedicabs. *Source*: Ipsos (2014)

Table 4.2 Population and motorization in Colombia

Year	National population (million)	Motorization (vehicles/1000 inhabitants)	
		Cars	Motorcycles
1990	34	30	6
1995	38	39	13
2000	40	47	22
2005	43	53	29
2010	46	65	65
2015[a]	48	77	83
2020[a]	51	90	116
2025[a]	54	110	146
2030[a]	56	130	167
2035[a]	59	149	192
2040[a]	62	169	209

[a]Projected. *Source*: Acevedo et al. (2009)

In small- and medium-sized cities, motorcycles are used not only for individual transport but also as *mototaxis* which provide informal door-to-door taxi services. Mototaxis charge slightly higher fares than public transport but offer a much faster service and better coverage (Econometria 2015). Existing regulation considers them to be illegal but enforcement efforts to remove them have been unsuccessful partly because an increasing number of the population rely on *mototaxis* to earn their living.

3.2 Public Transport Provision

Most public transport in Colombian cities is provided by buses operating in mixed traffic. Only Medellín has an urban rail system comprising 31 km of heavy rail (metro) and 4 km of light rail (tram). Seven cities, which concentrate more than 40 % of the country's population, have BRT systems (a total of 208 km), and one more city will start operations in 2016 (Fig. 4.5). Three cities have aerial cable car systems, also known as air gondolas (a total of 18 km). Twenty smaller cities (250,000–600,000 inhabitants) are implementing "strategic public transport systems" which are less infrastructure-intensive. Cities with less than 250,000 inhabitants are planning on reorganizing and integrating their public transport systems, made possible through a National Urban Transport Policy developed by the national government, which funds up to 70 % of the capital investments for public transport projects at the local level. The two showpieces of high standard public transport in Colombian cities are Bogotá's BRT system *TransMilenio* and Medellín's cable car system *Metrocable* (see later).

Notwithstanding these achievements, major problems persist. A major issue with public transport provision is its business model. Transport authorities issue operating permits to private companies for certain routes but the permits only define a

Fig. 4.5 Cali's BRT system (*MIO*). Photo by Fernando Oliveros (Flickr)

Table 4.3 Length (km) of public transport infrastructure in selected Colombian cities

	BRT	Aerial cable car	Heavy rail (metro)	Tram
Barranquilla	14	–	–	–
Bogotá	113	–	–	–
Bucaramanga	9	–	–	–
Cali	36	2	–	–
Cartagena	15	–	–	–
Manizales	–	4	–	–
Medellín	18	12	31	4
Pereira	16	–	–	–
Total length by mode (km)	*229*	*18*	*31*	*4*

Source: BRTData.org and data from local transit agencies (2015)

maximum number of vehicles that can operate on the route. They do not specify other key requirements, such as service frequency, vehicle types, ownership, maintenance, comfort, and the like. Moreover, contracts do not specify an end date, which de facto gives permit-holding companies an unlimited right to operating bus routes. Contracted companies do not own the majority of their fleet. Instead, they charge individual bus owners/drivers a monthly rent to operate on their routes. Therefore companies have an incentive to rent out their route to as many bus owners/drivers as possible. Bus owners/drivers, for their part, need to compete with each other on the road and collect as many passengers as possible in order to make a profit. In high demand corridors, these practices generate congestion, chaos, pollution, and road safety risks (Hidalgo and King 2014) (Table 4.3).

4 Urban Transport Problems

Growing traffic congestion in Colombian cities is one of the most lamented transport problems and is also the most visible (Ipsos 2014). In the eight largest cities, the estimated cost of congestion is $6 billion or 2 % of the GDP (DNP 2014). These cities also have significantly polluted air. By 2009, local limits for particulate matter (PM_{10})—which are much less stringent than World Health Organization standards—were exceeded in Medellín, Bogotá, and Cucuta. Urban transport is a major contributor to greenhouse gas (GHG) emissions in Colombia, accounting for about half of the national total. In 2015, almost 15 million tons of CO_2 equivalent were emitted in the air. This amount is expected to more than double by 2040 under a business-as-usual scenario.

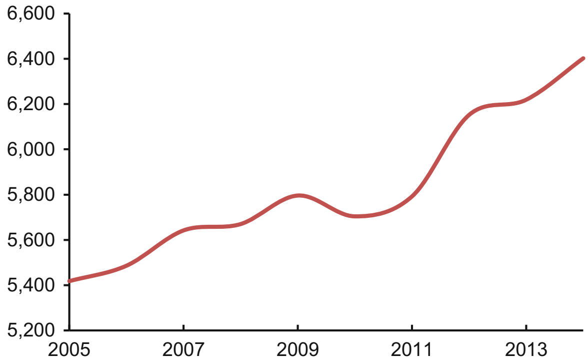
Public transport, in addition to private cars and motorcycles, is a major contributor to pollution. In Bogotá, about half (54 %) of the PM_{10} pollution is emitted from public transport vehicles which is higher than most other Latin American cities—the average is about one-third (32 %) (CAF 2011). High pollution from public transport is partly due to the age of the bus fleet in Colombian cities: the average age of buses is older than 10 years, with the exception of BRT fleets. The poor quality of diesel employed by buses and cars, with high sulfur content, is another major cause of pollution.

Road safety in urban areas has become a major public health concern (Fig. 4.6). Cities account for 61 % of traffic fatalities. The current rate of 13.4 fatalities per 100,000 inhabitants is very high in comparison to developed countries. However, there is great variation by location. In Bogotá and Barranquilla, the fatality rate is 8.2/100,000 inhabitants, while in Cali it is 14.8, and in Pereira 16.1 (INMLCF 2015). Motorcyclists are at high risk, accounting for 45 % of fatalities, followed by pedestrians (27 % of fatalities). Cyclists account for 5 % of fatalities.

Strategies to ensure safer conditions for pedestrians and cyclists are still limited despite a high share of walking. Bogotá, which has benefited from Mayor Enrique Peñalosa's progressive vision in urban transport, is a rare exception in terms of investments in cycling infrastructure. With 392 km of segregated bicycle lanes, it is the city with the largest cycling infrastructure network in Latin America. It has also instituted the *Ciclovía*, a weekly event, during which access to certain main streets by car is prohibited between 7 am and 2 pm (Fig. 4.7). As a result of these policies and investments, cycling has become enormously popular: 600,000 daily trips are made on bicycles, leading to the capital being called an "urban bicycling pioneer" in the continent. However, some commentators have noted that the increase in cycling has been at the detriment of public transport. Trips have shifted from buses to bicycles rather than from cars to bicycles (Ipsos 2014).

Other cities are far behind Bogotá in terms of cycling infrastructure. Medellín, Cali, and Pereira have 27 km, 19 km, and 3 km of bicycle lanes, respectively (Ríos Flores et al. 2015). In addition to the lack of dedicated infrastructure, security issues—street crime, assaults, robberies, pickpockets—form deterrents to the uptake of cycling in these places (Ipsos 2014; Verma et al. 2015).

Fig. 4.6 Increasing traffic fatalities in Colombia. *Source*: INMLCF (2015)



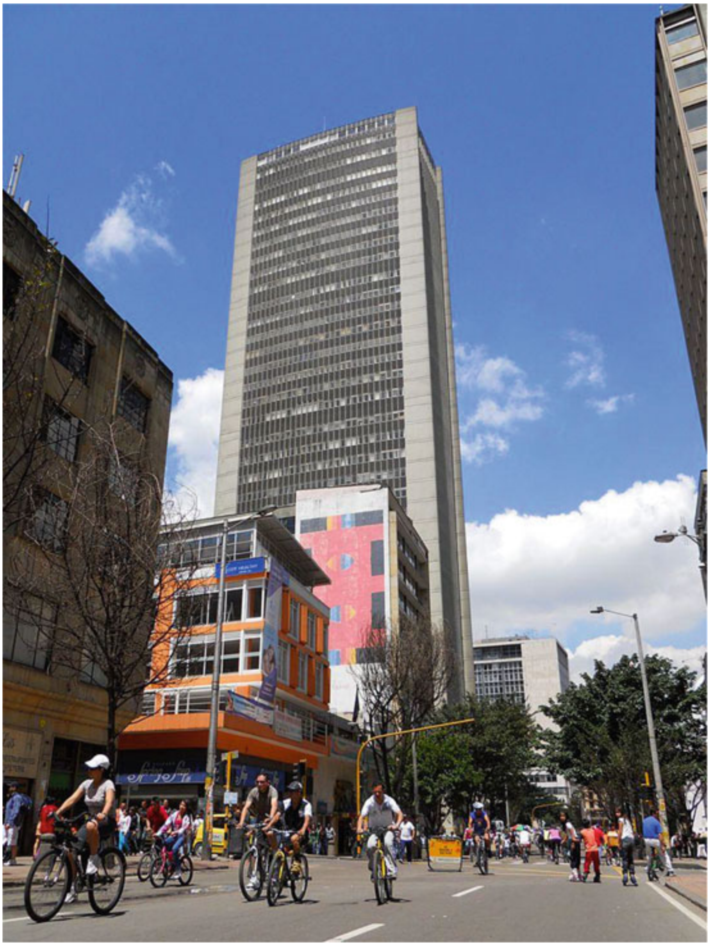


Fig. 4.7 Bicyclists on the Sunday Ciclovía. Photo by Pedro Felipe (Wikimedia)

Inequitable access is another chief concern in Colombian cities. The poor are priced out of areas covered by formal public transport services, or simply cannot afford the fares. As a result, relatively few of the urban poor use modern public transport systems such as BRT (Carrigan et al. 2013; Scholl et al. 2015). In order to access jobs and other necessary destinations, low-income groups are often forced to walk or cycle over very long distances, or use uncomfortable informal transport vehicles (Oviedo and Titheridge 2015). Even so, they spend a large proportion of their household budget (an average of 20 % in Bogotá) for work travel (Bocarejo and Oviedo 2012).

5 Urban Transport Governance, Decision-Making, and Financing

From the mid-1980s through to the 1990s, Colombia carried out an ambitious decentralization process, devolving many planning responsibilities to the local level, including the provision and regulation of public transport services (Alesina et al. 2005). Since then, the national government has only been involved in the provision of large mass transit projects, including Medellín's metro (which started operations in 1995), and Bogotá's BRT (which started operations in 2000). After TransMilenio's initial success, the national government launched a National Mass Transit Policy in 2003, which was instrumental in expanding mass transit systems from two to eight cities. The main strengths and weaknesses of the policy are summarized in Table 4.4. In total, 487 km of bus corridors (208 km of BRT and 279 km of bus priority corridors) have been built in the ambit of this program (Bocarejo et al. 2014b). For the most part, the national government has financed its participation in local transport projects though loans from international development banks.

The National Mass Transit Policy has radically transformed to the way in which public transport was provided in Colombia. Semiformal operations have been converted into organized systems, with efficient operators and strong oversight. Most new BRT systems, especially the one in Pereira, have had positive benefit-cost ratios and high social internal rates of return (Table 4.5). They have cut operational costs, travel times, air pollutant emissions, and traffic accidents. Crime rates have abated and land values have increased in areas crossed by BRT corridors. In addition to a growth in quantitative indicators, BRT projects have had intangible effects too. They have ameliorated the image of their cities, have helped sparkle an urban regeneration effect, and more generally, have provided hope for a better future (DNP 2015a; García and José 2005).

The Barranquilla BRT is an exception. Here, a combination of factors worked against the success of the BRT. Barriers included cost overruns, demand shortfalls, a rapid increase in private vehicles, a slow phasing out of the traditional bus system, and lack of integration between the BRT and other modes, including mototaxis (Bocarejo et al. 2014a; DNP 2015a; Hidalgo and Díaz 2014).

Table 4.4 Strengths and weaknesses of Colombia's National Mass Transit Policy

Scope	Strengths	Weaknesses
Institutional and governance aspects	• The current legal framework promotes coordination within and among municipalities	• Coordination is not effective in reality; institutions within and between jurisdictions are dispersed
	• All the new systems have a lead agency which plans, manages, and controls. Several agencies consolidate infrastructure and operations	• Lead transit agencies have limited scope and cannot act on certain elements of the transit system, such as infrastructure
	• The national government is part of the boards of the transit agencies	• No regional institutions, unless there is an agreement among municipalities ("Metropolitan Areas"). Even within Metropolitan Areas there are unclear responsibilities and weak accountability
		• Political cycles have meant that in some cities local leaders are not as supportive of project implementation as their predecessors
		• Incumbent private operators have a high negotiation power that have sometimes hindered planning and operation of projects
		• Lack of incentives for effective citizen engagement
Planning aspects	• There are established mechanisms for management and follow-up	• Focus on infrastructure development; lack of attention and delays in terms of operations, especially when technological components are needed, such as for fare collection and user information systems
	• Integral mobility plans coordinated with land use are required	• The quality of service remains unregulated. To keep operation costs low, occupancy levels are very high in most systems
		• Except for Cali, plans have not been comprehensive; they have focused on specific corridors only
		• Nonmotorized transport is not adequately integrated with the public transport systems
		• Specific changes in land use regulations are needed to consolidate urban development around BRT corridors

(continued)

Table 4.4 (continued)

Scope	Strengths	Weaknesses
Financial aspects	• Funding allocations for infrastructure by the national and local governments	• Insufficient funding to cover all current mobility needs
	• Opportunity to obtain additional funding through land use and demand management measures (congestion pricing and/or parking management)	• Infrastructure elements sometimes have been passed through to users by raising the fares
	• Public–private partnerships (PPPs) have helped bridge the financing gap	• A commitment to fully cover vehicle purchase costs and operational costs through fares (the so-called self-sustainability principle) limits the quality of service (i.e., it results in high occupancy, as well as low frequency in the periphery and off peak)
		• Self-sustainability, coupled with competition, means that new systems are forced to request unplanned subsidies from the local governments in order to continue operations
		• The process of determining fares is politicized
		• The fares are unaffordable for the poor
		• Lower demand has created cash flow problems among operators, leading to service disruptions, difficulties financing fleet renewals, and public opinion concerns
Implementation and operational aspects	• Funding and expenditures have been transparent	• Delays in the infrastructure construction of most systems
	• The public transport service structure has been well adapted to cities smaller than Bogotá, sometimes with a direct-service model instead of trunk-feeder services	• Significant cost overruns were incurred during the construction of all projects
	• BRT systems have been successful in reducing emissions and improving traffic safety	• Projects have been inaugurated before all the infrastructure and system components were in place
		• Limited reorganization of existing bus routes and scrappage of older buses has impacted demand due to on the road competition

(continued)

Table 4.4 (continued)

Scope	Strengths	Weaknesses
Legal aspects	• The current legal framework is extensive and covers most aspects of public transport planning, implementation, and operation	• There are too many regulations, sometimes contradictory
	• Existing laws promote transport and land use integration	• There are two overlapping frameworks, one for traditional public transport and another for mass transit
		• Insufficient instruments for travel demand management
Technical capacity	• A high level of responsibility transferred to the local level	• Discontinuity in local management and staff creates gaps in technical capacity
	• The policy promotes capacity building activities for local bodies	• The focus has been on transport planning while low priority has been assigned to capacity building efforts in operations, management, and customer service
	• National authorities provide technical assistance and funding to municipalities in the course of preparing transport-related projects	

Source: Hidalgo and Díaz (2014)

Table 4.5 Ex-post evaluation of five BRT systems in Colombian cities

City	Investment (million, 2012)	Benefit-cost ratio	Social internal rate of return[a] (%)
Barranquilla (2011)	$201	0.92	−13
Bogotá (2009)	$2675	1.6	24
Bucaramanga (2012)	$293	1.1	14
Cali (2011)	$739	1.2	15
Pereira (2011)	$131	1.7	45

[a]The social internal rate of return refers to the costs and benefits to society of investments in public transport, which includes the opportunity costs of having people not use public transportation rather than only the costs borne by individuals. *Source*: Carrigan et al. (2013), and Bocarejo et al. (2014a)

The long-term financial viability of BRT systems is a constant concern. As demand in most cities (excluding Bogotá) has been lower than predicted, most new systems are under financial stress. Faced with significant cashflow problems, operators are forced to reduce costs and cut service quantity and quality. The national government has finally recognized the difficulty of providing high quality and, at the same time, fully self-sustaining bus services, in which user fares cover all capital and operation costs. Thus, for the first time the recently approved National Development

Plan explicitly allows the provision of subsidies for public transport (DNP 2015b). An effort has also been made to reduce the burden that high fares impose on the poor. In 2014, Bogotá introduced a targeted subsidy for low-income residents, which is easing public transport access for this group (Rodríguez et al. 2016).

Applications by local authorities to the national government for transport funding are not automatically granted. They are required to demonstrate a proactive attitude and a commitment to particular projects. They must have adopted a local mobility plan integrated with the local land use plan, and must be willing to provide matching local funds for infrastructure, amounting to 30–60 % of the total cost. Typically, municipalities and regions use revenues from petrol taxes for this purpose. These taxes are collected locally and amount to 25 % of the petrol sale price. However, these revenues are often insufficient to cover the costs of public transport projects. As a result, local authorities often need to find additional ways to pay for new buses and cover other costs that the national government does not cover.

The involvement of the private sector in local transport financing is strongly encouraged in order to fill funding gaps. With the exception of Medellín, public transport projects around the country have been developed through public–private partnerships (PPP). According to this model, local governments have built the infrastructure and have tendered bus procurements and operations to private parties—often a new variant of the incumbent providers. Additional contracts have been developed with the private sector to set up fare collection and user information systems. These are then overseen by public regulatory agencies.

Currently, local governments still have a long way to go in terms of building technical capacity, coordinating the transport sector with other government sectors, and employing travel demand management strategies (e.g., congestion pricing and/or parking management) to raise additional funding. Local councils have been reluctant to approve direct user charges although the latter are explicitly authorized in the National Development Plan (DNP 2015b). In Bogotá, the city council has voted three times against the introduction of congestion pricing. As a result, it is unclear from where extra funding for public transport will be obtained.

6 Proposed Urban Transport Solutions and Implementation Issues

The crown jewels of Colombian urban and transportation planning are Bogotá's BRT system TransMilenio and Medellín's cable car system Metrocable. These are discussed in turn below.

6.1 Bogotá's TransMilenio

Until the late 1990s, Bogotá's public transport system comprised 21,000 old buses, microbuses, and minibuses affiliated with 68 different private companies. These were scarcely regulated by the local authorities (Ardila 2007). Drivers rented vehicles on a daily basis from individual owners and derived their income from the number of passengers moved. This led to fierce competition on the road—the so-called *guerra del centavo* (penny wars).

After coming to power in 1998, Mayor Enrique Peñalosa pledged to transform this substandard public transport supply model with a mass transit system which came to be known as TransMilenio, which encompass Bus Rapid Transit (BRT) trunkways integrated with feeder lines. The initial 14 km of the system started operations in December 2000 in the last month of Peñalosa's term in office. After this, his successors continued the project (Gilbert 2008).

As of April 2016, the system has 12 trunk lines totaling 113 km with 146 stations in which 1452 articulated buses, 313 biarticulated buses and 262 conventional buses with doors on the left and the right. Trunk service is complemented by 109 feeder routes with 903 buses. The system serves 2.4 million passengers daily, or approximately 35 % of public transport trips in the city. All the system infrastructure, including bus lanes, stations, terminals and bus depots are financed from public funds. Bus operations are covered with the user fare, and since 2013 there is a growing operating subsidy.

Passengers board the buses at special stations many of which can be reached by pedestrian bridges to avoid accidents and to speed up loading (Fig. 4.9). The elevated station platform and the bus floor are at the same height. All stations have electronic boards announcing the approximate arrival time of the next bus. Passengers purchase travel cards before boarding. A fixed fare of 2000 pesos is charged (70¢). The fares are collected by a separate private company. Users enter the station using a smart card, pass through a turnstile, and wait for buses inside the station, which is typically 5 m wide. Some buses stop at every station, while others are express services. Bicycle parking facilities are provided at terminal stations.

The system was built in stages and is eventually expected to cover 380 km (Fig. 4.8). Red articulated buses operate along reserved corridors, with two exclusive lanes each way on most of the routes; a feeder system takes passengers to the main stations. Each articulated bus can carry 160 passengers. More recently, new, larger biarticulated buses, with capacity for 240 passengers, were introduced. The buses are diesel-powered, with 13 % of the fleet being hybrid diesel-electric.

The system is operated by a special agency of the city, called TransMilenio SA, which monitors and controls the system through a satellite tracking system and communicates with the drivers through a wireless telecommunications system. The system is overseen by a public body, which awards contracts to private bus companies on a competitive basis. Private contractors are paid based upon the distance that their vehicles travel.

TransMilenio's implementation was very well received during the first years of operation, and resulted in cuts in congestion, air pollution and traffic incidents (Carrigan et al. 2013; Hidalgo et al. 2013). Nevertheless, services sustain very high occupancy and system expansion has been much slower than initially planned. There has been criticism over its cost and ownership structure, and a debate for the implementation of a metro system has undermined its initially high popularity (Gilbert 2008).

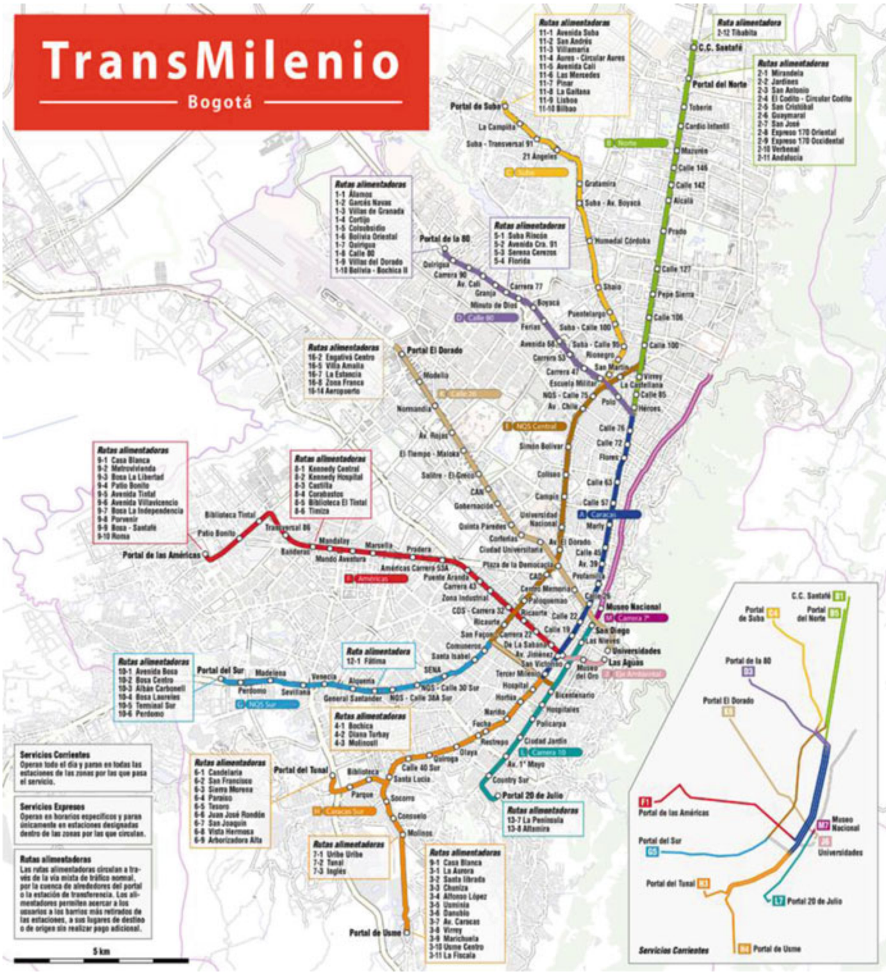


Fig. 4.8 TransMilenio system coverage map (2013). Map courtesy of Maximilian Dörrbecker (Wikimedia)

As the initial plans were delayed, the city administration in 2006 started a process for overhauling the rest of the public transport operations through a contracting scheme similar to TransMilenio, but without the BRT infrastructure. Such system, known as SITP (acronym in Spanish for integrated public transport system) was contracted in 2010 and covers all areas in the city. Implementation started in 2013 and as 2016, 82 % of the previous system has been replaced. In addition, planning for a first metro line as well as regional rail lines has advanced, and these new services are expected to be complementing the BRT system by 2021, along with additional BRT corridors. The main challenge of the local administration in the short term is recovering the BRT service quality; in 2015 only one out of five users declared being satisfied.

Fig. 4.9 Bogotá's BRT system TransMilenio. Photo by Pedro Felipe (Wikimedia)

6.2 Medellín's Metrocable

Medellín sits in a narrow river valley with steep hillsides. Most jobs and middle-class residences are located in the flat portions of the valley, which are well served by two metro lines. However, most low-income residents live on the slopes, in unplanned *barrios* that have grown haphazardly over time, especially in northern portion of the city. A difficult topography, combined with poverty and desperation, has produced inaccessible neighborhoods, ill-supplied with public spaces and other urban amenities. As a result, commuting is a long, expensive, and unsafe experience for many barrio residents.

With the explicit aim of improving accessibility to these areas of the city, the City of Medellín planned an aerial cable car system (Metrocable). While cable cars have a long history in tourist sites (e.g., ski resorts), they had not been employed for utilitarian urban transport until that time. This meant that the risks were high, especially in a geologically unstable area with high crime levels. Two attempts at tendering the construction of the project failed because bidders were not able to secure private insurance policies. In order for the third tender to succeed, the City needed to insure the construction through its own budget (Coupé et al. 2013).

The first cable car line (the K Line) opened in 2004, at a cost of $24 million and a maximum capacity of 3000 passengers/h/direction—low compared to BRT. The project was led by the "Metro de Medellín," a public company that operates the local metro and the BRT systems. The line connected one particularly violent barrio with an existing metro station. In conjunction with the cable car construction, public spaces along the line saw a significant improvement, funded by the municipality.

Fig. 4.10 Medellín's aerial cable car *Metrocable*. Photo by Jorge Gobbi (Flickr)

The City invested more than $300 million in urban upgrades between 2004 and 2011 (Coupé et al. 2013). Local impoverished communities, wholly excluded from public decision-making until then, were invited to provide input on how to spend the public budget for these upgrades.

The project was embedded in a wider "Integrated Urban Project" which dealt with affordable housing, public space improvements, and construction of urban amenities such as parks, libraries, community centers, and a synthetic football field. After the success of the K Line, the City built four more between 2008 and 2016, connecting the CBD to other poor areas on the hills (Fig. 4.10). Today Medellín has almost 12 km of aerial cable car infrastructure, all of which are well integrated with the remainder of the mass transit network. Following Medellín's example, Cali and Manizales have also built cable car systems in geographically inaccessible areas. Meanwhile, Bogotá is currently building a new line and two more are planned.

Medellín's Metrocable proved beneficial on many levels and has achieved worldwide recognition. Due to its use of electricity rather than fossil fuel, it has helped to reduce local pollution emissions. Accessibility to jobs for the poor has been greatly improved. The local real estate market was revitalized, and community cohesion was strengthened (Bocarejo et al. 2014a; Coupé and Cardona 2013). However, as with TransMilenio, this case demonstrates that cable cars alone cannot automatically lead to social inclusion. This can only be achieved through a multi-pronged approach based on an understanding of the mobility patterns of low-income residents. In addition to building aerial infrastructure, Medellín's planners emphasized pedestrian accessibility to stations, coordinated transport and land-use interventions, and encouraged public participation in the decision-making process. These were important success factors.

7 Conclusions

While Colombian cities are faced with growing motorization, congestion, air pollution, traffic fatalities, insecurity, and major access inequalities, the country has also made strides to modernize its urban public transport provision. Local governments have joined forces with the national government and the private sector to help alleviate urban transport problems, and lead cities toward a safer, healthier, and more productive future. In the last few decades, progress is evident. Fifteen cities have acquired new bus systems, which serve more than three million passengers per day. BRT systems are in place in seven cities, which have produced very positive socioeconomic impacts and have fostered a more elevated urban culture. The integration of local mobility and land use planning has been mandated in national policies (Díaz and Bongardt 2013).

Notwithstanding major progress, new problems have appeared too. Formal high quality public transport systems are much more expensive to run than the earlier informal systems based on substandard paratransit vehicles. A requirement for financial self-sustainability, together with a lower passenger demand than expected, has placed bus and BRT operators under pressure and has forced them to lower the quantity and quality of the services provided to passengers. More recently, the national government has allowed operators to raise fares in line with operating costs, while requiring local governments to provide subsidies for lower income and vulnerable groups. Operators are now searching for additional forms of funding to cover their costs.

The high densities of Colombian cities can be harnessed in favor of public transport but also to sustain nonmotorized travel. Conditions for walking and cycling, which are currently very unsafe, need to be improved through infrastructure investments. Air quality and crime issues also need to be addressed in order to encourage more journeys on foot and by bicycle. Beyond pull measures, such as public transport provision, push measures, including Travel Demand Management in the form of vehicle license quotas, parking fees, and congestion pricing, need to be explored as a way of achieving sustainability goals.

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Chapter 5
India

Sujaya Rathi

Capital city	Land area	Total population	Urban population	GDP per capita	Passenger cars
New Delhi	3,287,590 sq. km	1,300 million	32% (401 million)	$1,499	11 / 1,000 people

Data source: World Bank
Maps source: d-maps.com

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The Urban Book Series, DOI 10.1007/978-3-319-43851-1_5

1 Introduction

Despite having a number of extremely large cities and rapid rates of urbanization, India is a predominantly rural country: its hundred most populated cities account for only 16 % of the total population (IIHS 2012). The driving forces of India's urbanization are diverse and include natural population growth, rural-urban migration, and changes in municipal boundaries and area reclassification (Gogoi 2013; Gupta 2014). Recent estimates indicate that most Indian cities will double their population and built-up area by 2030, and quadruple their mobility demand (CSTEP and IUT 2014; McKinsey Global Institute 2010; Swamy 2012).

In economic terms, urbanization has had positive impacts: the hundred most populated cities contribute 43 % of the total GDP (IIHS 2012). However, the sheer number of people now living in urban areas poses transportation problems of an unrivalled magnitude. Current motorization rates surpass both the population growth rate and the urbanization rate. However, growing motorization has not translated into increased accessibility. Sprawling development patterns (both in slums and planned settlements) have severed linkages between residential, employment, recreational, educational, medical, and other activities. Traveling is becoming increasingly difficult in terms of comfort, safety, cost, and time. This is adversely impacting the economic efficiency of Indian cities, as well as the health and well-being of urban Indians. With almost one-third of India's urban population below the poverty line, the mobility problems of the poor, who cannot afford private transport and cannot access public transport, are of special concern. As Indian cities continue to sprawl, the poor are forced to travel increasingly long distances by foot or cycle (Nair 2015).

The chief factors that stand in the way of resolving urban transport problems are institutional, including a weak administrative framework, limited planning capacity, and the lack of integrated land use and transport (IIHS 2015). Despite several ambitious programs launched by the national government, local governments have been unable to transform the face of transport in their cities (Mahadevia et al 2013). In this context, this chapter reviews urban transport trends, problems, and potential solutions in urban India.

2 Urban Land Use Patterns and Spatial Structure

Historically, Indian cities were based around pedestrian movement; most people worked within a small radius of their home (Fazal 2012). Today, most of the larger cities include an old district in their core, which retains small town characteristics

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(narrow, congested streets and intermingled activities) but this is often just a small part of the total urban area. Large cities are also marked by the presence of informal settlements, which are scattered throughout the built tissue, including the periphery (so-called "resettlement areas"). There are also various types of planned residential colonies built by the public, private, or cooperative sectors. Planned commercial districts are spatially dispersed in a polycentric fashion. Industries are concentrated near traditional commercial zones but are also located within newly developed industrial parks in the urban outskirts. Within urban areas, there is no clear demarcation of different activities. Delhi is a classic example: the poor live in informal settlements within the central commercial areas and in the periphery; the elites are concentrated in centrally located, as well as peripheral, planned districts; and the middle classes are dispersed all over the city (Tiwari 2001).

Indian cities have been described as having "high density, low-rise, low accommodation." The level of space consumption per capita is low by international standards. In Mumbai, for example, a typical middle-class family occupies 5 m^2 per capita, compared to 55 m^2 per capita in Manhattan (Patel 2011). In the last decades, population densities in the cores of the ten largest Indian cities have declined further (IIHS 2012). Not only has the public sector tolerated peripheral growth and urban sprawl, it has actually (unintendedly) encouraged it through specific policies designed to decongest city centers. The so-called Floor Space Index[1] has been restricted to 1.6 as compared to 5–15 in other Asian city centers. In peripheral developments a higher Floor Space Index is allowed than in the centers. Thus, policy has induced firms to decentralize—a trend seen in Kolkata, Bengaluru, Chennai, and Hyderabad (Bertraud 2002).

On the edges of Bengaluru and Chennai, a number of "Special Economic Zones" and "technology parks" have appeared. In Special Economic Zones special economic laws apply, with the goal of attracting foreign investments (Topno 2005). New residential districts have grown around these new employment centers but the housing here is not always affordable for workers. In addition, haphazard and speculative developments have mushroomed along the major road corridors that connect the inner cities to the surrounding areas. Within the larger regional system, these typically fall outside municipal jurisdictions (the Urban Local Bodies) and are therefore uncontrolled (IIHS 2012; Ahluwalia 2015). In a context of growing motorization and poor public and nonmotorized transportation planning, these development patterns have led to major traffic congestion problems (Batra 2009; Mohanty 2014).

3 Trends in Transport Use and Mobility

3.1 Automobility

In 2012, there were 160 million motor vehicles registered in India (MoRTH, GoI 2013). While motorization remains low by international standards (11 cars per 1000 people), the number of registered motor vehicles grew 26-fold between 1981 and

[1] The Floor Space Index is the total developed area, including all the floor areas in a multi-storey building.

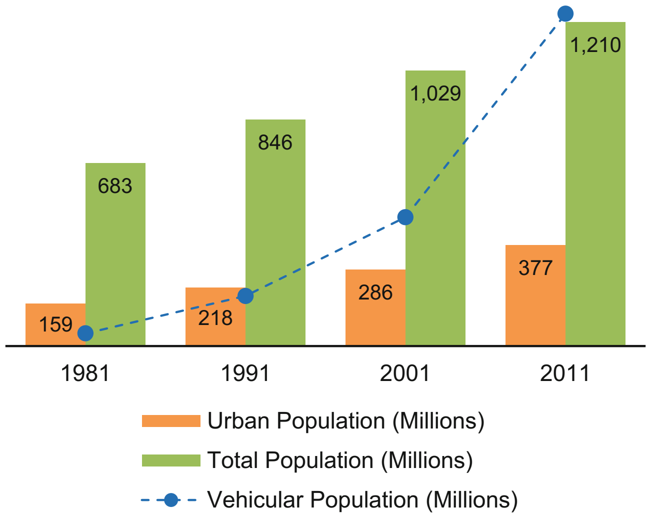

Fig. 5.1 Population, urbanization, and motorization in India (1981–2011). *Source*: Registrar General (2011)

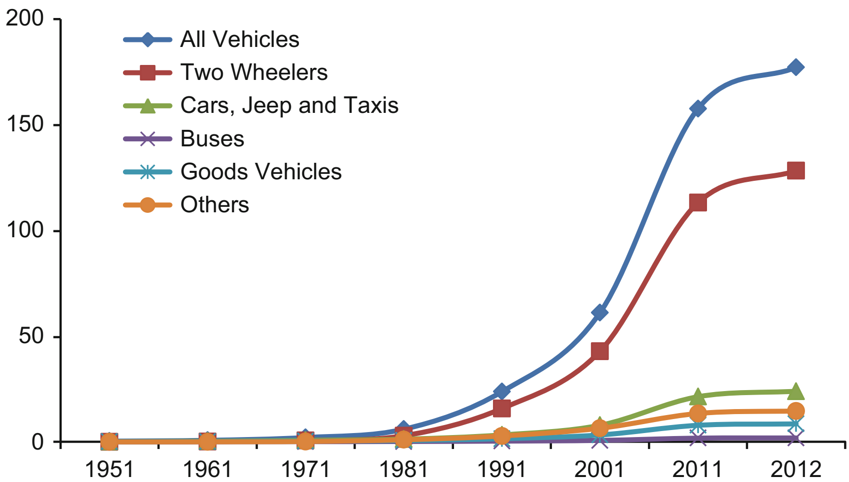

Fig. 5.2 Trends in registered vehicles in India. *Source*: (MoRTH, GoI 2013)

2011, while the overall population and the urban population during the same period grew by factors of 1.8 and 2.4, respectively (Figs. 5.1 and 5.2) (Registrar General 2011). By some estimates, the number of motorized vehicles will quadruple by 2030 (Ghate and Sundar 2013).

There are various reasons behind this exponential increase in motorized vehicle ownership, in addition to India's rapid economic growth. The deregulation of the automobile sector has given impetus to domestic vehicle production, incentivizing the entry into the market of numerous manufacturers (including affordable and fuel

Table 5.1 Travel patterns in Indian cities

City category	Population range (million)	Motorized trip length (km) (2007)	Motorized trip length (km) (2011)	Motorized trip rate (2007)	Motorized trip rate (2011)
1	<0.5	1–3.5	3.5–4.5	0.7–0.7	0.7–1.6
2	0.5–1	2–3.5	3.5–7	0.8–1	0.4–1.6
3	1–2	4–6	6–14	0.9–1	0.9–3.5
4	2–4	4–8	5.5–8	1–1.2	1–1.3
5	4–8	7–10	8–11.5	1.2–1.4	1.2–1.5
6	>8	9–13	11–16	1.2–1.4	1.3–1.4

Note: A larger number of cities were sampled in 2011 than in other years
Source: MoUD (2008) and CSTEP and IUT (2014)

Table 5.2 Modal split in Indian cities (as a percentage of total trips)

Population (million)	Walk	Mass transit	Paratransit		Car	Two-wheeler	Bicycle
			Fast	Slow			
0.1–0.25	37	16	10	20	3	24	26
0.25–0.5	38	21	9	17	3	30	21
0.5–1	31	25	8	12	10	29	16
1–2	30	31	6	8	3	40	12
2–5	29	42	5	3	5	29	16
>5	28	63	3	4	6	15	9

Source: Singh (2009)

efficient cars and motorized two-wheelers). Easy access to auto finance and low insurance rates have also fueled car ownership.

Travel data for Indian cities show that people are now making more trips (both in total and by car), and their trips are longer (Tables 5.1 and 5.2). However, people in the informal sectors display different travel behavior. Among these groups, especially in smaller cities, walking and cycling trips account for 40–80 % of the commuter trips despite inadequate and unsafe conditions for nonmotorized travel (Tiwari 2002; Kunieda and Gauthier 2007). For the poor, this is often the only option, as public transport fares are too expensive for much of this group: approximately half of the urban slums residents spend nearly one-third of their family income on public transport (Tiwari 2007). The main public transport patrons are individuals employed in the formal sector, who can afford motorized travel.

Public transport development has not kept pace with the increase in travel demand, compelling people to turn to either cars or informal paratransit (MoUD 2008). Only older and larger cities, such as Kolkata and Mumbai, in which the rate of population growth has abated, and mass transit systems (bus, rail, ferry) have been established, have had lower rates of car use increase, in comparison to smaller and faster growing cities with inadequate public transport systems (Fig. 5.3). Public

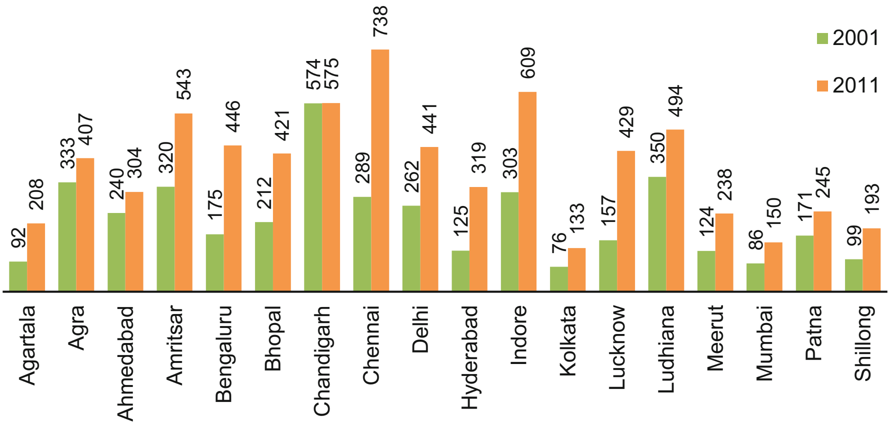

Fig. 5.3 Motorization trends (vehicles/1000 people) in select Indian cities. *Source*: MoRTH, GoI (2013), and Registrar General (2011)

transport remains the predominant mode of travel in these megacities. In cities with fewer than five million inhabitants, cars and two-wheelers constitute a significant share of vehicles on the road.

The heterogeneity of traffic on Indian roads adds another dimension to urban and transport challenges. A mixture of vehicles with widely varying sizes, speeds, occupancy, and heights share the same road space without segregation (Figs. 5.4 and 5.5). Traffic control and management is primitive or nonexistent, often without even the most basic street signage. In this context, traffic congestion and chaos reign (Pucher et al. 2005).

In almost all cities in India, the typical government response to easing congestion has been the construction of additional road infrastructure—ring roads, signal-free corridors, and flyovers (equipped with pedestrian overpasses in some cases)—or the expansion of existing infrastructure. In a vicious circle, these interventions have created more urban sprawl and produced some extremely unlivable and unsustainable urban spaces and structures (Gogoi 2013; Gupta 2014). In Bengaluru, for example, recent road construction projects not only did not alleviate traffic but resulted in a higher congestion index, with bottlenecks merely shifted around the city (Directorate of Urban Land Transport 2011).

The reasons behind these investment choices are political. While much of the population is so poor that it cannot afford motorized transport and has to spend hours of walking and cycling for travel, government policies have focused on serving the needs of an elite minority. The concentration of wealth and power is among an economic and political elite that has distorted transport policies in India (Pucher et al. 2005).

Fig. 5.4 Heterogeneous traffic in Guwahati (2009). Photo by author

Fig. 5.5 Heterogeneous traffic in Ranchi. *Source*: (ITDP 2015), Creative Commons Attribution 3.0 License)

3.2 Public Transport

Public bus transport accounts for a majority of all public transport use in India although this mode has been losing ground in recent years (Indian Institute for Human Settlements 2015). While the absolute number of public transport buses per capita has no doubt increased in cites, the share of buses as a percentage of registered vehicles has declined from 11 % in 1951 to a mere 1 % in 2012. Bus ridership levels vary widely by city, as do ridership trends. For example, between 2006 and

2011, Delhi and Chennai experienced an increase in bus ridership of 91 % and 36 %, respectively, while Mumbai saw a decrease of 26 % (MoRTH, GoI 2014). Despite ridership gains in a few large cities, the poor financial performance of bus enterprises has limited the ability of operators to improve services, which, in turn, has driven passengers towards other modes. Almost everywhere, informal operators (two-wheelers, rickshaws, and the like) have stepped into the market to fill major service gaps. The local economies are such that the unit operating cost for two-wheelers is lower than the fares charged by public transit operators. This makes paratransit an attractive option compared to formal buses (Centre for Science and Environment 2012).

Other than bus-based public transport services, two types of urban rail systems operate in Indian cities: urban (metros) and suburban. The impact of metro services has been mixed. For example, in Delhi and Kolkata, the ridership is high is some routes, mainly due to the dense and linear form of these cities. However, the presence of metros has not contained motorization (CSTEP and IUT 2014). Suburban rail is found in some cities, including Mumbai, Kolkata, Chennai, and Hyderabad, but is often considered as a low priority, and therefore is not well leveraged and integrated with the urban systems. Another lacuna that hinders rail ridership is a lack of connectivity at the start and end of a journey (the "first and last mile") for many potential passengers. Paratransit has emerged partly to address this gap (Fig. 5.6).

Fig. 5.6 Public transport in Kolkata. Photo by Arne Hückelheim (CC BY-SA 3.0)

3.3 Paratransit

Paratransit in Indian cities—also referred locally as “intermediate public transport”—is mostly informal. It includes rickshaws (auto, cycle, and manual) and casual carpooling systems (Fig. 5.7). Rickshaws operate in one of two ways. They are either hired for door-to-door trips (in the same way as taxis) or they operate along fixed routes and charge fixed fares (the same way as buses). Nearly 75 % of the global auto-rickshaw population is found in India and an estimated 2–7 million cycle-rickshaws circulate in Indian cities (IDFC 2012; Mani and Pant 2012).

Paratransit is ubiquitous in smaller cities and towns in which the population thresholds are too low, the trip distances are too short, and the activity centers too scattered to justify the introduction of formal urban bus systems. In larger cities, paratransit both competes with and complements (i.e., feeds) mass transit services. Paratransit provides first and last mile connectivity for passengers who live at a distance from stations. Rickshaws are preferred by some users over mass transit for whole trips because these vehicles are widely available, flexible, cheap, and can easily maneuver through narrow streets and congested urban conditions.

While providing a valuable service, paratransit also poses many challenges, in terms of passenger and driver comfort and safety, and environmental pollution (IDFC 2012). The regulatory environment in which rickshaws operate is problematic; some of the legislation is very restrictive; some is highly ambiguous. In theory, motorized rickshaws are regulated by a national government act and associated laws adopted by state governments while nonmotorized rickshaws are governed by the respective state acts. However, local governments often set their own quotas for issuing paratransit permits, thus laying the ground for negotiation and corruption.

Fig. 5.7 Cycle-rickshaw in old Delhi. *Source*: Bialek (2011). GNU Free Documentation License, Version 1.2 or any later version

More recently, app-based taxi services are becoming popular, especially in larger cities such as Kolkata, Mumbai, and Bengaluru. These services are quite competitive in terms of cost compared to private cars. As a new phenomenon, their long-term impact on urban transport is uncertain but their use is set to increase (Thakkar and Chanchani 2015).

4 Urban Transport Problems

4.1 Congestion and Parking

Traffic congestion levels are huge in Indian cities and vehicular speeds are as low as 15 km/h during peak periods (Directorate of Urban Land Transport 2011; MoUD 2008). Delays cost millions of dollars to the nation (Institute for Competitiveness, India 2012). To speed up their journey and bypass others, motorists avail themselves of any possible shortcuts, even driving on sidewalks (Fig. 5.8). In a context where only 30 % of the urban roads have sidewalks, this behavior is extremely detrimental to pedestrian safety and comfort (Bhatt and Mehta 2013).

Adding to the congestion is a severe shortage of parking spaces, both on- and off-street (Rye 2010). In some cities (e.g., Madurai, Agra, Pune, and Surat), nearly 60 % of the road length is blocked by on-street parking. In the densest cities such as Mumbai, Kolkata, Chennai, and Delhi, a parking place occupies more space than a low-income family of four (Gauthier 2012). The parking shortage is a product of irrational parking pricing, combined with poorly enforced parking policies.

Fig. 5.8 Sidewalks encroached by motorcycles. Photo by CSTEP

However, lax land use planning is also responsible, which has permitted the development of monofunctional lots, inaccessible by public transport (Chanchani and Rajkotia 2011; Roychowdhury 2013).

4.2 Health and Safety

Transport affects the health and safety of urban residents by exposing them to pollution and dangers on the roads. Large Indian cities (population more than one million) contribute nearly one-quarter (23 %) of the total road accidents. Pedestrians, cyclists, and motorcyclists constitute a majority of urban road fatalities (up to 80 % in Mumbai); riders of motorized two-wheelers alone represent 29 % of all fatalities (MoRTH 2012). Pedestrian deaths are higher in the urban outskirts while injuries are more prevalent in inner cities (Tiwari 2011). In addition to road fatalities, there are hundreds of fatalities every year at railroad crossing gates as safety guidelines are unenforced (Kumar and Bindra 2013). There is large variation in the fatality risk across urban regions (ranging from 3.2 deaths per 100,000 people in Kolkata to 34.4 per 100,000 people in Vishakhapatnam), which is reportedly related to urban density (Singh 2012).

Air pollution levels in urban areas are among the highest in the world. While SO_2 and NO_2 levels comply with (low) local standards, particulate levels (both respirable and non-respirable) in most cities are alarming (Central Pollution Control Board 2012).[2] Delhi is one of the most polluted cities in the world with a $PM_{2.5}$ level of 153 μg/m^3 (Mathiesen 2015). High pollution levels are quickly becoming a concern for smaller cities too. Cities with fewer than four million inhabitants contribute almost half (47 %) of the total emissions (CSTEP and IUT 2014; Mathiesen 2015). Greenhouse Gas (GHG) emissions (the primary causes of global warming) are also growing. The transport sector contributes about 7.5 % of CO_2 emissions in India and this share has been increasing over time (Ministry of Environment and Forests 2010). Within cities, cars and two-wheelers (motorcycles and scooters) contribute 60–90 % of the GHG emissions while accounting for less than one-third of all trips (Central Pollution Control Board 2008; Indian Institute for Human Settlements 2012). The most important causes of high emissions from transport are the age old and the inefficient engines of the motorized two- and three-wheeler fleet as well as illegally adulterated fuel with kerosene and lubricating oil (Pucher et al. 2005). Most of the recent progress in reducing air pollution has resulted from regulations requiring cleaner fuels (see Sect. 6.5).

[2] Local air quality standards are set in the National Ambient Air Quality Standard, produced by the Central Pollution Control Board. These standards are generally less stringent than the World Health Organization standards.

4.3 Equity

The lack of accessibility to jobs and services affects the livelihood of the Indian urban poor (one-third of the population) directly or indirectly. The poor in Indian cities cannot afford private motorized transport and are reliant on nonmotorized, informal, or public transport (World Bank 2005). However, informal settlements in core areas are generally inaccessible by public transport. Public transport might be available to slum dwellers in peripheral areas but the fares are often too high for these residents (Rathi et al. 2013). The problem of overall low per capita incomes in India is compounded by extreme income inequality.

Poor women are significantly less mobile than poor men. Urban transport-related security of women is a very salient issue in India. Many cases of sexual harassment and violence against women occur while they are using public transport or even while walking on public streets. A range of interventions have taken place to tackle the issue, including the employment of female taxi drivers (Mumbai) and female conductors (Bengaluru, Hyderabad), the installation of Closed-Circuit Television Cameras (CCTVs) in public transport vehicles and stations (Ahmedabad), and the design of smartphone apps which assign safety scores to public spaces (e.g., Safetipin). However, the problems have not gone away. More efforts in a more coordinated manner still need to be made by the police, transport agencies, and gender advocacy organizations (Khan 2015; Mahadevia et al. 2013).

In the case of the differently abled, the physical design of transport infrastructure (e.g., unsafe road crossings, crowded buses, missing handrails in buses, high steps in bus stops and vehicles, lack of reserved seats in public transport) represents another major barrier to their autonomous mobility. However, cultural constraints inhibit their full participation in public life too. People with disabilities are often confined to their homes. To overcome some of these problems, flexible door-to-door modes, such as rickshaws, are preferred over fixed route modes, such as rail and even Bus Rapid Transport (BRT) (Kunieda and Gauthier 2007; Mahadevia et al. 2013).

4.4 Oil Security

India is a net fuel importer and the country consumes 65 Mt of diesel and 15 Mt gasoline annually (diesel is preferred due to its cheaper consumer price). The transport sector is responsible for 70 % and almost 100 % of this consumption, respectively (Nielsen 2013). A steep increase in fuel consumption, due to growing motorization, has drained the country's foreign exchange reserves. The fuel import bill has increased more than 100-fold between 1981 and 2012, from $883 million to almost $123 billion (Ministry of Petroleum and Natural Gas 2011). This raises major energy security concerns as a result (CSTEP and IUT 2014). Estimates for 2016 indicate that the import bill is likely to decrease to $73 billion, due primarily to fluctuations in international oil prices and exchange rates, rather than a reduction in consumption (Press Trust of India (PTI) 2015).

5 Urban Transport Governance, Decision-Making, and Financing

India's urban transport governance is plagued by institutional fragmentation, low levels of institutional coordination, limited planning capacity, lack of public participation, and restricted scope for land use and transport integration.

5.1 Institutional Setup and Capacity

Urban transport planning in India has been characterized as a "constitutional and institutional orphan" (Working Group on Urban Transport 2012). The responsibilities for policies, planning, investment, operations, and management are scattered among a myriad of national, state, and local governmental organizations (Table 5.3). These organizations work along administrative and sectorial lines in an uncoordinated rather than holistic manner (Vaidyanathan and King 2011).

Table 5.3 Transport-related government organizations and their functions

Organization	Function
Urban transport planning	
Ministry of Urban Development	Overall responsibility for urban transport policy and planning
Development Authorities with state governments	Allocate land uses (relevant law: State Development Act)
Road transport	
Departments of Transport Development within state governments	License and inspect vehicles, issue permits, set motor vehicle tax rates (relevant law: Motor Vehicle Act of 1988)
State Transport Undertakings	Operate bus services (relevant law: Road Transport Corporations Act of 1950)
Ministry of Road Transport and Highways	Administers the Motor Vehicle Act of 1988 and determines vehicle and emission standards
Infrastructure and traffic	
Public Works Departments within state governments	Build and maintain state roads
Ministry of Road Transport and Highways	Build and maintain national highways
Municipalities	Build and maintain local roads, road signage, and traffic lights; license and control of nonmotorized vehicles; clear road encroachments; allocate land uses
Police	Enforces traffic laws
Ministry of Petroleum and Natural Gas	Regulates prices and quality of fuels
Departments of Environment within state governments	Monitor air quality

India's top-down, centralized planning style—a combination of Soviet-era and British colonial legacies—makes the governance of urban transport issues complex and difficult. In the past, Soviet-style 5-year plans were prepared, primarily concerned with state and national level development; urban development was not a focus area. More recently, multiple laws have been adopted, which mandate a decentralization reform in urban transportation planning, with local civic groups in charge of city-based projects. However, few genuine efforts have been made in this direction (Vaidyanathan and King 2011). As for urban planning and development, this is mainly rooted in the Town and Country Planning Act of the United Kingdom of 1947, based on a detailed zoning plan. However, this British style "command and control approach" is inappropriate for India's urban context since it lacks sufficient flexibility needed for dealing with the fast changing dynamics of Indian cities. Moreover, it undermines the role of market forces in determining the scale and location of economic activities and does not respond to the needs of a majority of workers (59 %) who are employed in the informal sector (Ahluwalia 2015; Chen and Raveendran 2014).

As for urban transportation, local authorities still have very little decision-making powers in this matter. They are not legislatively or financially empowered to plan and act. Decisions lay with state governments, which are far removed from the concerns of particular cities. Urban residents are thus very disconnected from transport governance. They do not, for example, have a forum in which to share information or advocate solutions (NTDPC 2013). In larger cities, transport governance is particularly problematic, not only due to the scale of issues and a lack of citizen input, but also because larger cities often include rail transport infrastructure and services within their territory and rail is typically overseen by national and state agencies. This creates a major scope for conflicts and inefficiencies.

In addition to centralization and institutional coordination issues, weak transportation planning capacity at the state and local levels presents a major barrier to dealing with transport issues and urban systems (HPEC 2011). Recently, for example, the national government required cities to compile Comprehensive Mobility Plans covering their territorial jurisdictions. Analysis of these plans indicated compilations of urban transport project proposals without rigorous cost–benefit analyses of alternatives. Major issues in Indian cities such as pedestrian transport, public transport accessibility, and the needs of vulnerable and low-income groups were typically neglected (Chotani 2010; The Energy and Resources Institute (TERI) 2011). While the plans succeeded in generating a substantial amount of transport-related data, this effort was mainly in vain because limited funding was provided for implementation. In some cases, these plans were in contradiction with the plans prepared by higher levels of government. In Bengaluru, for example, the Structure Plan (2011) and the Regional Master Plan (2015) were not aligned to each other and, consequently, there were gaps or duplications and incoherent investment decisions (Rathi and Bhattacharya 2014).

5.2 Financing

In 2005, the Indian national government launched the Jawaharlal Nehru National Urban Renewal Mission, a 7-year program (2005–2012) which made $20 billion available for urban infrastructure investments. One year later (in 2006), the National Urban Transport Policy was adopted, which defined the priorities for investments in urban transport. At least at a rhetorical level, public transport and nonmotorized modes were prioritized over personal motor vehicles. These two programs offered significant financial impetus to city administrations, and also enticed states to reform certain institutional aspects of urban transport.

Since then, the Jawaharlal Nehru National Urban Renewal Mission funds have been used to build new mass transit systems (metro and BRT) in many cities, and to procure thousands of higher quality urban buses, including features such as digital passenger information displays and Closed Circuit Television Cameras (CCTV). Bus purchases were not part of the original purpose of the Mission funds. However, a decision was made to include them after 2009 in order to provide an economic stimulus to the local bus-building industry. In fact, certain government-mandated specifications for buses clearly benefited these companies.

Meanwhile, Indian metro systems have been financed through a variety of other sources, including soft loans from the Japan International Cooperation Agency, as well as Mission funds (Goel and Tiwari 2014). Mechanisms such as Public–Private Partnerships (PPPs) for the construction, operation, and maintenance of urban infrastructure are relatively new. Rather than easing the burden of cities, PPPs have often led to disputes and a large “viability gap” of public funding, further straining urban transport operations and management. Taking advantage of the fact that the public sector lacks experience in designing PPP contracts and assessing risks, private companies participating in PPPs have often manipulated ridership figures for their own gain. Examples include the Delhi Airport Express Metro and the Hyderabad Metro. The current ridership of the Delhi Metro—the world’s 12th largest system in terms of length and number of stations (190 km long)—is reported to be 2.6 million passengers per day, although the original feasibility study projected a daily ridership of 3.1 million passengers for a 65 km system (Goel and Tiwari 2014).

The costs of many metro projects have been very high relative to India’s GDP per capita (Table 5.4). However, metro projects have frequently been preferred over the enhancement of bus systems. It is not clear why, as the process of decision-making regarding mass transit technology is not transparent. In the case of the Bengaluru Metro, the environmental impact assessment mentions that a metro system was decided upon after “several alternatives” were assessed and compared but none of these was ever documented. In the case of the Hyderabad Metro, allegations were made that the decision to award the contract was made well before the tendering process had begun, showing collusion at the highest level, promoting “big-ticket projects” (Ramachandraiah 2009; Vaidyanathan et al. 2013). A preferential treatment of rail over bus systems is also reflected in taxes incurred by the respective operators (Table 5.5). While bus operators are overloaded by taxes, rail operators are exempted from most taxation.

Table 5.4 Urban rail transport investments

Project	Total (million)
Delhi Metro Phases I & II	$590
Kolkata Metro (Pre-Jawaharlal Nehru National Urban Renewal Mission)	$40
Kolkata Metro East-West Corridor	$90
Bengaluru Metro	$160
Chennai Metro	$296
Public–Private Partnerships	
Delhi Airport Express Link	$80
Mumbai Metro Phase I	$510
Hyderabad Metro	$330
Gurgaon Metro	$22

Source: Goel and Tiwari (2014)

Table 5.5 Comparison of taxes incurred by bus operators and rail operators in Delhi

Delhi Transport Corporation (bus operator)	Delhi Metro Rail Corporation (rail operator)
1. Wealth tax	1. Wealth tax
2. Taxes on acquisition of immovable property	Exempt from
(a) Tax on acquisition of land (state)	(a) Property tax
(b) Property tax (municipal)	(b) Sales tax
3. Taxes on acquisition of buses	(c) Works' contract tax
(a) Value-added tax (state)	(d) Income tax
(b) Central excise (national)	(e) Capital gains tax
(c) Customs duty for imports (national)	(f) Customs
(d) Octroi (municipal)	(g) Excise
(e) Entry tax (state)	
4. Taxes related to operations	
(a) Excise duty on consumables (national)	
(b) Value-added tax on consumables (state)	
(c) Excise and value-added tax on spare parts	
5. Tax on use of vehicles for passenger transport	
(a) Motor vehicle tax (state)	
6. Advertisement tax (municipal)	

Source: Kharola and Tiwari (2008)

A review of public taxation and expenditures for transport indicates that private cars and rail systems are favored. Notwithstanding a pro-bus and pro-cycling rhetoric, the Jawaharlal Nehru National Urban Renewal Mission allocated a majority of funding (more than 70 %) for road widening projects and the construction of flyovers while funding for nonmotorized transport infrastructure was minimal (IIHS 2015). In some cases, buses are taxed more than personal vehicles. For example, in the State of Karnataka, all automobile taxes amount to just 5 % of the taxes paid by the local bus corporation. Clearly, the stated principles and fiscal strategies of the National Urban Transport Policy have been inconsistent.

6 Proposed Urban Transport Solutions and Implementation Issues

Many of the recent interventions in urban transport are a result of support from the Jawaharlal Nehru National Urban Renewal Mission funds, although sometimes only loosely based on the principles set forth in the National Urban Transport Policy principles, as mentioned above. Currently, the Jawaharlal Nehru National Urban Renewal Mission is being phased out without having succeeded in abating motorization rates. Its main achievements are reviewed below.[3]

6.1 Institutional Coordination and Capacity Building

India lacks cooperation among different transport agencies, departments, and ministries as well as overall coordination of transport and land use policies, as noted above. In order to improve these issues, the National Urban Transport Policy proposed the establishment of Urban Metropolitan Transport Agencies in all cities with more than one million inhabitants. These agencies would be backed by legislation and funding for urban transport projects and policies would be routed through them. At present, there are only eight or ten such agencies in existence. Discussions regarding the formation of many others are underway across India but the implementation time frame is unclear. The existing agencies act more like committees within existing organizations than as independent planning institutions (Mohan 2014). For example, in Bengaluru, a Directorate of Urban Land Transport was created with a mandate to coordinate land-based transportation projects but in reality it merely handles administrative protocols and bureaucratic hurdles; it has neither funding nor regulatory powers to intervene in transport matters (Vaidyanathan and King 2011). Only the Hyderabad Urban Metropolitan Transport Agency has, to a certain extent, achieved its original mission (Mohan 2014).

One reason why fully fledged institutional reform has not taken place is that local governments have low planning capacity and insufficient professionals trained in the new sustainability paradigm. Dated higher education curricula and India's severe brain drain are partly responsible for this outcome. To promote better practices and train professionals on the job, the national government has provided financial assistance for training sessions and awareness-raising campaigns (e.g., air pollution). Centers of Excellence in Urban Transport sponsored by the Ministry of Urban Development have also been set up within universities.

[3] Recognizing the overwhelming urban transport problems still facing Indian cities, the national government is planning on launching several successor programs, which are more ambitious than the Mission. These include: the Smart Cities Mission; the Atal Mission for Rejuvenation and Urban Transformation; and the Heritage City Development and Augmentation Yojana.

These offer postgraduate degrees in urban transport planning and management, conduct research, organize conferences and workshops, and provide technical assistance to the government itself. However, much more can still be done in terms of capacity building.

6.2 Improving Public Transport

The selective privatization of bus services in several Indian cities, with Delhi, Kolkata, Bengaluru, and Hyderabad leading the way, has led to higher productivity, lower costs, more passengers per bus, and higher revenues per bus km of service. However, experience to date has shown the crucial need for public regulation of safety, route and schedule coordination, and service quality (Pucher et al. 2005). In addition to privatization, the Jawaharlal Nehru National Urban Renewal Mission funds have been used to procure modern buses replacing old, dangerous vehicles, as noted above, as well as to initiate BRT systems in 12 cities.

The Delhi BRT was one of the nation's first "full" BRTs. While it has clear institutional responsibilities and a thoughtful and inclusive design, this BRT has faced many operational challenges, as well as stiff opposition from car-owning elite. It has been widely lambasted in the press as an abject failure, with public-interest litigation leading to a court-ordered shutdown of the system. Today it continues to face public relations obstacles. Despite high ridership, it has failed to be extended beyond its initial pilot length. In contrast, the Ahmedabad BRT (Fig. 5.6), which was launched little more than a year later, is now internationally lauded as a success story, receiving multiple national and international awards. Implemented much faster than Delhi, it also benefited from thorough design, clearly assigned organizational responsibilities, and strong political backing. Today the system is well received by city residents, extending to nearly 90 km and serving 132,000 passengers daily, while also recovering its operating costs. The differences between the two systems have been attributed to the different planning approaches and timing. While Delhi's plan-making was long, technically focused, and sequential, Ahmedabad's was shorter, more politically oriented, pragmatic, and incremental, with more opportunities for feedback and adjustments (Rizvi and Sclar 2014; TNN 2016). Nevertheless, even Ahmedabad's BRT has failed to increase the public transport modal share (TNN 2016). Other BRT projects have been plagued by fragmented planning, operational inefficiencies, political struggles, land acquisition disputes, cost overruns, and slum rehabilitation issues. In all cities which have attempted BRT implementation, these systems have not been perceived as a backbone of the urban transport system but rather as a secondary system. BRTs in Pune, Indore, and Jaipur have been dismantled in order to be replaced by high cost metro systems (Mahadevia et al. 2013).

6.3 Prioritizing Nonmotorized Transport

One of the most crucial needs in Indian cities is the provision of improved rights of way for pedestrians and cyclists. These nonmotorized travelers, who account for about half of all trips made and are among the most vulnerable roadway users, have been largely ignored by policy makers. In a context of narrow roads, densely built central cities, and lack of funding, it is very rare to find any special provisions for pedestrians and cyclists. As a rare exception, in the planned city of Chandigarh, 160 km of cycle paths were built between 2001 and 2003 (Chhabra 2002). On some arterial routes, special pedestrian paths were also constructed. While scarce roadway space hinders nonmotorized transport, the real problem lies with government priorities that favor motorized traffic. Since the powerful elite are more likely to drive private cars, they have strongly favored road projects over improvements for pedestrians and cyclists (Pucher et al. 2005).

Earlier drafts of the National Urban Transport Policy promised 50 % national government financing of both cycle tracks and pedestrian paths in large cities. In the first stage, it would finance 50 km of cycle tracks in all cities with at least a million residents, and 100 km of cycle tracks for all cities with at least three million residents (Pucher et al. 2005). In reality, the financial allocation patterns heretofore adopted have not supported the main objectives of the National Urban Transport Policy. Chennai, Delhi, Hyderabad, and Pune have spent less than 20 % of their Jawaharlal Nehru National Urban Renewal Mission funds on nonmotorized transport infrastructure (IIHS 2015; Joshi and Joseph 2015).

More recently, various bottom-up cycling initiatives have emerged, led by higher-income cycling enthusiasts. Examples include bicycle sharing schemes such as Cycle Chalao (Mumbai) and Namma Cycle (Bengaluru), albeit with limited coverage and ridership. Other cities including Bhubaneswar, Mysore, Jaipur, Rajkot, Vadodara, and Ahmedabad are following suit (Kumar 2013; Rohith 2013). However, utilitarian cycling in many cities suffers from serious neglect in public policies and projects (Joshi and Joseph 2015).

6.4 Traffic and Travel Demand Management

Better traffic management in all Indian cities is crucial in order to mitigate some of the current traffic problems. Most medium-size and small Indian cities (with the exception of the planned city of Chandigarh) lack even basic provisions such as road signage, traffic signals, lane markings, and other regulatory signage. The traffic regulations that currently exist are not well known due to lack of driver training. Moreover, regulations are rarely enforced by the police. In traffic disputes, the police often favor motorists, even if they are at fault, since they are more affluent than nonmotorized travelers (Pucher et al. 2005). India's largest cities have benefited from modest improvements in traffic management through the introduction of more advanced technology and stricter enforcement of traffic regulations (Pucher et al. 2005). In Delhi, for example, the local government has recently initiated a pilot to restrict the use of private cars based on license plate numbers. The experiment exempts women, cars using compressed natural gas, and those belonging to senior government officials and judges, as well as two-wheelers (which constitute the majority of the vehicles on Delhi roads). The pilot has eased congestion but its impact on air pollution has been rather limited (Najar 2015, 2016).

6.5 Fuel Standards

Over recent decades, the Indian government has introduced a series of regulations to limit pollution from private cars, buses, and trucks. Between 1991 and 2000, national regulations for new vehicle emissions reduced allowable levels of carbon monoxide (CO), hydrocarbons (HC), and nitrogen oxides (NOx) (Pucher et al. 2005). Lead in fuels has been phased out and the permissible levels of sulfur and benzene in fuels have been reduced. In the late 1990s, Delhi was forced to adopt the rather drastic policy of requiring all buses, taxis, and trucks to convert from petrol and diesel to compressed natural gas (CNG) within a period of a few years. By mid-2000s, the city was winning awards for its bold efforts to curb air pollution and support alternative fuel initiatives (Solomon 2003). However, in the absence of substantial reductions in travel, Delhi's success was short-lived and air pollution is acute.

In 2014, the Bureau of Energy Efficiency introduced fuel economy standards for passenger cars (Ministry of Power, GoI 2015), requiring all car manufacturers to attain a fleet average of 54.5 miles per gallon by 2025 (Gordon-Bloomfield 2015) However, to an extent this is in conflict with existing fuel policies, which are focused on fuel quality and emissions rather than fuel economy. Some preliminary steps have been taken toward the adoption of electric vehicles. A National Electric Mobility Mission Plan and a Faster Adoption & Manufacture of Electric Vehicles Policy have been instituted by the national government. The current policy climate in India focuses mainly on electric buses. However, a better understanding of the technology and policy landscape is required by the administrative bodies in charge of policy implementation, such as the State Road Transport Undertakings, as well as more robust assessment methods for evaluating costs and benefits.

Phasing out or converting the most polluting motor vehicles has proven difficult. The highly polluting two-stroke engines of motorcycles, scooters, and auto-rickshaws pose serious environmental problems since these vehicles are more affordable than private cars and have been growing very rapidly in number. Although unpopular across society, it seems necessary to mandate all new motorized two- and three-wheelers to have much cleaner engine technology (Pucher et al. 2005).

7 Conclusion

Urbanization, growing incomes, changing lifestyles, and urban sprawl have intensified the travel demand in India. This has serious environmental, economic, and social implications for Indian cities. Private vehicles offer unparalleled convenience, and with the increased purchasing power of the middle class, the car and two-wheeler fleet has skyrocketed. Public transport has failed to remain competitive, which has increased the attractiveness of private mobility solutions, including informal modes. The mass of motorized vehicles competing for space on narrow roads has overshadowed nonmotorized modes. Longer walking and cycling trips lengths, coupled with the great risk of traffic accidents, have reduced the space and opportunity for pedestrians and cyclists. The urban poor are especially disadvantaged in this situation.

The current state of affairs is unsustainable and there are various obstacles to implementing policies to deal with India's urban transport problems. Among these, financial and political barriers are crucial. Budget problems at every level of government—national, state, and local—severely limit the extent to which experienced professionals can be engaged in public institutions and public subsidies can be provided for measures in favor of urban sustainability. The urgency of improvements often leads to ad hoc public initiatives that are not aligned with long-term visions. Increased participation by the private sector in the bus and rail sectors might ease public budget pressures but experience to date with PPP models has not been encouraging. Another formidable obstacle to improved transport policies is the political influence of the automobile and highway lobbies in India, as well as affluent Indians, who benefit the most from increased adaptations of transport policies to their car-oriented lifestyles (Pucher et al. 2005).

A more sustainable way forward is to promote a more integrated approach to urban transportation planning. A paradigm based on measuring the outcomes rather than the feasibility of proposed solutions is needed. This requires an enabling framework, derived from a robust, integrated, and participatory institutional framework. Different sectoral ministries, including the Ministry of Road Transport and Highways and the Ministry of Urban Development, need to develop a shared agenda for urban transport. Urban transportation planning needs to be placed centrally within the context of India's development goals. A multipronged approach is needed in each sector, as well an understanding of the inter-sectoral impacts of decisions related to urban transport. Local government needs to be empowered to act through legislative authority, financial independence, and professional capacity. Its aim should be to reduce the number of cars on the road, prioritize pedestrians and cyclists, enhance public transit systems (BRT and/or rail, based on a rigorous assessment of alternatives), manage traffic efficiently, encourage the use of cleaner fuels and vehicles, and stir new development toward transit nodes and corridors, thereby curbing energy use, emissions, and congestion.

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Chapter 6
Indonesia

Yusak O. Susilo and Tri Basuki Joewono

Capital city	Land area	Total population	Urban population	GDP per capita	Passenger cars
Jakarta	1,919,440 sq. km	250 million	52% (130 million)	$3,475	39 / 1,000 people

Data source: World Bank
Maps source: d-maps.com

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1 Introduction

Indonesia is the largest archipelago in the world, with 17,504 islands. Of these, only approximately 6000 are inhabited (CAI-Asia Centre 2009). The five major islands are Kalimantan, Sumatra, Papua, Sulawesi, and Java. The archipelago bridges two continents, Asia and Australia. This strategic position has had great influence on the country's cultural, social, political, and economic life.

With a population of 255 million, Indonesia is the world's fourth largest country (BPS 2015). From the beginning of 1990s, it has experienced rapid urbanization. The portion of urban population has increased from less than a quarter of the total in 1980 to more than half in 2015. Significant urban-rural disparities in infrastructure provision and job opportunities have driven urbanization trends. Moreover, the populace considers big cities as the epicenter of the "good life" (Dikun 2003; Morichi 2005; Boquet 2010). Census forecasts suggest that, by 2035, two thirds of the population (305 million by then) will live in urban areas (BPS 2015). Urbanization has been accompanied by substantial economic growth. According to some projections, by 2050 Indonesia will be the fourth largest economy in the world, after China, India, and the USA (Price Waterhouse Coopers 2015).

In line with population and economic growth, motorization has also increased rapidly. In 1987, there were only eight million motorized vehicles registered in Indonesia. By 2013, the number had increased to 104 million: a spectacular increase within 26 years; half of these vehicles were registered in Java (BPS 2015). Private car ownership is seen as a mark of elevated social status (Belgiawan et al. 2015). Moreover, the economic benefits of motorization are substantial. In the absence of adequate mass transit systems within Indonesia's sprawling cities, cars have provided urbanites with a flexible and cheap transport option. They have also improved market access in rural areas, which is desperately needed. However, in the longer term, motorization may stifle local development, increase pollution, and create safety hazards (Susilo et al. 2007a, b; Susilo and Stead 2012; Hossain and Susilo 2011).

Motorcycle ownership has also skyrocketed. Indonesia is currently the third largest motorcycle market in the world, after China and India. In 2012, there were 76 million motorcycles in operation, as compared to 14 million in 2000 (BPS 2012). Motorcycles are popular because they are affordable, flexible, and maneuverable on congested roads. At the same time, they disrupt the operation of other modes. Motorcyclists' encroachment of pedestrian space and their lack of compliance with traffic rules are leading causes of road accidents (Indriastuti and Sulistio 2010; Joewono et al. 2015).

Urbanization and motorization have transformed urban structures, as well as transportation demand and supply. Against this backdrop, this chapter discusses transportation issues in the Jakarta Metropolitan Area (hereafter referred to as simply Jakarta). The capital is the largest and one of the most important cities in Indonesia. However, its transport profile is not representative of all cities in Indonesia. There is a large diversity across the country, as each metropolitan area has planning autonomy, following very general national transport and land use planning guidelines.

2 Urban Land Use Patterns and Spatial Structure

Jakarta is the largest metropolis in Southeast Asia, and the second largest urban area in the world, after the Tokyo-Yokohama region. It has a population of 27 million, with ethnicities and cultures as diverse as the Indonesian archipelago itself (Demographia 2015). The density is very high: almost 15,500 inhabitants per km^2 (Bappenas 2013) (By comparison, New York's density is 11,000 inhabitants per km^2; US Census Bureau 2015). The city proper (DKI Jakarta) has expanded from a nucleus of 180 km^2 in 1960 to a sprawling megalopolis in the early 2000s. In this process, it has engulfed four adjacent cities: Bogor and Depok (south), Tangerang (west), and Bekasi (east). Area natives refer to this agglomeration as "Jabodetabek" (Fig. 6.1).

Since the early 2000s, Jakarta's population growth rate has been 2 % per year on average (Ministry of Transportation 2012). While the central city is more populous than the hinterland, the surrounding municipalities are growing faster. In the last 40 years, Bogor has grown more than threefold in population, while Tangerang and Bekasi fourfold (Fig. 6.2).

2.1 Socioeconomic Structure

Jakarta is the main hub of economic activities in Indonesia. There is some economic specialization within the metropolitan region. While Jakarta concentrates national and international businesses, services, and government agencies, most industries are located in Tangerang and Bekasi; Bogor is renowned for tourism and natural resources. Jakarta's urban core has the highest Gross Regional Domestic Product in the country—about fivefold that of the surrounding municipalities, or, in other words, half that of the metropolitan region overall. In 2010, the poverty level in the inner city was among the lowest in Indonesia (3.5 %) compared to a national average of 13 % (TNP2K 2011a, b, c).[1] These factors explain why Jakarta acts as a magnet for internal migrants.

2.2 Land Use and Spatial Development

Jakarta is an old city, which has developed over fifteen centuries (first as Sunda Kelapa and later as Batavia). Its blueprint and supporting infrastructure were created during the colonial era (1602–1942). In investing in roads, the Dutch administration had two main objectives in mind: (1) to connect areas rich in resources, such as

[1] People with expenses lower than the average monthly expense per capita (*garis kemiskinan*) are classified as poor (BPS 2013).

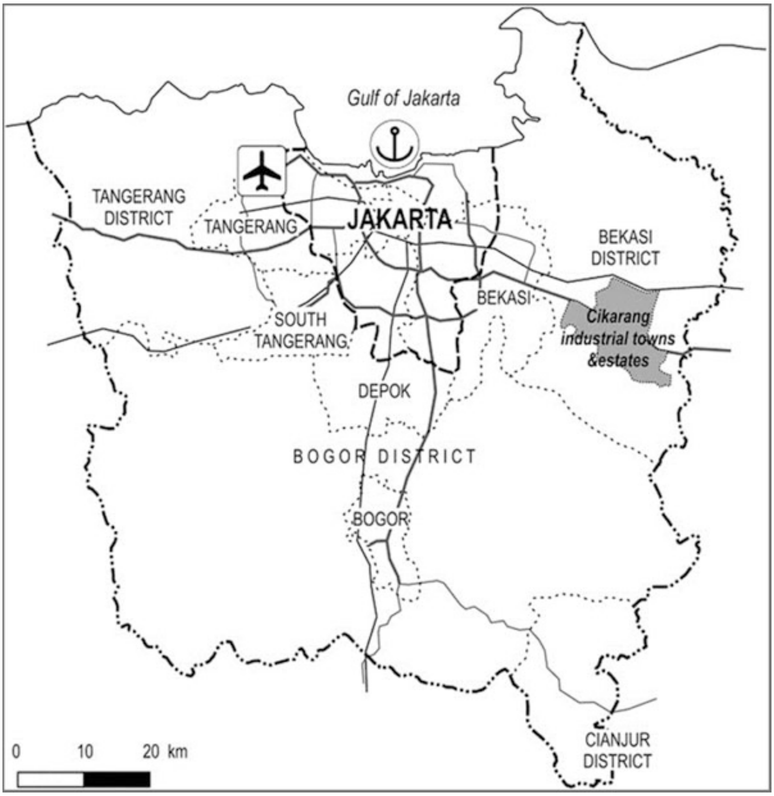

Fig. 6.1 Map of the Jakarta Metropolitan area. *Source*: Urbanalyse (2013)

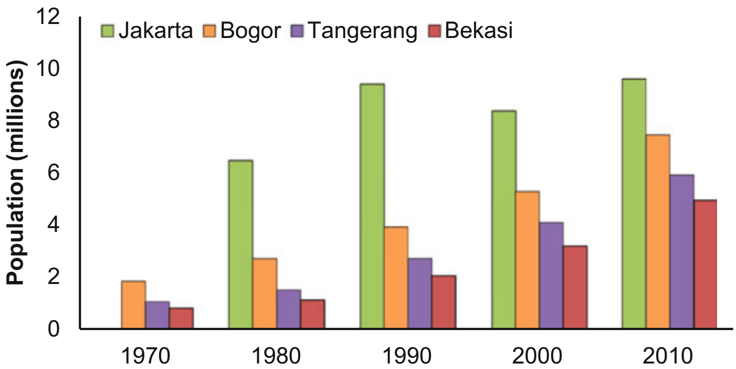

Fig. 6.2 Population growth trends. *Sources*: Ministry of Transportation (2012) and Bappeda DKI Jakarta (2013)

minerals, spices, and agricultural products, to the main port in the capital and (2) to ease the access of its army troops to the hinterland. Both aimed at subjugating the locals, establishing Dutch authority, and supplying the Netherlands with goods from overseas. Indonesia became independent in 1945, after a 3-year occupation by Japan.

The period following independence was characterized by stormy nationalism and revolutionary ideas. Jakarta's modern planning was driven by a strong vision of Sukarno, the country's first president. Sukarno aimed to strengthen the city's position as national capital and Asian global city. To this end, he led the development of hundreds of high-profile buildings, including office towers, commercial centers, hotels, and high-rise condominiums. Notwithstanding these efforts, Jakarta had no official and comprehensive land-use and transportation planning system in place until the 1970s. Roads were developed and public transport operations were set up as the need arose (Rukmana 2014; Cybriwsky and Ford 2001; Firman 1998; Goldblum and Wong 2000).

In the mid-1960s, Indonesia experienced one of the most tumultuous periods in its modern history. A new president, Suharto, took power; his presidency lasted more than three decades. Determined to "modernize" and "westernize" the capital,[2] the new government demolished many tramways and railway tracks (some were also abandoned) and replaced them with road corridors, which, by the 1980s, became congested. In 1978, the first toll road was built to connect Jakarta and Bogor (Dinas Perhubungan 2010). Its success spurred the construction of many other inter- and intra-urban toll roads, a trend that has not stopped since.

By 2009, the Jakarta inner city was served by 6700 km of roads while the metropolitan region encompassed 13,700 km of roads, many of them urban toll roads, which financially penalize poor travelers (Ministry of Transportation 2012). The density of the road network was 2 km per km^2 in the metropolitan region and as high at 10 km per km^2 in the core. These density levels were low by international standards in comparison to large cities such as Paris (24 km per km^2), Tokyo (22 km per km^2), and Singapore (12 km per km^2) (Dinas Perhubungan 2013). Insufficient road density, coupled with other issues (see later), has produced high levels of congestion. Gridlock is a trademark of Jakarta's urban experience.

Alongside skyscrapers and roads, pockets of slums (*kampung*) built by rural migrants and the urban poor are growing too, in various parts of Jakarta, especially in the periphery. Kampung are associated with poverty, informality, and socioeconomic segregation. While kampung have existed since the 1950s, their development increased after the economic crisis of 1998, which led to a massive closure of businesses and industries rendering many unemployed (Silver 2007; Goldblum and Wong 2000; Firman 1999; Rukmana 2014; Cybriwsky and Ford 2001).

Middle- and upper-class suburbanization (in low-density, car-oriented areas) has also been visible in Jakarta since the early 1980s. In the 1990s, with skyrocketing housing prices in the inner city coupled with deregulation measures, the phenomenon escalated. Middle-income families left for the suburbs in search of more affordable

[2] Between 1950s and 1970s, highways were seen as the transport panacea in many western metropolitan areas. The idea was picked up by the new government of Indonesia in the mid of 1960s.

accommodation. The wealthy abandoned older inner city neighborhoods seeking higher quality and more exclusive housing. Suburbanization of offices, shopping centers, and industrial parks followed residential sprawl. Large portions of agricultural and forested land were converted to urban use. Several new "autonomous" satellite towns were built, sustained by three highways stretching from the center to the peripheries. However, most ended up serving as bedroom communities for inner city employees. Daily traffic congestion between the fringe and the CBD intensified (Firman 1998, 1999; Leaf 1994; Silver 2007; Susantono 1998; Rukmana 2014; Goldblum and Wong 2000; Henderson 2003; Hudalah et al. 2013; Winarso and Firman 2002).

3 Trends in Transport Use and Mobility

3.1 The Rise of Motorcycles

Starting in the late 1990s, private motorization (in the form of cars but especially motorcycles) exploded in Jakarta (Fig. 6.3). The car ownership level increased from 17 % in 2002 to 25 % in 2010. During the same period, motorcycle ownership increased from 34 % in 2002 to 72 % in 2010. The portion of households owning two or more motorcycles increased from 3 % to 22 % (Nobel et al. 2013). By 2013, there were 16 million registered vehicles in the inner city (12 million motorcycles

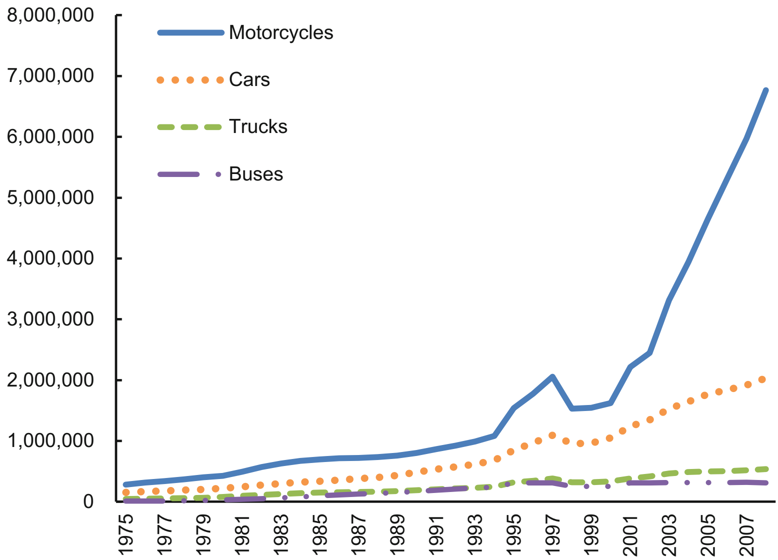

Fig. 6.3 Motorization trends in Jakarta (number of registered vehicles). *Source*: Ministry of Transportation (2012)

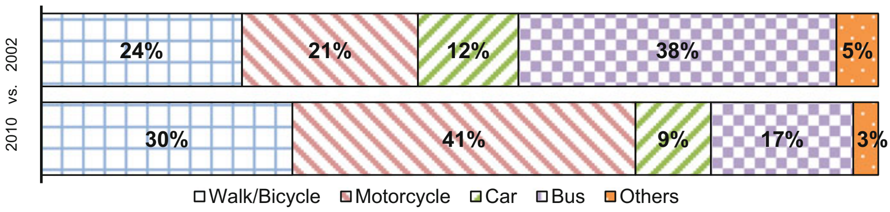

Fig. 6.4 Commuting modal share trends in Jakarta. *Source*: SITRAMP Person Trip Survey; JUTPI Commuter Survey; JICA (2012)

and four million cars) (Bappeda DKI Jakarta 2013). Consequently, the contribution of the motorcycle as a commute mode doubled (Fig. 6.4). By 2012, motorcycle trips came to represent more than half of the trips within the region—compared to only 14 % in 2000. Meanwhile, bus ridership halved from 50 to 25 % of the commuting trips within the region.

Motorization is related to the expansion of the Indonesian middle class in the last few decades. Cars signify economic status and social acceptability for upwardly mobile families, which will often acquire debt in order to purchase one. By contrast, the motorcycle is a middle-class marker, used mainly by those with a monthly income of 1.5–6 million rupiah[3] ($1500–6000). Overall, the use of motorized vehicles is concentrated among individuals in their 30s. Motorization has also been boosted by aggressive marketing and car-oriented planning measures. Indonesian automobile producers have launched in the mid-2000s a cheaper car, which lacks certain safety features, while local authorities continue to believe in visible and quick investments (i.e., roads) as a measure of success.

3.2 More Trips, Longer Trips, Slower Trips

Between 2000 and 2012, the average trip distance within Jakarta doubled to around 15 km (Ministry of Transportation 2012). Strikingly, trips are longer for lower income travelers than wealthier ones. In earlier decades, the opposite was true: higher income individuals made longer trips than lower income individuals (Table 6.1). This reversal reflects the residential suburbanization of the lower income people, who have moved out of the inner city and towards areas such as Bekasi, Tangerang, and Depok, while their jobs have remained in the core.

Not only are Jakarta's residents travelling longer distances but they are also making more trips. In 2002, 743,000 incoming trips per day were registered in the inner city (originating in the surrounding region). By 2010, the number of incoming trips had increased to 1.1 million (an increase of nearly 50 %), with trips origins nearly equally distributed among satellite municipalities (Nobel et al. 2013). While

[3] Indonesian Rupiah (10,000 IDR was worth approximately 0.75 USD in 2015).

Table 6.1 Average commute distance by income

Income	Work		School	
	1985	2000	1985	2000
High	9	10	4.4	7.4
Medium-high	8	10	3.5	4.6
Medium-low	7	10	2.7	4
Low	5.6	6	2	2
All	6.7	8.5	2.7	3.5

Source: ARSDS Supporting Report No. 3, JICA (1985); SITRAMP Mini Person Trip Survey (2000)

Fig. 6.5 Congestion in Jakarta. Photo courtesy of Center for Sustainable Infrastructure Development

home-based trips are the most common type, trip patterns vary by age, gender, income, residential location, and household composition. Travelers in the 31–40 age group make more trips than others. Individuals who are part of larger families make more family-related trips while individuals with smaller families tend to have tighter time-space constraints (Susilo and Avineri 2014). Residents in suburban areas make more trips but also tend to combine trips more.

Due to urban sprawl and congestion, travel times have also increased dramatically in Jakarta. Even certain segments of toll roads are congested on a daily basis (Fig. 6.5). For example, travelling between Manggarai and Pasar Minggu (both in south Jakarta) during the morning peak typically took 22 min in 1985, 36 min in 2000, and 95 min in 2011. The average speed decreased from 26 km/h in 1985 to 16 km/h in 2000 to 6 km/h in 2011. Similarly, travelling from Cilandak (south Jakarta) to Monas (central Jakarta) during the morning peak took 38 min in 1985, 49 min in 2000, and 100 min in 2011. The average speed decreased from 25 km/h in 1985 to 19 km/h in 2000 to 9.5 km/h in 2011 (Ministry of Transportation 2012). The economic loss caused by traffic congestion in a single corridor amounts to 5500 billion rupiah per year, accounting for vehicle operating costs and travel time. Suburban residents suffer the most of these losses.

4 Urban Transport Problems

Urban transport problems in Jakarta can be classified into three categories: (1) road provision, maintenance, and management; (2) public transport provision and management; and (3) health and environmental impacts.

In terms of the road network, the key issues are the ineffective use of the space, congestion, and poor nonmotorized transport facilities. For example, rail and road traffic cross at grade in some points along the network producing chaos and substantial delays. Some road segments are taken over by street vendors while the sidewalks and pedestrian overpasses are in poor condition. A weak understanding of urban transport issues among stakeholders is among the major reasons why these issues remain unresolved. There is a lack of knowledge about travel characteristics in Jakarta, especially at the individual level, such as travel distances, patterns, and variability by group; modal accessibility by group; travel demand distribution across space and time; and impact of transport on air quality, health, and society (Dinas Perhubungan 2010).

Several public transport options exist in Jakarta, the main being is the bus (Fig. 6.6). Medium-to-large-sized urban buses, with a capacity of 40–55 seats (and room for up to 60–100 people standing), run along the major corridors. Minibuses

Fig. 6.6 Various public transport options in Jakarta. Photo courtesy of Muhamad Rizki

(paratransit), operated by their owners, as well as motor-taxis (*ojek*), are commonly used as feeders (Susilo 2014). Overall, the bus system is of low quality as passengers are often faced with long waiting times, high travel costs, low quality of vehicles, uncomfortable travel, disruptive and competitive behavior on part of drivers and conductors, overcrowded major terminals, and ineffective route distribution (Dinas Perhubungan 2010).

Jakarta also includes an extensive commuter rail system (KA Commuter Jabodetabek), which originates from the colonial era. It encompasses 235 km of electrified tracks divided among six lines, and 80 stations. In the last two decades the commuter train services have been continuously upgraded. The whole network has been electrified; first class and express services have been introduced, with air-conditioned cabins. The latter charge higher fares but offer significantly faster and more comfortable travel. With growing incomes, premium services are becoming increasingly affordable and popular among commuters. But in lower class cabins used by poorer commuters, overcrowding persists. Given the city's rapid development, the system coverage is insufficient. While KA Commuter Jabodetabek serves 850,000 passengers daily, this constitutes less than 3.5 % of all Jakarta's commuters. In addition, rail services are poorly integrated with bus services (Dinas Perhubungan 2010). A new rail-based system, the Jakarta Mass Rapid Transit, is currently under construction (see later).

In terms of health and environmental impact, the number of traffic accidents is alarming. In 2008, more than 2000 traffic accidents occurred in Jakarta (excluding the inner city), which resulted in 523 fatalities, and more than 2700 injuries. The inner city has among the highest number of road accidents and resulting deaths in Indonesia (BPS 2014). As for air quality, average SO_2, CO, and NO_2 emissions comply with local limits, which, however, are more lenient than World Health Organization standards (Ministry of Transportation 2012).

5 Urban Transport Governance, Decision-Making, and Financing

Jakarta (the inner city) is divided into five administrative zones, based on geography (Utara, Barat, Pusat, Timur, and Selatan—respectively North, West, Center, East, and South), as well as district (*Kabupaten Administratif Kepulauan Seribu*). Parallel with these administrative zones, two institutions, namely the Bureau of Transportation (*Dinas Perhubungan*) and the Bureau of Public Works (*Dinas Pekerjaan Umum*), deal with transportation issues. The Bureau of Transportation deals with transport and traffic management, while the Bureau of Public Works is responsible for building and maintaining infrastructure. They have autonomy over Jakarta's administrative territory. The two Bureaus are overseen by two national ministries, the Ministry of Public Works and Public Housing (*Kementerian Pekerjaan Umum dan Perumahan Rakyat*) and the Ministry of Transportation (*Kementerian Perhubungan*). The relationship between the local and national governments is hierarchical in the sense that laws and regulations adopted by lower levels of governments should not contradict those adopted by a higher level. This setup is standard in Indonesia.

Since many institutions are involved in Jakarta's transportation arena, coordination is problematic. One example of poor (horizontal) coordination is the management of overloaded freight trucks. The Ministry of Transportation sets the maximum weight limit allowed for trucks. It does so based on vehicle specifications but without considering the quality of the roads on which trucks will travel. The characteristics and design life of roads are specified by the Ministry of Public Works and Public Housing based on estimated traffic loads. The Ministry of Trade and Industry is also involved. It determines the allowable size of trucks, as well as the specifications for spare parts, such as tires. While higher quality tires may help handle heavier truckloads, the load and vehicle size may not be in line with the road design along a truck's route.

Another example of poor (vertical) coordination relates to performance evaluation indicators. While the responsibility for local transport planning and implementation lays with local governments, performance evaluation indicators are determined by the Ministry of Transportation. Although referred to as "indicators" they are rather broadly defined and resemble general goals or guidelines, which localities must use to measure the success of their transport plans. For example, local governments are required to increase the safety and security of land transport services; satisfy the needs for transport infrastructure; provide premium quality in public transport operations; increase competitiveness among modes; and develop sustainable and integrated land transport (Ministry of Transportation 2005). The principle underlying this approach is that the national government should only provide a vision for the whole country, rather than specific objectives. As a consequence of the great variability in local capacity and knowledge, the performance evaluation indicators are understood, translated, and implemented in very different way across the country—which defeats their very purpose.

These examples demonstrate that each institution operates based on its own vision, ideology, and focus, with little input from its counterparts, and little consideration of issues experienced elsewhere. Poor institutional coordination (and lack of political will) translates into poor implementation of transportation projects. In the past four decades, a multitude of transport plans have been prepared by various local, national, and international agencies, but many of them have remained on paper (see later).

On the positive side, a coordination platform in Jakarta, known as Musrenbang (*Musyawarah Perencanaan Pembangunan*), has formed under the local administration. It also provides for community input on priority issues. In addition, an effort was made to integrate transport planning for the entire metropolitan region, based on a three-pronged strategy: (1) public transport development; (2) traffic restraint; and (3) network capacity enhancement. This strategy was known as "macro planning" or PTM (*Pola Transportasi Makro*) (Dinas Perhubungan 2013). Its first version, which was prepared in 2007, covered the development of the road network, the bus system, the rail system, the mass transit system, and alternative transport, including water transport along existing canals (Dinas Perhubungan 2010). The second iteration, prepared in 2010, added new elements, including the construction of several toll road corridors, the expansion of busway corridors, the increase in busway capacity, and the construction of a monorail infrastructure. By then, city authorities had realized that a critical issue was the provision of cross-border transport services between Jakarta and the hinterland. This was addressed in the latest “macro planning” version, which covered the period between 2007 and 2012. However, this strategy too suffered from overlaps and competition with other plans.

Notwithstanding its experiments with Musrenbang and “macro planning,” Jakarta still lacks a strong umbrella organization to manage its transport system across borders and across institutions. It also lacks the involvement of stakeholders who have an integral vision and who are prepared to cope with the highly complex transport problems in the region.

6 Proposed Urban Transport Solutions and Implementation Issues

Many of early transport proposals, which came after the establishment of the “New Order,” focused on road-based solutions, including busways (Dinas Perhubungan 2010). Rail-based projects, including the electrification of the existing commuter rail and its equipment with double tracks, new stations, and elevated tracks, started in the early 1980s and continued slowly into the mid-1990s. While the commuter rail was modernized and its routes consolidated, it expanded little. In the late 1990s, the first proposals for Transit-Oriented Development appeared in the form of development consolidation along rail lines (Susantono 1998). In the last few decades, the most significant new developments have been the construction of a bus rapid transit system (TransJakarta), the construction of a monorail system (Jakarta Mass Rapid Transit), the rise of Internet-based shared transport services, and the implementation of various TDM policies.

6.1 TransJakarta

In operation since 2004, TransJakarta is the first Bus Rapid Transit (BRT) project in Indonesia (Fig. 6.7). BRT was presented as a cost-effective way to provide higher quality public transport services at affordable fares (Joewono et al. 2012). In the first year of operation, it served nearly 16 million passengers (approximately 44,000 passengers per day). The average load factor on weekdays was more than 90 % and sometimes nearly as high as 150 % (BLUTransjakarta 2005). While the system covered only 13 km and served 17 million passengers annually in its early stages, by 2013 it had grown to 172 km, served 12 corridors (and three additional ones planned), and it was carrying 112 million travelers annually (Bappeda DKI Jakarta 2013). Its introduction has been beneficial in environmental terms too. Running on

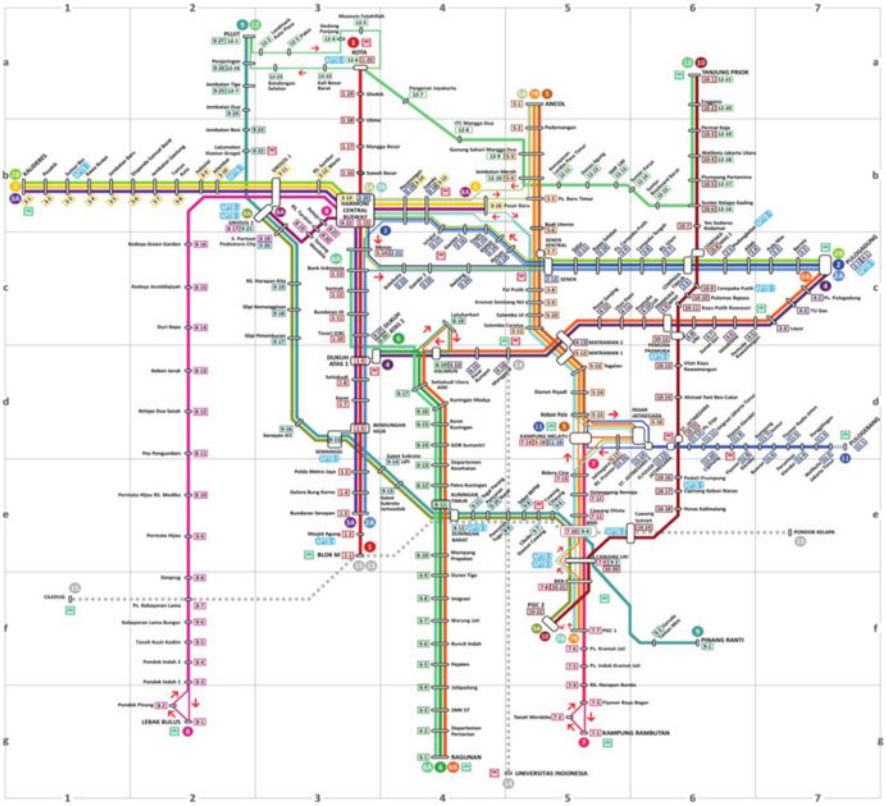

Fig. 6.7 TransJakarta's built and planned (*dashed*) corridors. *Source*: TransJakarta (2015) available at http://transjakarta.co.id/peta-rute

compressed natural gas (CNG) and diesel buses, as of 2008, TransJakarta had reduced transport-related CO_2 in Jakarta by more than 32,000 tons per year and NO by nearly 400 tons per year (Yunita 2008).

TransJakarta is currently one of the largest BRT systems in the world in terms of coverage (Adiwianto 2010; BLUTransjakarta 2009). However, its ridership is significantly lower than other BRT systems around the world (Yunita 2008). By way of comparison, Bogota's TransMilenio has 84 km of dedicated infrastructure and carries 1.4 million daily passengers (Yunita 2008). The reason for this difference is TransJakarta's lower quality of service. It lacks bus priority signals at intersections, its feeder system is weak, and the travel information provided to prospective travelers is poor (Fig. 6.8).

Currently, six operators are involved in the TransJakarta system, with a variety of partnerships with the government. The fare is fixed: 3500 rupiah (25¢) during the peak and 2000 rupiah (15¢) off-peak (Adiwianto 2010). The government provides subsidies to operators in order to sustain these low fares, especially in view of rising

Fig. 6.8 TransJakarta buses on a busy corridor. Photo courtesy of Muhamad Rizki

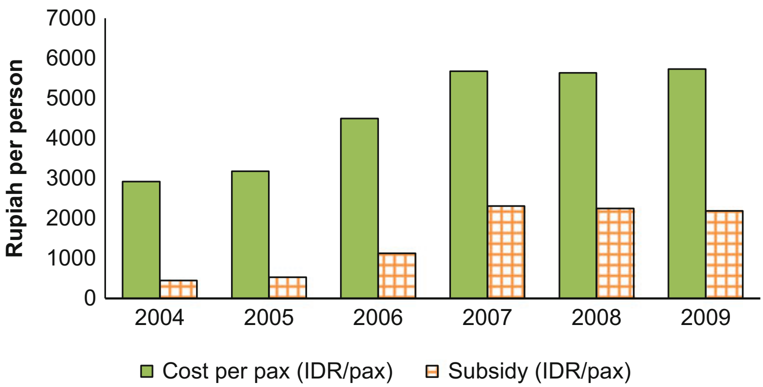

Fig. 6.9 Subsidies received by TransJakarta ($1 = 13,700 rupiah.). *Source*: Adiwianto (2010)

operational costs. The amount of subsidy depends on the number of passengers, as well as the operators' financial performance (Fig. 6.9). As the number of passengers has grown, the cost recovery has declined (Fig. 6.10). In addition to its lack of financial autonomy, TransJakarta suffers from other management issues, which are a corollary of a poor institutional coordination in the capital, and a lack of comprehensive transport and land-use planning (Adiwianto 2010).

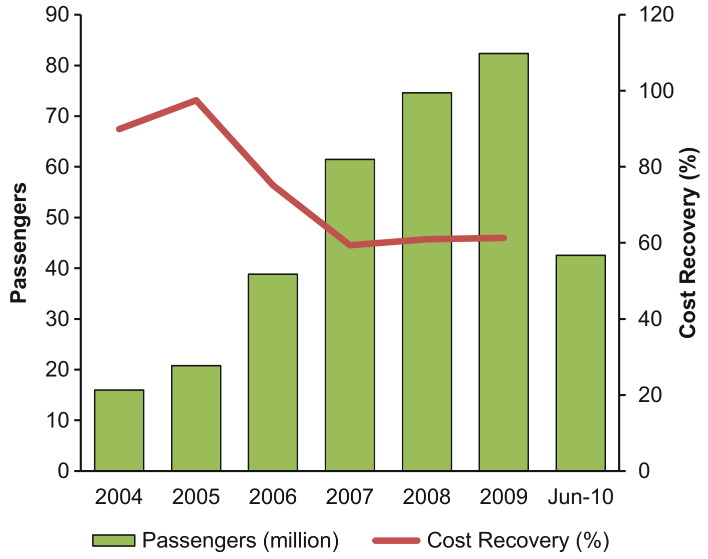

Fig. 6.10 TransJakarta's passenger volume and cost recovery. *Source*: Adiwianto (2010)

Fig. 6.11 Construction works for the new Mass Rapid Transit system. Photo courtesy of Muhamad Rizki

6.2 *Jakarta Mass Rapid Transit*

Clearly, TransJakarta does not have enough capacity to serve all Jakarta's travelers. Rather than expanding the BRT, a new rail-based system, the Jakarta Mass Rapid Transit (MRT), was planned and is now under construction (Fig. 6.11). While the idea of building an MRT system has been around since the late 1980s, the project was substantially delayed. In fact, plans were shelved for some time during Indonesia's political and economic crisis of the late 1990s. However, it returned to the forefront of the urban agenda once the country emerged from the crisis in the early 2000s. Based on the current project, the MRT will be more than 110 km in length. The first stage is scheduled to begin operation in 2018, while the second stage is expected to be complete by 2020.

The MRT, which has strong support of the Indonesian presidents and Jakarta's governor, is funded by the national government and the provincial government of Jakarta. It is also supported by the Japanese government through its Japan International Cooperation Agency (MRT Jakarta, 2015). Both the public and the government have invested high hopes in the MRT, which is seen as a panacea to Jakarta's transportation problems. The system is expected to carry more than 300,000 passengers per day, shrink average travel times by 28 min, produce 28,000 new jobs, cut CO_2 emissions by 30,000 tons per year (by 2020), and reduce traffic accidents (Deputy Governor for Industrial, Trade, and Transportation 2014).

6.3 Emergence of Internet-Based Shared Transport Services

Internet-based (i.e., smartphone app-based) services, including Uber and GrabTaxi[4] but also Go-Jek,[5] a mototaxi service, have appeared in Jakarta and other Indonesian cities over the last few years. In 2013, Indonesia had 42 million internet users and 237 million registered mobile phones, so travel apps are very popular with users. However, these services viewed by the authorities as informal or "unofficial" public transport and they have led to controversy. Detractors claim that these demand-responsive modes do not meet all government requirements for public transport services thus unfairly undercutting buses. The app companies argue that they operate in the information technology arena rather than the public transport arena and should not therefore have to comply with public transport regulations. Moreover, they provide employment for citizens. The use of motorcycles for public transport (legally prohibited for now) has raised another controversy. Initially tolerated as a bottom-up initiative, which filled the gap left by regular public transport services, Go-Jek was banned at the end of 2015. However, due to a major public outcry the decision was reversed within a day. While present in a major way in nearly all Indonesian cities, Go-Jek remains, in theory, illegal. To accommodate users' dynamic needs, and recognize the positive contribution of technology in providing transport services, laws and regulations need to be upgraded. At the same time, public safety must be a priority for regulators.

6.4 Travel Demand Management

Many TDM ideas have been proposed in Jakarta over the years, including a high occupancy vehicle scheme, road pricing, and work/school schedule staggering. To date, a three-in-one policy (meaning that vehicles in high occupancy lanes must

[4] A Malaysian-based enterprise, in operation since 2012, and present in six countries in the region.

[5] A local enterprise. In addition to providing a door-to-door passenger transport service, it also provides a delivery service for food and groceries.

have at least three occupants) was implemented along main corridors in the mid-1990s. However, this policy did not ease congestion since solo drivers found ways to circumvent the rule, such as hiring other passengers (including children), locally called “jockeys.” Some people now consider this as their occupation. Besides the three-in-one scheme, motorcycles have been banned from crossing certain main roads. Naturally, motorcycle users are unhappy about this policy and feel discriminated against.

In 2015, a pilot electronic pricing scheme was designed. Local administrators plan to launch it along main corridors in the very near future. However, implementation is on hold due to ongoing public transport infrastructure works, which will provide a travel alternative to people affected by the pricing scheme. The political will to redistribute car use through staggered work and school schedules has been lacking. Overall, the planning and implementation of TDM strategies has been poor. As a result, the competition for road space is tight between public and private transport modes, especially along busy and congested corridors (Dinas Perhubungan 2010).

7 Conclusions

Since Indonesia gained its independence 70 years ago, Jakarta has “exploded” in terms of population, economy, and motorization. Its transport problems are staggering. While many plans and policies have been designed to alleviate these problems, they have not been implemented or, if implemented, they have met with little success. Limited human and financial resources have certainly constituted a barrier. There have been several major obstacles to developing more sustainable transport policies. These include: a capital-intensive road engineering approach focused on easing congestion for car drivers; a concern with short-term mitigation rather than future visioning; a lack of institutional coordination, which could lead to joint transport and land-use development; an ingrained passivity on part of local and regional administrators; an insufficient amount of research into the travel behavior and activities of local communities; and a low commitment to transport sustainability on part of politicians (Susilo et al. 2007b). These issues have led to a low level of respect for transport-related rules and policies. They have also resulted in a low level of certainty among potential investors in Indonesian transportation infrastructure.

The picture is not entirely bleak though. Despite its problems, TransJakarta serves a substantial number of users. A new rail system is currently under construction, and new, Internet-based and flexible travel sharing modes have appeared. They respond to local taste, culture, and travel behavior and offer new opportunities for addressing urban transport problems. However, they also require sensitive regulation. While less-standardized indigenous transport modes present some challenges, they also open the doors to more inclusiveness, demand-responsiveness, and efficiency in urban transport, sometimes at no cost or effort for the government and can be formalized and integrated into the existing transport system (Ames et al. 2014; Susilo 2014; Susilo et al. 2007a).

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Chapter 7
Iran

Ali Soltani

Capital city	Land area	Total population	Urban population	GDP per capita	Passenger cars
Tehran	1,648,000 sq. km	78 million	69% (54 million)	$4,763	113 / 1,000 people

Data source: World Bank
Maps source: d-maps.com

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1 Introduction

Iran's urban population (currently 70 % of the total) is increasing at an average annual rate of about 3 % and is expected to continue to do so during the next decade. The country includes one megacity (the capital, Tehran) and several large cities. Cities with more than one million inhabitants are categorized locally as "metropolitan areas": Tehran (8.2 million), Mashhad (2.8 million), Isfahan (1.9 million), Shiraz (1.6 million), Karaj (1.6 million), Tabriz (1.4 million), Ahwaz (1.1 million), and Qom (1.1 million) (Statistical Centre of Iran (2012). The focus of this chapter is on these metropolitan areas, which have reached income levels that can support high rates of car ownership and usage. Tehran is the most densely populated metropolitan area and tends to influence transport policy on a national scale (Allen 2013).

Urban transport has become a major concern in large Iranian cities but in a country with still vast oil reserves, meeting sustainability goals has proven particularly challenging. While the overall car ownership level is lower than in developed nations, Iranian cities suffer from high levels of congestion, air and noise pollution, and accidents. In Tehran, 16 million vehicular trips take place daily, and the average speed during peak hours in the Central Business District is as low as 15 km/h. Other metropolitan areas do not fare much better. Transport is now the main source of pollution in all large cities and poses a serious threat to the health of urban citizens. Globally, Iran is the seventh largest producer of greenhouse gas (GHG) emissions, while it ranks 17th in terms of national population. Traffic accidents have also become a leading cause of death in urban areas.

Traditionally, policy responses to transport problems have favored private transport. More recently, a consensus has emerged that current levels of car use, fuel consumption, and pollution are unsustainable. As a result, shifts toward more efficient and low-impact urban transport systems are increasingly considered as desirable.

2 Urban Land-Use Patterns and Spatial Structure

Among the oldest in the world, Iranian cities are multilayered. They juxtapose a variety of forms ranging from traditional Islamic *mahalla* (neighborhoods) to modernist grid-form districts (Fig. 7.1). In broad terms, the texture of Iranian cities can be described as a combination of the following: (a) historic; (b) modified historic, (c) modern grid, and (d) modern informal. Accordingly, inhabitants display different travel patterns.

Characterized by low building densities, relatively high population densities, irregular lots, winding street networks, and mixed land use, picturesque historic textures are ideal for pedestrian movement. While appearing chaotic and impenetrable to outsiders, they contain an organic hierarchy of roads and low rise, highly clustered buildings. Motorized vehicles have difficulty in accessing neighborhoods built in this manner. While positive in terms of traffic calming, inaccessibility poses

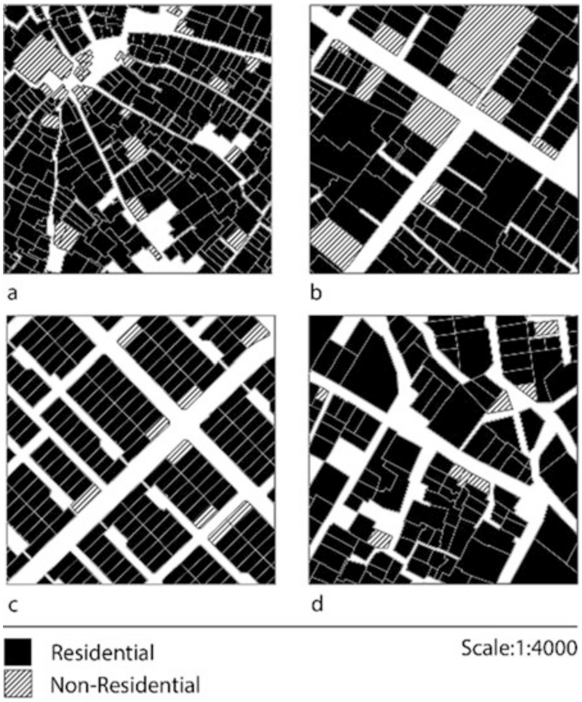

Fig. 7.1 Typical Iranian urban textures: (**a**) historic, (**b**) modified historic, (**c**) modern grid, and (**d**) modern informal. Maps by author, based on Shiraz's patterns of urban form

a major risk in case of emergencies, such as earthquakes, which have proven disastrous in the past. For example, a strong earthquake in Bam (2003) led to the tragic deaths of more than 30,000 people, who could not be easily evacuated. Recent proposals to widen historic streets in Tehran and a few other cities have failed due to financial constraints and social resistance.

The modified historic texture originated with the Shah's (Mohammad Reza Pahlavi) urban renewal efforts. After coming to power during WWII, he strongly supported a policy of modernization and secularization. In the 1970s, as city centers began to become crowded with cars, the historic neighborhoods near the core were adapted to the automobile. To ease vehicular access, the main collector roads were gradually widened and the tightly woven urban fabrics were made more permeable. Districts thus renovated typically have a semigrid street network but retain irregular lots.

Laid out in a standard grid, modernist neighborhoods are well connected, clearly legible, and easily navigable by car. However, due to ever-growing car traffic, safety (especially at junctions) and privacy have gradually been decreased. This texture is present in middle-class areas but also on public land allocated for worker housing (developed by housing cooperatives). In the past decade, social housing for low-income groups (e.g., the *Mehr* project) has been built in this pattern as well (Isalou et al. 2014). Recently, efforts have been made to reduce traffic volumes and speeds in grid neighborhoods by adding roundabouts at larger intersections, installing speed bumps, and creating cul-de-sacs.

The concentration of investments in big cities has attracted a mass of migrants in search of more job opportunities and a better life. Informal settlements can be found on marginal land in the urban fringes. In some senses, their fine-grained and spontaneous informal textures reflect those of the historic cities. They do comply with contemporary planning codes for roads, buildings, and public spaces. However, unlike historic neighborhoods, informal settlements lack basic services such as water, sewer, garbage collection, and paved roads.

Most Iranian cities have similar characteristics of overall urban form and spatial growth patterns. First, most cities have a mono-centric shape (Fig. 7.2) whose center has the highest levels of population and employment density. Urban expansion has occurred through the construction of concentric ring roads at ever-greater distances from the center. The construction of ring roads and major highways (Fig. 7.3) coupled with low-income rural–urban migration has led to the unrestrained development of low-density areas in urban peripheries. Land consumption has occurred faster than population growth in many cities. For example, the annual population growth in Tabriz has been 1.6 % since 2001 while the annual area growth has been 4.6 %.

A portion of the middle class has also suburbanized, in search for more comfortable housing, which a growing number of households can afford. In this manner, the traditionally classless and intermingled Iranian cities have begun to segregate and polarize in physical and economic terms. As elsewhere, suburban neighborhoods are associated with car-oriented lifestyles. Developers and planners have assumed that their residents will fulfill most of their travel needs by car. This expectation has become a self-fulfilling prophesy for the most part. However, those who work in the city centers also use buses or metros, if available, to commute long distance from

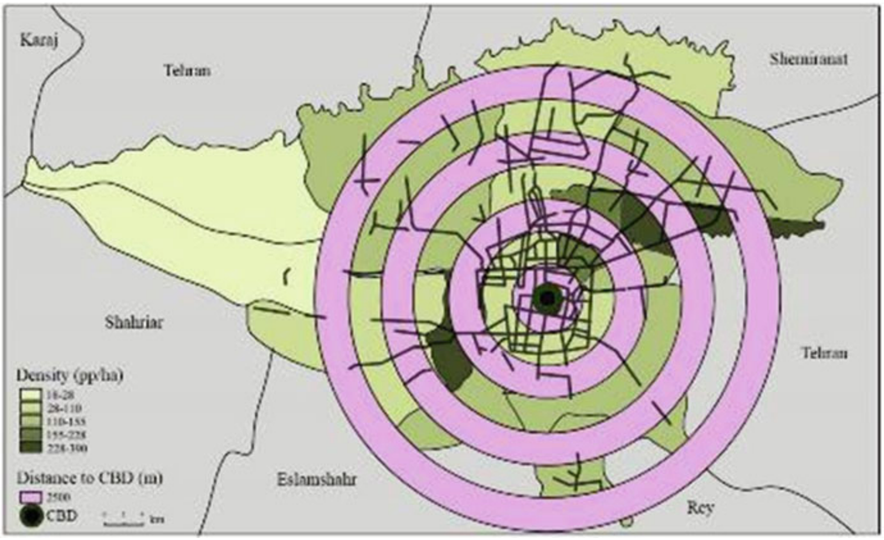

Fig. 7.2 Tehran's mono-centric structure. Source: http://www.atlastehran.ir modified by author

Fig. 7.3 Highways connecting (or dividing) housing estates in Shiraz (2014). Photo by author

the suburbs. Some cities, including Tehran, Mashhad, Isfahan, and Tabriz, have made serious efforts to develop public transport infrastructure. However, these efforts have not been coordinated with land-use development activities at the urban or local scale. Therefore, developments often occur in areas those are poorly covered by public transport.

3 Trends in Transport Use and Mobility

3.1 Car Ownership and Use

National levels of car ownership in Iran are among the top 50 in the world. There are currently 16 million vehicles in use across the country, containing a population of 77.5 million. This translates to one car for every four or five persons. In 2011, the urban population owned more than 85 % of these vehicles and motorization is growing by 15 % per year (Statistics Centre of Iran 2012). For many urbanites, cars are the preferred transport option—including Tehran, despite a good quality subway and bus network (Table 7.1). Single occupancy driving is also common. Some measurements in Tehran and Shiraz show that the vehicle occupancy rate is typically only around 1.5–1.6. Consequently, demand for road and parking space in urban areas is high. The government has tried to meet this demand. Shiraz, for example, spends more than 70 % of its municipal budget for the construction of new roads,

Table 7.1 Modal split in Tehran

Mode	Share (%)
Cars	32
Taxis	17
Metro	12
Buses	11
Para-transit (minibuses, school buses, employer buses)	18
Motorcycles	7
Nonmotorized	3

highways, and overpasses (Soltani 2014). Given the development of the car industry in Iran, the availability of cheap fuel, and a growing economy, these trends are expected to continue.

3.2 Public Transport

Only three cities in Iran, including Tehran, Mashhad, and Shiraz, have urban subway lines, and the construction of new systems is planned in another eight metropolitan areas. The Tehran Metro (with 86 km of lines) provides nearly three million trips per day. With a 4-min headway, it has achieved high levels of ridership. In Tehran, metro projects have had strong political support (Allen 2013). In the rest of Iran, metro development has been fraught with difficulties. In addition to high capital costs ($80–100 million per km), other barriers have been in the way, including a lack of advanced excavation technology, a shortage of experienced system designers and builders, drilling risks, and presence of underground water. In addition, since the Iranian Revolution of 1979, various international sanctions against Iran have made it very difficult for the country to acquire rolling stock and other equipment from abroad.

It is questionable whether subways are a suitable option for many Iranian cities. Due to the relatively low urban population density (less than 7000 persons per km^2 in Shiraz, for example), subways cannot possibly recover their maintenance and operation costs on their own. The Tehran Metro system only recovers 25 % of its operational expenses through ticket sales and advertising.

In all metropolitan areas, with the exception of Tehran, buses are the main mode of public transport. However, their numbers are far from sufficient. In total, there are 25,000 buses in service in Iranian cities, which equates to an average of one bus for more than 2000 urban residents. In some large cities, the bus provision is much lower. Shiraz, Tabriz, and Ahwaz only have one bus for 3500, 5600, and 2400 people, respectively. By contrast, Singapore, Hong Kong, and London have one bus for 1300, 1100, and 1000 people, respectively (Land Transport and Authority 2014).

In addition to the size of the bus fleet, urban bus services are undermined by congestion. Slow-moving buses (average speed of 20 km/h, with a 10 min headway) are common. Stations and terminals do not provide for the comfort and safety of

Fig. 7.4 BRT in Tehran. Photo by author

passengers. Achieving sufficient population and space coverage are among other concerns. Large portions of the built-up urban areas, especially those housing low-income and migrant populations, fall outside the bus service coverage (Soltani and Ivaki 2011). Public spending on buses tends to be small. For example, from 2009 to 2014, Shiraz only spent 5 % of its municipal budget on bus rolling stock and infrastructure (Soltani 2014). Under these circumstances, it is unsurprising that buses have a poor image in the minds of middle-class citizens, and as a result, have been relegated to a "mode of last resort," primarily for the poor.

Some steps have been taken to address the problems facing the bus systems. Five cities, including Tehran, Mashhad, Isfahan, Tabriz, and Shiraz, have introduced either a Bus Rapid Transit (BRT) system (none of them the "full" type) or exclusive lanes for regular buses (Fig. 7.4). These cities have seen some positive results. Tehran's BRT routes (ten in total) transport about two million passengers daily or 20 % of the total passenger volume served by buses, although BRT buses constitute just 3 % of the total bus fleet. However, most of BRT buses are "metro-buses," i.e., larger, articulated vehicles. In terms of fuel, they comply with the Euro V standard.

3.3 Nonmotorized Transport

Iranian cities of the past were famous for their attractive public spaces. Isfahan, at the height of its glory in the sixteenth century, was a beautiful city of grand boulevards, covered bridges, palaces, mosques, and minarets. Shiraz was known as the city of gardens, nightingales, and flowers. Some examples of historic public spaces, which survive to this day, include *Toopkhane* Square in Tehran (facing the Municipality Palace), *Naghsh-e-Jahan* Square in Isfahan (an outstanding example of Islamic architecture and a UNESCO World Heritage site), and the monuments produced by the *Zandiyeh* dynasty in Shiraz.

By contrast, modern Iranian cities lack, for the most part, a public realm suitable for walking and socializing. The invasion of cities by cars has led to a loss of the sense of place, which had been cultivated throughout history. In most contemporary transportation masterplans, walking is not even formally recognized as a travel mode. Many planners take the view that walking around town is pointless activity, akin to aimless wandering, and does not need to be prioritized or considered in planning. Accordingly, public spending on pedestrian infrastructure is already small (only 3 % per year Shiraz) (Soltani 2014). As a result, sidewalks are often broken, unswept during the day, unlit at night, too narrow for comfortable circulation, obstructed by mailboxes, hydrants, and poles, or occupied by shopkeepers' wares. Local codes for sidewalk design are rarely implemented in practice.

Cycling does not fare much better than pedestrian transport, despite the fact that this mode has a long tradition in Iran. The first bicycle is thought to have arrived in the country nearly 120 years ago. In some traditional Iranian cities, which retain old cultural and social values, cycling is still prevalent. For example, Bonab in the north-west is considered a cycling paradise—although the riders are mostly male. Due to high demand, segregated bicycle lanes have been built here in the last decade. In addition, the creation of shared bicycle routes along the popular hiking trails in the surrounding Zanjan Province is on the agenda. Other cities too have seen some investment in cycling infrastructure. In Tehran, some segregated bicycle lanes have been built in the last 15 years, especially in the center (along *Keshavarz* Boulevard). Also, a bicycle sharing scheme ("Bicycle Home") has recently started operation in Tehran and Isfahan. However, despite low rental fees, these schemes have not achieved very high levels of use.

Overall, urban utilitarian cycling faces major barriers. An unsupportive physical environment is an obvious culprit but other factors are at play too. Climate is partly responsible for the low popularity of this mode. The extremely cold winters in north-west and scorching summers in the south and east preclude comfortable cycling during a good part of the year in these regions. In addition, many cities are too hilly for those who are physically unfit (e.g., the elderly). Culture and image play a role as well. As with walking and bus riding, cyclists are stigmatized as poor and unsophisticated. Strict religious and cultural norms prevent women from cycling in most public places (exceptions include certain areas in the north of Tehran and the recreational Kish Island). Therefore, the provision of infrastructure alone cannot likely bring about a revival of cycling in Iran, unless some of these other factors are tackled at the same time.

4 Urban Transport Problems

4.1 Car-Dependence

The car reigns supreme among middle- and high-income urban residents in Iran. No other mode can rival it comfort and reliability. For many, it also symbolizes freedom, privacy, success, independence, and identity. Although car prices are much higher than in neighboring countries, purchasing power has recently increased in Iran and car ownership has been growing at a rate of 15 % per year (Allen 2013). Car use is strongly supported by government policies. Fuel prices, car taxes, and road tolls are kept low; and the domestic automotive production is at an all-time high (more than one million low-efficiency vehicles are produced domestically each year due to sanctions).

A combination of these factors has led to a situation where most people drive on a daily basis. Apart from the carless, only a small minority of people living in high-density central areas choose not to drive in order to avoid long waits in traffic. In Tehran, 15 million trips are made daily, more than 55 % of which are work and school-related, and many of them follow a regular pattern to which public transport could cater. Car ownership cannot be easily restricted but measures could certainly be put in place to limit car use, especially in areas with heavy pedestrian traffic.

In addition to cars, the use of motorcycles (by lower income men only) has intensified considerably (Fig. 7.5). In southern cities they are fairly common. In Tehran there are three million motorcycles in use (some used as taxis). Motorcycles are popular because they are relatively cheap to purchase, easy to maintain, quick to ride on congested streets, and exempt from certain restrictions that apply to cars. However, motorcyclists tend to carry a high risk of accidents. Since most do not use helmets, injuries in case of accidents tend to be severe.

Fig. 7.5 Motorcycle use in Tehran. Photo by author

4.2 Traffic Congestion and Parking Shortage

Congestion in urban areas, especially in Tehran, has assumed gigantic proportions. More than three million cars circulate daily on the streets of the capital—some of them belonging to commuters from satellite towns. To place this number in perspective, some traffic experts estimate that Tehran's road capacity limit is 700,000 cars (Atlastehran 2015). Local residents are estimated to waste an accumulative 4.3 billion hours annually in traffic jams.

Parking shortage has also become acute, especially in city centers, where jobs and activities are concentrated. Most parking takes the form of open-air, low quality lots which are either free or charge cheap fees. Multistory garages are uncommon. For new residential development, planning regulations mandate a minimum of one parking space per unit. Usually, this rule does not apply to commercial, office, and industrial buildings, which attract a high number of daily visitors. Consequently, CBDs are crowded with drivers searching for parking spaces or parked in unsuitable places such as sidewalks and building entrances. In Tehran the ratio between parking supply and demand is around 1:4 but as low at 1:13 in the CBD. Recently, some reluctant attempts have been made to introduce paid parking schemes in CBDs.

4.3 Traffic Safety

Iran is among the five least safe places in the world to drive. Annually, more than 20,000 people die in traffic accidents each year. Up to half of the victims are pedestrians. One-third of fatal accidents take place in the inner cities, as opposed to exurban highways (Zamanian et al. 2014). Since the majority of the victims are men in the 18–50 age group (i.e., active working adults or breadwinners), the damage to families and the economy at large is enormous. The high number of fatalities has been attributed to high speeds and reckless driving within urban areas (above 60 km/h), inadequate separation of vehicles and pedestrians, and a shortage of pedestrian crossings and overpasses. However, building overpasses involve high costs (including the costs of designs, building materials, land acquisition, road widening, dislocation of utility infrastructure, etc.), which, from a return-on-investment perspective are mostly deemed unjustifiable. Moreover, they are unpopular with pedestrians. In many cases, to avoid climbing stairs, pedestrians venture to cross the road at grade. Some overpasses, particularly those which are poorly lit at night, are perceived as unsafe (Soltani and Mozayani 2013). Providing escalators and better lighting might overcome these problems, but only partially. The ultimate solution would be to make streets safe for pedestrians rather than relegating them to overpasses and tunnels.

4.4 Informal Transport

Minibuses and mototaxis are the two main forms of informal transport encountered in Iranian cities. In Tehran, there are 1100 minibuses and three million motorcycles in circulation (some of the later are personal, not for taxi use). Informal transport mostly serves commuters from remote areas. Both minibuses and mototaxis are major polluters because of their inefficient engines, old age (17 years on average for Tehran minibuses), and frequent acceleration and deceleration in congested traffic. In Tehran, informal transport vehicles are estimated to emit 840 t of pollutants per year (Allen 2013). The image of these modes is general poor. They are seen as unclean, unsafe, unpredictable, and unreliable. However, no specific rules for their movement and parking have been adopted, and there is no strategy for their management, improvement, and integration with formal transport.

4.5 Inequity in Transportation

Physical access to schools, jobs, healthcare centers, and services is a significant concern for vulnerable and disadvantaged groups in Iran. However, the government has not been very successful in providing subsidized public transport services. As a result, the poor have difficulty in reaching their necessary destinations at affordable cost. Disabled persons encounter daily barriers in their urban environment, which could be overcome at relatively low cost through the installment of ramps and lifts, or the designation of reserved parking areas. These features are currently absent in urban areas.

Women are another disadvantaged group from a transport perspective. They are less likely than men to have access to a car or possess a driver's license; only 30 % of license holders are female in Iran. Moreover, women are generally prohibited from riding bicycles in public. However, religious norms and cultural inhibitions are beginning to loosen. In Tehran's parks, sport complexes, and recreational sites, female cyclists are becoming more visible (Fig. 7.6).

4.6 Environmental Impacts

Iran has the fourth largest oil reserves in the world. Partly because of this, Iran's energy consumption is rather high by international standards. The per capita energy consumption is 15 times higher than Japan and 10 times higher than the EU (IEA 2015). The transport sector is the largest oil consumer. Between 1967 and 2009, its share increased from 12.5 million gallons to nearly 310 million gallons. Gasoline consumption has recently been growing at a rate of 10 % per year (Taghizadeh 2010). Despite Iran's extensive oil resources, at least a third of this gasoline is

Fig. 7.6 Women cycling in public in Tehran. Photo by author

imported from abroad. In 2005 alone, $4 billion dollars were spent on official gasoline imports. After the imposition of international sanctions on Iran, the direct purchase of foreign gasoline was severely limited and could only take place through mediator countries, such as India, which increased the costs further. To keep gasoline consumption at an affordable level, the government continued to subsidize the consumer price. In 2008, the national government allocated $84 billion to gasoline subsidies around the country. These fuel subsidies have led to more travel, which in turn resulted in high levels of pollution. Motorized vehicles are responsible for 75–80 % of the air pollution in Tehran (Jacobson 2012). Iranian cities, including Tehran, Isfahan, and Ahwaz are among the most polluted cities in the Middle East. The widespread use of older diesel vehicles has exacerbated the public health crisis which has arisen from air pollution (Fig. 7.7).

5 Urban Transport Governance, Decision-Making, and Financing Issues

More sustainable urban transportation planning in Iran faces three key barriers: (1) fragmentation of decision-making, (2) corruption in the planning process, and (3) a strongly car-oriented policy paradigm.

In the late 1980s, the country decentralized and municipalities became financially independent from national government. Since then, local authorities have

Fig. 7.7 Air pollution along a congested corridor in Tehran. Photo by author

devised various schemes to increase local revenues, including the conversion of public land from less profitable to more profitable uses (e.g., from parks to commercial uses). In their haste to convert land, little attention was paid to the impacts on the adjacent transportation network. (Traffic Impact Assessments are not required for new development.) Moreover, land development has stimulated mobility in areas where the existing infrastructure does not have sufficient capacity to absorb the additional traffic flow. The inappropriate use of the available infrastructure and facilities (e.g., inefficient traffic control and management) has further exacerbated the congestion.

This type of land-use conversion is a prime example of an approach to planning in Iranian cities, where decisions are made quickly in the absence of background studies. Transit planning (e.g., of the monorail systems in Tehran and Qom) and transport infrastructure construction (e.g., of overpasses and interchanges) suffer from the same lack of appraisal. Due to poor planning decisions at the onset, these projects have had much shorter life spans than anticipated. This has been further exacerbated by corruption and inadequate technical capacity.

Within individual cities, decision-making is highly fragmented. No local government has a comprehensive and integrated long-term vision for sustainable transport. A collection of public authorities, including the municipality and the traffic police, are in charge of different pieces of transport management, each proceeding with their tasks in an uncoordinated (and inefficient) manner, with little consideration of

Fig. 7.8 Surviving traditional streets in Tehran. Photos by Kamyar Adl

the impact of their actions on other sectors. For example, in historic cities (e.g., Isfahan, Shiraz, and Tabriz), the construction of tunnels, highways, overpasses, and interchanges has damaged the delicate built tissue predating the automobile, thus disrupting or uprooting established and coherent communities (Fig. 7.8).

Despite the damage to inner urban areas, other cities continue to pursue a car-oriented approach to transportation planning (Fig. 7.9). In Tehran, very large road

Fig. 7.9 The Nawab highway cutting through downtown Tehran. Photo by author

projects have been launched in recent years, including the Niayesh and Towhid tunnels along the Bakeri, Imam-Ali, Hemmat, and Sadr freeways. The projected costs are enormous: $2.8 billion for the Towhid tunnel, $1 billion for the Sadr-Niayesh freeway, and $0.5 billion for the Imam-Ali freeway.[1] In total, their budgets would have been sufficient to extend Tehran's metro by 77 km or to purchase an additional 28,000 buses, which would have nearly doubled the existing length of the metro system or increased the existing bus fleet by a factor of 5 (Fazeli 2014). Prior experience in Tehran has shown that road construction only reduces traffic congestion in the short term. In the long run, it fuels travel demand with disastrous social and environmental consequences.

6 Proposed Urban Transport Solutions and Implementation Challenges

Metropolitan areas in Iran have attempted both pull and push approaches to alleviating transportation problems. These have had some positive impacts but have also met with challenges. The most relevant examples are discussed as follows.

[1] These are the official cost projects released by the City of Tehran. The real costs will likely be higher.

In 2010, a new “Targeted Subsidies Reform” was adopted to eliminate energy subsidies and modify the fuel pricing scheme (IMF 2011). The reform is still in its infancy and its overall impact on energy consumption and efficiency is yet to be determined since a change in habits will likely take place only gradually (Moshiri 2014). However, early reports suggest that it is contributing to a limitation in vehicle use.

Cordon pricing schemes were implemented in a 30 km^2 area within Tehran’s CBD, and, in a more partial way, in the centers of Isfahan and Hamedan. Drivers wishing to access the area are required to pay an annual fee. Monitoring is through automatic cameras. The scheme has been successful in reducing traffic within the cordon in Tehran. However, it has a limited citywide impact. Moreover, gains in terms of pollution and congestion reduction are being offset by the growing levels of motorization.

Some large cities, particularly Mashhad and Tehran, are committed to improving their public transportation systems. Bus fleets are being renewed and the average vehicle age has been lowered to 5 years. At least half of the existing diesel buses have been replaced by buses which run on natural gas (Allen 2013). In addition, vehicles are now required to have annual safety and emissions inspection. Mashhad has built a new urban subway and a BRT system. However, these efforts have not been translated into higher public transport ridership. The rate of growth in car use has superseded the rate of growth in public transport use.

7 Conclusion

In recent decades, Iranian cities have relentlessly pursued policies in favor of car use. Car-oriented planning policies have shaped cities in which people need to drive tens of kilometers to reach their destinations. Urban life has become inconvenient for many people without a car. Traditional Islamic cities, which were densely and compactly built, and supported walking and socializing, have been damaged by the automobile.

At the same time, high levels of congestion, pollution, and accidents are increasing further and are undermining the quality of life in large cities. While fuel prices are low (and heavily subsidized) in oil-rich Iran, cars are still too costly for a significant portion of the population. Urbanites who cannot afford a car rely on grossly inadequate public and nonmotorized transport systems.

Urban sprawl and fragmentation have added another layer of urban problems. There is little order in the way different land uses are arrayed across the urban landscape. Most metropolitan areas include vast tracts of informal settlements for the poor (often without formal public transport services), as well as middle-class suburban estates, in which people lead increasingly isolated, individualistic lifestyles, cocooned in their cars. Policies that might lead more livable and sustainable cities are few and far between.

To overcome these problems, Iranian cities need to undergo a radical paradigm shift in transport and urban planning. For example, investments which are now consumed by roads and fuel subsidies could be diverted toward transit (buses, BRT, and metros). Public transport planning and land-use planning could go hand in hand in order to ensure alternative transport options to new developments. At the same time, transit could be extended into areas that are not currently served, and pedestrian planning could assume a central place, particularly in districts with high population densities.

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Chapter 8
Mexico

Priscilla Connolly

Capital city	Land area	Total population	Urban population	GDP per capita	Passenger cars
Mexico City	1,972,550 sq. km	122 million	79% (96 million)	$10,307	195 / 1,000 people

Data source: World Bank
Maps source: d-maps.com

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1 Introduction

This chapter addresses transport issues of Mexico's capital city and surrounding metropolitan area. Some issues, such as the scale of transport needs and the amount of resources available to meet them, are exclusive to this city. Other problems, including the lack of integration and connectivity between transport systems and the clientelist relations between government and providers, are common to all Mexican cities. Moreover, policies implemented in Mexico City are copied throughout the country, so a careful analysis of the capital should be a requirement before implementing the same models elsewhere. In recent years, Mexico City has been heralded internationally for its sustainable transport policies: another reason for a critical evaluation of results.

Mexico City (*Ciudad de México*) was the name given to New Spain's capital founded on the site of Tenochtitlan, the center of the *Mexica* (Aztec) empire conquered by Hernán Cortés in 1521. Three centuries later, the newly independent nation adopted the name Mexico, maintaining Mexico City as its capital and designating the surrounding areas as a Federal District (DF), with a different administrative structure to the federal states.[1] The DF included towns and villages outside the city proper, as well as extensive agricultural, forest and mountainous lands to the South and West. By the 1950s, urban growth of the city had absorbed many towns and villages, both within the DF itself and in the surrounding state to the North of the city: confusingly called "Mexico State" (*Estado de México*). The term "Mexico City Metropolitan Zone" came into use after 1970, to include those municipalities with built-up areas contiguous with the historic Mexico City. At present, the *Zona Metropolitana del Valle de México* or Metropolitan Mexico City contains the DF and 50 metropolitan municipalities: 49 in Mexico State and one in Hidalgo State (Fig. 8.1). In 2010, the population of Metropolitan Mexico City was 20 million: 11.2 million in the metropolitan municipalities and 8.8 million in the DF. The growth rate from 2000 to 2010 was 0.9 %, 0.3 % in the DF and 1.3 % in the metropolitan municipalities (CONAPO 2012). In terms of employment, consumption and the spatial economy, the metropolitan area functions as an integrated city, although the flows from the metropolitan municipalities to the DF are far greater than in the opposite direction.

In 1997, for the first time in 70 years elections were held for the DF's head of government, which has been held by the left-of-center party ever since, in opposition to both of the parties controlling both federal government level and the neighboring states that form part of Mexico City. This administrative and political delimitation of Mexico City has important implications for the city's transport. First, compared to the metropolitan municipalities, the DF is highly privileged because of the historical accumulation of infrastructure investment,

[1] In January 2016, the DF acquired the status of a Federal Sate and was renamed "Mexico City." For the sake of clarity, this will still be referred to as "DF" throughout this text.

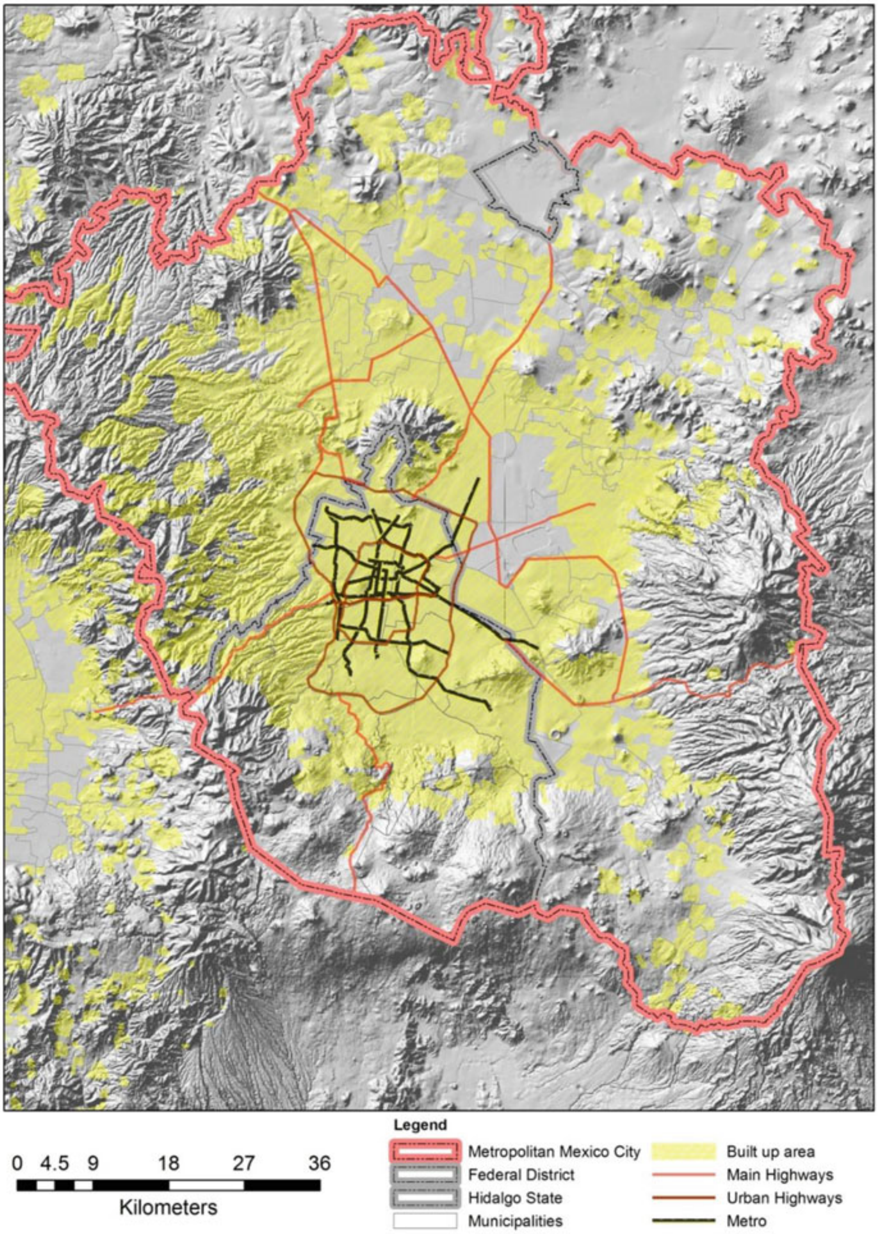

Fig. 8.1 Metropolitan Mexico City 2010. Map by Héctor Hidalgo

especially in the metro. This is due to both the traditional economic concentration in the capital and the direct involvement of federal government until the political reform of 1997. Second, the political antagonisms and rivalries between the different metropolitan governments have obstructed integrated transport policies for the whole area.

2 Urban Land-Use Patterns and Spatial Structure

The Aztec origins of the city explain many of the major features of the present-day spatial structure and social segregation. The main routes in and out of the city, later the first metro lines, coincide with the prehispanic causeways connecting the island city to the mainland. More importantly, as the lake dried up during and after the colonial period, the rich tended to live on the higher southwestern reaches of the city, less affected by perennial flooding and better provided with freshwater. The poorer population occupied the lakebed to the East, prone to dust storms or flooding, depending on the season. This basic segregation pattern was reinforced by successive investments in roads and other infrastructure systematically favoring the richer half of the city. The socioeconomic segregation would be more severe were it not for the fact that 70 % of Mexico City's housing has been informally produced, a situation that has led to a certain proximity between poorer socioeconomic groups within the richer, southwestern areas of the city. Like other Latin American cities and unlike North American cities, in Mexico City the rich tend to live in the central areas at lower densities, while the poor live on the periphery at high densities.

The city's main nonresidential activities were traditionally concentrated in the historic core and along two major axis stretching west and south, developed from the mid-nineteenth century onward. This decentralization process produced a gradual shift of government offices and commercial development. Mexico City was also the major industrial center of a country undergoing rapid industrialization, following import substitution policies implemented from the 1940s to the 1980s. Heavy industry was located mostly to the north of the DF and in neighboring municipalities in purpose-built estates. After the 1980s, free trade agreements transformed Mexico's economic base, pushing export-oriented industry to the north of the country. What is left of the Mexico City's industry has moved mostly to the municipalities to the North of the metropolitan areas, leaving semiderelict industrial zones, some of which have converted to warehousing and transport facilities. Meanwhile, new tertiary activities, particularly in finance and other production services sectors, have reestablished the economic supremacy of the capital city (Garza 2010). Many of these new tertiary activities are located in high profile developments such as Perisur area to the South and Santa Fe to the West, built for automobile access. In spite of all these transformations, Mexico City remains relatively centralized in terms of employment and service concentration (Fig. 8.2).

Mexico City also retains a high degree of centrality regarding the rest of the country, accommodating 18 % of the national population. The second largest city, Guadalajara, has a metropolitan area of just under 4.5 million inhabitants, followed by Monterrey, with 4.1 million. Seven other metropolitan areas have populations of over a million and these, together with Guadalajara and Monterrey, house a further 19 % of the total population. A further 20 % inhabited metropolitan areas have 0.1–1 million inhabitants, while the rest of the population (43 %) live in towns with less than 100,000 inhabitants and rural settlements (CONAPO 2012).

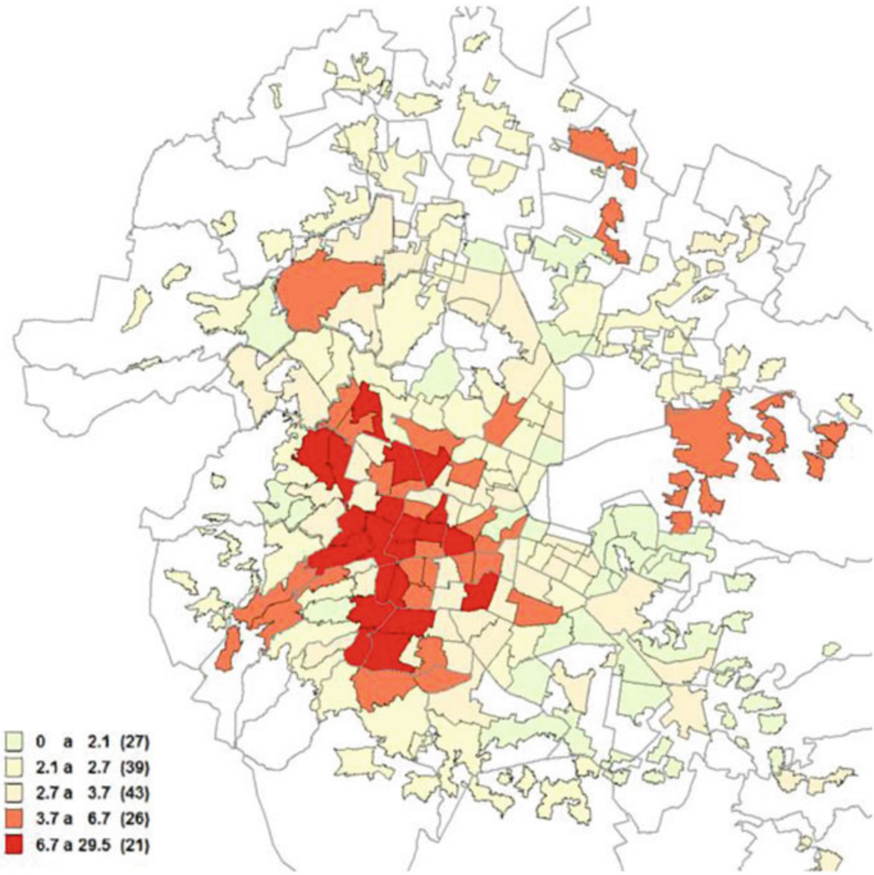

Fig. 8.2 Centrality index in Mexico City districts (nonreturn home daily trips/return home daily trips). Data source: INEGI/GDF travel survey 2007

3 Trends in Transport Use and Mobility

3.1 Tends in Mobility and Transport Modes

Given the general acceptance that ever-growing mobility is inevitable and even desirable, one might expect to find an increase in daily travel by the population of Mexico City, the major hub of an emerging economy integrated by neoliberal policies into global capitalism. Comparison of travel surveys over three decades (1979, 1984, 1994 and 2007) suggests that this is not the case. Mobility indicators decreased between 1994 and 2007. Excluding walking, the average number of trips per person over 5 years of age in 2007 was 1.1, compared to 1.3 in 1994 and 1.2 in 1983 (DDF 1994). Compared to an average of 3.8 trips per person in the United States in 2009

Fig. 8.3 Bicycle use is higher in poorer neighborhoods outside the central areas. Photo by author

(Santos et al. 2011: 10) and 2.5 average in Paris in 1998 (Henry and Hubert 2002: 3), mobility levels in Mexico City are low.

These averages conceal sharp contrasts in daily mobility across class, age, and gender groups. Mobility rates positively correlate with income, while men travel more than women. People between 18 and 64 travel twice as much as older age groups (Connolly 2009). The overall tendency of convergence is not due to increased mobility of the female, low income, young, or old population, but is because the more mobile population travel less. In 1994, the richest centrally located municipalities averaged 6.6 motorized daily trips per household, compared to less than 4.0 in the poorer peripheral municipalities (Fig. 8.3). In 2007, this index had reduced to 5.1 in the richer areas, while only marginally increasing on the poorer periphery (Connolly 2009).

An aging population explains the decreasing journeys to school. Correspondingly, journeys to work increased by 20 %, while other travel purposes have risen dramatically. Foremost among these are escorting purposes, reflecting the growing tendency to accompany children to school, due to increased insecurity and the growing dependence of the elderly (Table 8.1). Significantly, women were responsible for two-thirds of such accompanying trips in 2007. Women also account for similar proportions of trips made for shopping and recreation. The noticeable drop in weekday trips for meals reflects the growing practice of continuous work hours, with a short break at lunchtime, instead of going home to eat at midday. This cultural change is in itself a reflection of the growing transport difficulties facing Mexico City's population.

In terms of modal split, travel increasingly involves two or more public transport modes. The use of public transport has decreased but still accounts for over two-thirds of travel. Between 1994 and 2007, trips by car and taxi went up by 30 %

Table 8.1 Weekday trips by purpose of travel in Mexico City

Trip purpose	1994	2007	% change
Return home	46 %	45 %	5 %
Go to work	23 %	25 %	21 %
Go to school/university	14 %	9 %	-32 %
Go shopping	4 %	5 %	22 %
Take/collect someone else	4 %	5 %	39 %
Social/recreational	3 %	3 %	9 %
Trips on job	2 %	1 %	-30 %
Go to eat	<1 %	<1 %	-19 %
Other	4 %	6 %	5 %
Total	20,573,725	21,954,157	7 %

Data source: 1994 and 2007 travel survey

and 120 %, respectively, compared to total increase in daily travel of less than 7 %. Nevertheless, the private car is still a minority mode, accounting for less than 30 % of total trips in 2007. Taxis are cheap and abundant in Mexico City; their use is becoming a necessity for those without access to a private car (see later). Against this, there has been an increase in both bicycle and motorcycle use, although their modal participation is still very low. It is worth noting the very low percentage of trips that involve the use of both public and private transport, such as park-and-ride or bike-and-ride, at least up until 2007.

The political decision to abolish the public bus companies in the Federal District and Mexico state after 1994, leading to their substitution by lower capacity privately concessioned collective taxis, has been widely criticized, especially in official documents (SETRAVI 2002: 28 and SETRAVI 2010: 41; Navarro 2010: 185; CAF/OMU 2015). However, this is only partially true. The relative participation of collective taxis and combinations has dropped slightly, while the vehicle size of each concession has increased over the past four decades (see later). However, the individually concessioned vehicle derived from the taxi system undoubtedly forms the real "backbone" of public transport in Mexico City, as in many other urban areas in the country.

Table 2 shows the importance of collective taxis, along with private cars and the metro: the official "backbone" of the transit system. Over half of all daily travel in Mexico City involves the use of collective taxis, many using two or more of them. Almost a third of all trips use a private car while 19 % of travelers use the metro, mostly in combination with other forms of transport.

3.2 *Recent Changes in Transport Supply*

There have been recent innovations in transport supply that have resulted in changes in general travel behavior since 2007. Most importantly, the Bus Rapid Transit (BRT) system in the DF (see later) increased in size from one route to five, plus three routes of a similar system in the adjacent Mexico State. The five routes in the

Table 2 Use of transport modes in weekday trips in Mexico City (2007)

Mode	%
Collective taxi	51 %
Private car	29 %
Metro	19 %
Suburban bus	10 %
Taxi	8 %
DF government bus (RTP)	3 %
Bicycle	2 %
Other	1 %
Metrobús (BRT)	1 %
Trolleybus	<1 %
Light railway	<1 %
Motorcycle	<1 %

Source: OD Survey micro-data, 2007
Note: adds up to more than 100 % due to multiple-mode trips.

DF carry an average of 900,000 passengers a day on weekdays (Metrobús 2014), while those in Mexico State carry another 389,000 (SECOM 2015). This increases the share of BRT from approximately 1 % to 6 %, mostly due to travelers switching from collective taxis and, to a lesser extent, private cars. In 2012, 20 % of travelers said they used the BRT instead of their car (Metrobús 2014).

Another transport change has been the introduction of a suburban railway connecting the northwest of Mexico City to the downtown area. However, ridership on this line has been less than expected: 178,000 passengers a day compared to an estimated capacity of 300,000, contributing less than 1 % to the total modal split (Excelsior 2015). Since 2007, an additional metro line was completed connecting the central area with the southeast periphery of the DF. Inaugurated in 2012, the line was partially closed a year later for technical faults.

Complementing these recent transport projects, in 2010 the DF government introduced a bicycle rent scheme (*EcoBici*) in various high-income and tourist areas in the central city (Fig. 8.4). Current usage averages at around 30,000 riders a day with more than 130,000 registered users (ECOBICI 2015). In spite of these optimistic results, *EcoBici* has had little impact on overall metropolitan travel behavior outside these central areas. A survey in 2012 asking which mode of transport *EcoBici* users would have used if the rental bicycles were not available found that 43 % would have walked and 2 % would have used their own bicycles (CTS/SMA 2013). Only a quarter of *EcoBici* users reported that the bicycle was their main mode of transport (SMA/CEMCA 2012).

Fig. 8.4 *EcoBici* bicycles for rent the historic center. Photo by author

3.3 The Rise in Automobility

The rise in automobility, in spite of efforts to improve public transport and nonmotorized transport options, reflects an upsurge in motorization rates, intensity of vehicle use, and gasoline sales in Mexico City, as well as in the country as a whole.[2] However, both car ownership and car use are still luxuries that only a minority of the population can currently afford. According to the 2007 OD survey, 67 % of households have no car at all, 23 % have one car, and only 10 % have more than one. On average, 29 % of all trips in Mexico City were by car, but only 22 % of people with household incomes below three times the minimum wage use one, compared to 70 % of those with incomes above 10 times the minimum wage.

Car ownership and use is concentrated in the richer, more central areas to the Southwest, while inhabitants of the poorer periphery tend to use public transport (Fig. 8.5). Paradoxically, car use is greater in some central areas better served by cheap transit systems, owing to the preferences and entrenched automobile

[2] Nationally, the intensity of vehicle use tripled from 106,000 km/vehicle/year in 1990 to 339,000 in 2010, while the total number of registered private cars rose from 6.2 million to 21.6 million over the same period. Furthermore, the average 4260 km/vehicle/year/capita in Mexico City is among the highest out of major Mexican cities, although somewhat less than in Guadalajara (4342) and considerably less than metropolitan areas on or near the United States border: 4416 in Tijuana and 6308 in Mexicali (Medina 2012). The motorization rate in Mexico rose from 169 vehicles per 1000 people in 2000 to 332 in 2013, while in the DF this indicator rose from 396 to 541 (INEGI/DEMA 2015). This is still low by international standards. In the United States the corresponding indicator for 2008 was 809 (ChartsBin 2011).

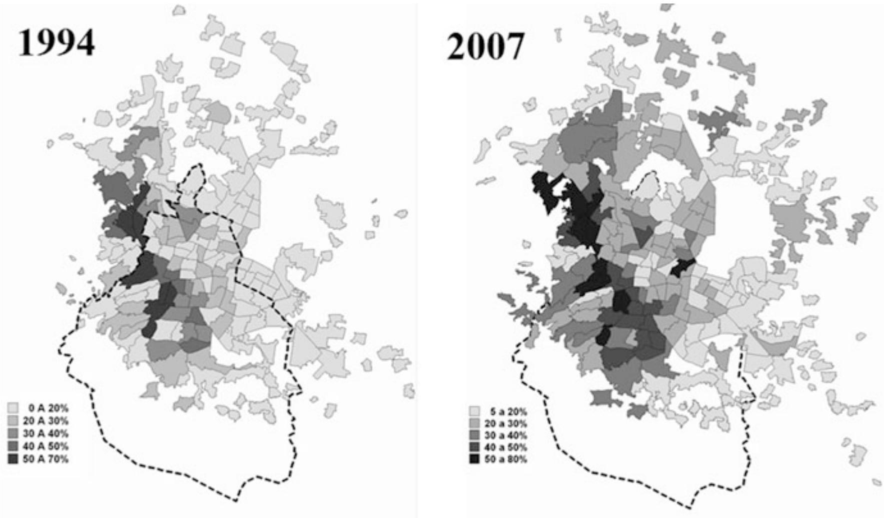

Fig. 8.5 Percentage of return home trips by car in Mexico City travel survey districts. Data source: 1994 and 2007 travel surveys

dependence of their higher income residents. However, car use is spreading outward to the low-income districts due to the high cost, inefficiencies and insecurity of public transport. Within this general pattern, people living in higher income suburbs in Mexico State are much more car dependent than people with similar incomes living in more central locations with better access to transit.

Between 1994 and 2007, car use only increased for three travel purposes: going out to eat, other social or recreational purposes, and escort journeys (Connolly and Duhau 2010). The first two are related to public security concerns, reflecting a preference for car use at night, while escort journeys are largely undertaken by women due to the increased car use in everyday social practices related to childrearing and elderly care. The tendency of increased car use is related to lifecycle situations, particularly having children and/or the need for multipurpose trips, such as family visits after work.

Mexico City has been planned around the automobile since the early 1930s, becoming even more geared to cars in recent years. Social practices regarding consumption, education, health services, and recreation, especially in new housing developments for all social classes, increasingly require the use of a car, even though two-thirds of the population do not own one. This explains the doubling of taxi use between 1994 and 2007. The majority of taxi users belong to the low- and middle-income groups. Neither the extremely poor nor the rich use this mode of transport, while taxi fares in Mexico City are reputedly among the 10th cheapest out of 72 widely visited cities in the world (PriceofTravel 2015). The governance of taxi services is therefore an important issue considered later in this chapter.

During the last decade, both local governments of Metropolitan Mexico City have built restricted access second story urban freeways over existing ones, thus

Fig. 8.6 Motorized landscapes in Mexico City. Photos by the author and Héctor Hidalgo

increasing the disadvantage of travel by foot and in public transport using street-level roadways (Fig. 8.6). At the same time, although parking meters have been installed in some central areas, planning regulations stipulate minimum rather than maximum parking provision for both residential and nonresidential land uses, a policy which also reflects continuing support for private car use.

4 Urban Transport Problems

Mexico City's transport challenges can be grouped into three types of problems. The first and perhaps the most pressing concerns the difficulties faced by the population in moving around the city. The second type of problem refers to safety and security related to travel. The third concerns the detrimental effects of transport on the city as a whole, most importantly, atmospheric pollution and other environmental impacts.

4.1 Costs and Inconveniences of Daily Travel

From the point of view of the resident and visiting population, Mexico City's daily travel problems mainly concern cost, time, discomfort and, especially, insecurity. The relative importance of each is reflected in objective indicators and the perception of the population expressed in surveys and in-depth interviews.

Inhabitants of both the DF and Mexico State spend a lower percentage of their income on transport than in most other states: 10 % and 12 %, respectively, compared to the national average of 13 % (INEGI 2013). Mexico City also has cheaper transport than many other Latin-American cities. The average annual expenditure per capita in 2007 was $534 for Mexico City, compared to the average of $715 in other large Latin American cities. Only Lima, Santiago, Guadalajara, and León (Mexico) registered lower averages (CAF/OMU 2010). However, this advantage is not spread evenly. Another household survey found that in 2013, residents of the DF spent only 9 % of their income on transport, compared to as much as 23 % in Mexico State, while the national average was 14 % (SHF 2014). This advantage reflects accumulated investment and subsidies in certain elements of the transport system, principally the metro. A metro ticket or a bus ride in the DF cost less than 30¢. A suburban bus or collective taxi ride can cost 60¢-$3.[3] In the DF, 77 % of travelers spend less than 20 % of their personal income on transport, compared to 43 % in the metropolitan municipalities (Ruiz 2012). Behind these averages, there are extreme cases of people who spend high proportions of their income on daily travel, particularly in new housing developments on the periphery. Some people pay more for traveling than for mortgage payments, often leading to the abandonment of recently acquired dwellings (CIDOC 2015).

Increasing travel time spent in getting around Mexico City is a main complaint expressed by residents and government alike. In 2007, residents of the DF and metropolitan municipalities, respectively, spent on average 100 and 122 min on daily travel. Car travel is only marginally quicker than these averages: 8 min less in the DF and 13 min less in the metropolitan municipalities (Connolly 2009). Furthermore, this modest reduction is not so much due to the fact that car travel is quicker, but rather, that cars tend to be used for shorter trips, while public transport is preferred for longer ones (Connolly and Duhau 2010). Notwithstanding this evidence, the general perception is that traveling by car takes up less time, one reason often given for rejecting public transport. Paradoxically, the major complaint by motorists is traffic congestion leading to unnecessarily long travel times. Other motivations for car travel have to do with comfort, convenience, and personal safety.

Discomfort and inconvenience are the main causes of dissatisfaction with Mexico City's transport conditions. Collective taxis inevitably receive the lowest ratings in surveys, followed by buses, trolleybuses, and taxis (El Universal 2014: 109; Parametría 2013). The suburban train is considered the best transport service, although few people use it because of its high cost and limited access. The BRT systems are highly rated, although at least half of people consider that they are overcrowded (Metrobús 2012). The metro and other publicly run services generally receive intermediate ratings (El Universal 2014).

Excess travel demand not only causes crammed conditions and high temperatures inside the metro, buses and collective taxis, but also implies long waiting times. During peak hours and technical delays, it is often necessary to wait for various metro convoys or buses to come and go before being able to get on. Once aboard, it is practically impossible to find a seat and often it is extremely difficult to alight at the right station. People who have to travel with children or carry objects face difficulties in boarding public transport vehicles. In the metro and BRT, there are sections reserved for women, children, the elderly and disabled people, although this is not always respected.

Most complaints concern the collective taxi system that provides over half of all transport and suburban buses operating in the metropolitan municipalities.

[3] The exchange rate is approximately 15 Mexican pesos to the US Dollar (2015).

Overcrowding and long waits are only part of the problem here. The deplorable state of the buses, microbuses, *combis* and other minivans is also a concern. Another is the reckless driving of the operators, who have to compete among themselves for passengers as their earnings depend on the fares they receive. Many of the drivers are also often very young, inexperienced and under the influence of drugs or alcohol.

Public transport passengers are not the only ones to complain about the collective taxis and their drivers. Motorists blame congestion on these ubiquitous vehicles and their drivers, who stop anywhere they like for picking up or dropping off passengers. Car drivers also blame congestion on other motorists for double or triple parking. Generally, motorists see more parking provision, urban freeways and more vehicular under- and overpasses as solutions to congestion. Car users also blame cyclists for obstructing the roads (while cyclists blame motorists for the same reason). When gridlock occurs, which happens quite frequently, many drivers disregard the traffic code as they try to escape the jam.

Lack of connectivity between modes of transport is a major problem in Mexico City, prolonging travel times, increasing discomfort and exposing travelers to risk of assault. Even the transfers between different lines of the metro involve long walks of up 800 m. Connections between modes of transport are even worse, often requiring crossing roads and/or maneuvering crowded passages through street vendors' stalls. Major metro termini have nodal interchange installations called CETRAMs (Centros de Transferencia Intermodal). Although originally well designed, the CETRAMs have not been adequately maintained since they were built in the early 1980s and are generally considered to be unsafe. Two CETRAMs have been rebuilt by private concessionaries and the construction of two other major terminals is underway. These new enclosed structures employ private security companies which may give travelers a sense of security while they walk even further distances up and down stairs past arrays of shops providing rather useless goods and services: unlike their informal competitors who provide cheap food, clothing, and other day-to-day items. A unified ticketing system using a rechargeable card is only available for the metro and DF's BRT system. All other forms of transport need separate tickets and cards, or fares are paid on boarding the vehicle.

4.2 Safety and Security

The lack of security is by far the most common complaint against public transport, especially the buses and collective taxis. Security is also one of the main reasons given for preferring the private car. Complaints concern two types of hazard: the risk of being assaulted, robbed, or sexually harassed (security) and the risk of traffic accidents (safety). Of the two types of risk, most people consider the problem of assault a greater problem.

Personal security is a major problem facing the country, especially since the upsurge in turf wars sparked by the hard-line "war on drugs" policy. The risk of kidnapping, extortion or being caught in crossfire is severe in many regions. Apart from these extremely violent situations, falling victim to some kind of delinquency is an everyday reality in Mexico. Over 28 % of the country's population aged 18 or more was victim to some kind of crime in 2013, up from 24 in 2010, and many people were victims of more than one crime. The figures for the DF and Mexico State are even higher: 52 and 93 crimes per 100 inhabitants, respectively, for 2013. In the DF, 40 % of the crimes occurred in the street or on public transport and a further 12 % involved total or partial theft of a vehicle. Insecurity costs the country the equivalent of 1.3 % of GDP or about $430 per person per year. Measures that people take to protect themselves often involve self-restriction of mobility. These include not allowing children to go out (70 %), not going out at night (53 %), not walking (43 %), not using a taxi (31 %), not going out to eat (29 %), not going to the cinema or theater (29 %) (INEGI 2014).

In this context, it is hardly surprising to find that 70 % of the population of Mexico City feels insecure in public transport, while 57 % feels insecure on the streets (El Universal 2015). The problem of armed assault on public transport is most severe in the metropolitan municipalities to the North and East of Mexico City, especially on buses. Almost all travelers on these routes have experienced first-hand some kind of robbery, either aboard a vehicle or on the ground. Sexual harassment, especially on the metro, is another frequent problem. To combat this, the metro and BRT authorities introduced segregated travel, with certain areas of the vehicles reserved for women, children and seniors at peak hours. The DF bus authorities introduced in 2008 special pink buses exclusively for use by women (Fig. 8.7).

Accidents are generally perceived as a lesser risk than public insecurity issues. Even so, road safety in the country as a whole ranks 7th worst globally, with an average of 24,000 deaths per year from accidents (Wradio 2013). In the DF, 15,742 accidents were registered in 2013, with 370 fatalities; in Mexico State, the figures are 10,607 and 138 (INEGI/ATZUS 2015).[4]

4.3 Environmental Problems

Atmospheric pollution was a hallmark of Mexico City in the 1980s and 1990s, although the enforcement of biyearly emissions test, the prohibition of older vehicles to circulate one day a week and the introduction of catalytic converters since 1990 have done much to improve vehicle emissions at the local scale. In fact, the air pollution program (ProAire) is one of the few examples of concerted transport-related governance at a metropolitan scale, although some municipalities have recently opted out of the "one day of the week off the road" measure.

In spite of these policies, air quality in Mexico City is still poor, with ozone, PM_{10}, and $PM_{2.5}$ levels often exceeding internationally recognized standards.[5]

[4] Both these figures are underestimated, as many accidents go unregistered or are registered under another cause, such as "accidental trauma" or "heart failure."

[5] If the annual level of PM_{10} in Metropolitan Mexico City complied with the Mexican standard of 50 μg/m^3, 400 deaths could be avoided on the short term; with the European standard of 40 μg/m^3, 1000

Fig. 8.7 Government run "pink" buses exclusively for use by women. Photo by author

Table 3 Contribution of mobile sources to atmospheric pollution (%) in Mexico City (2008)

Source	PM_{10}	$PM_{2.5}$	SO_2	CO	NO_x	COT	VOC	NH_3
Private cars	3.9	9.3	24.8	40.7	32.3	9.9	15.3	16.8
Taxi	0.7	1.8	4.8	12.1	11.2	1.7	2.4	3.3
Micro-buses and vans	0.2	0.6	1.3	7.3	3.1	0.9	1.3	0.6
Buses	1.6	6.2	6	2.3	11.7	0.6	0.9	0.1
BRT	0.0	0.1	0.0	0	0.1	0	0.0	n/a
Motorcycles	0.4	0.9	1.3	9.9	0.9	2.9	4.4	0.2
Goods vehicles and pickups	8.9	32.5	9.5	19.9	17.3	3	4.4	1.6
Total transport (%)	16	52	50	99	82	21	31	24
Total (tons/year)	24,296	5499	6704	1,568,428	188,087	946,733	591,399	20,177

Source: ProAire (2011)
Note: These figures do not account for the pollution emitted by airplanes, trains and car and asphalt production facilities.

The combination of the city's mean altitude (2240 m), tropical latitude, prevailing winds and funnel effect of surrounding mountain ranges exacerbate the atmospheric pollution, as well as causing thermal inversions in winter (Connolly 1999). Transport

deaths could be avoided; and with the OMS and EPA standard of 20 μg/m^3, 2300 deaths could be avoided. Ozone levels of above 50 ppb cause 2000 hospitalizations and 800 deaths (ProAire 2011).

is responsible for much of this atmospheric pollution, especially $PM_{2.5}$ (52 %), SO_2 (49 %), CO (99 %), and NO_x (82 %). Clearly, private cars contribute disproportionately to most pollutants (Table 3). Greenhouse gas emissions are another major problem caused by transport worldwide. As well as 50 % of carbon emissions, transport is responsible for almost all nitrous oxide emissions (ProAire 2011). Meanwhile, noise pollution has a relatively low profile on the political agenda in Mexico City, in spite of the fact that noise levels exceed 80 dB during the daytime in most of the main traffic routes (GDF/UAM 2011).

5 Urban Transport Governance, Decision-Making, and Financing

5.1 Generic Types of Transport Provision in Mexico City

Transport in Mexico City is provided by a disparate set of arrangements forged over a long period between private and public agencies. Lack of coordination between government actors responsible for transport provision is the major obstacle to the successful implementation of an integrated transport policy. Each transport mode wields a different quota of political clout, obstructing effective coordination between the systems. The largest transport organizations, such as the metro, are more powerful than the government secretariats that are supposed to coordinate and plan the city's transport. These secretariats have recently changed their names both in the DF and in Mexico State from "transport" to "mobility," without substantial changes to their responsabilities. Apart from drawing up the transport plan (now "mobility" plan), their main function is to register and regulate concessioned transport in their respective jurisdictions. However, there are sharp differences between the resources and institutional frameworks operating in the DF and metropolitan municipalities, not to mention political rivalry, which has hampered coordination at a metropolitan level.

The metro absorbs the greater part of the subsidies,[6] although per passenger trip this is only about half of that given to buses, light rail, and trolleybuses. Thus, direct DF government subsidies accounted for more than half of the metro's budget in 2013 (STC 2013). At the other extreme, the growing BRT system, organized as a Public Private Partnership (PPP), is costing the government much less per passenger, absorbing only a small fraction of the total.[7] The concessioned buses and collective taxis also receive subsidies in the form of soft loans for exchanging old vehicles for new ones. These schemes operate in both the DF and the State of Mexico.

[6] Data on transport subsidies from GDF (2012).

[7] The subsidies received by the BRT are hidden in the direct subsidies received by the government bus company (RTP) which operates on two lines of the system.

5.2 *Transport Systems Administered Directly by the Government*

At present, only the DF government provides transport services directly, although the government of Mexico State ran some bus services in seven municipalities from 1982 to 1996.

With 12 lines covering 226 km, 195 stations and 3213 carriages in operation, Mexico City's metro system competes with New York and Tokyo in terms of total ridership: about 4.5 million daily. Massively used, massively subsidized and controlled by a state enterprise (*Sistema de Transporte Colectivo* STC), most of the metro was built under contract by the leading Mexican construction company and a consortium of French technology providers between 1967 and 2000. After the financial crisis in 1982, two new metro lines were developed that were supposed to be at lower cost. The new predominantly street-level metro lines that resulted implied a switch from a close-knit network to an extended radial solution, while at the same time facilitating road transport by building bridges and underpasses. The most recent metro line was developed and operated via PPP's, with disastrous technical results leading to its partial closure from March 2014 to November 2015.

The operation of the metro has been in the hands of the DF government enterprise STC since its creation in 1967. Most of the 14,258 workers employed by STC belong to the Metro Workers Union, adding a powerful actor to the transport governance arena. Other transport systems administered directly by the DF government include trolleybuses, light rail, and buses. Investment in trolleybuses and their infrastructure, as well as their operation, is handled by a public enterprise "Electric Transport System" (STE). STE has a strong traditional union. It also controls the single light railway, a converted tramline that connects the southernmost metro station with Xochimilco. Both trolleybuses and the light railway have minimal modal participation and are highly subsidized.

The other mode of transport in which the government has direct control are the "RTP" buses. The lack of a satisfactory response from private investors in buses led to the creation of the Passenger Transport Network (RTP) in 2000, a government company that owns the buses and runs the service. In 2013, RTP operated 94 routes with 1290 buses and a daily ridership of 370,000. Of all the transport modes directly operated by the DF government, RTP receives the most subsidy per passenger: 9.3 pesos for every 3-peso ticket, absorbing 11 % of all subsidies to transport.

5.3 *Transport Run by Public–Private Partnerships (PPP)*

Bus Rapid Transit (BRT) was introduced in Mexico City following an agreement in 2002 between the World Bank subsidiary EMBARQ and the GDF, setting up the Center for Sustainable Transport in Mexico. The Center for Sustainable Transport collaborated directly with the GDF in the design, implementation and evaluation of the DF's BRT (named *Metrobús*), as well as advising on other transport and mobility policies. In addition to the usual BRT features, the operators own, operate and maintain the buses, paying the drivers a fixed salary. Ticketing firms collect the fares and pay them to private trust funds which, in turn, pay the operators on a distance basis, independently of the number of passengers.

The first *Metrobús* line began operation in 2005 and another four have since been built, with line 6 to be opened in 2016. Every time a new line is built, collective taxis and other buses are removed, a process requiring intense and costly negotiations with the leaders of the respective organizations. On lines 1 and 5, these organizations have opted to convert into BRT operators, becoming established firms with salaried bus drivers. On other lines, the previous concessionaires were paid off, often with taxi licenses or concessions for alternative collective taxi routes. The terms of each negotiation vary, as does the amount awarded to each operator.

The operational indicators for 2014 estimate a ridership of 260 million a year, averaging 920,000 a working day. The five existing routes have 153 intermediate stations and 18 terminals, covering 105 km of dedicated lanes served by 431 vehicles operated by 10 companies (GDF/POA 2015). The Metrobús saves an estimated 115,000 tons of CO_2 equivalent, for which the GDF has received finance from the World Bank in the form of carbon bonds and other payments. In 2007, the Metrobús received the "Roy Family Award" for the PPP arrangement enabling its implementation (CTS 2009).

Following the *Metrobús* example, Mexico State government is also implementing a BRT project in the metropolitan municipalities, called *Mexibús*.[8] The first line started operating in 2010 on a 16 km route with 24 stations and an estimated daily ridership of 128,000. The second route (line 3) has 16 km and 58 buses started operations in 2013 and moves about 70,000 passengers daily. The third route (line 2) was inaugurated in 2014 and has a daily ridership of 185,000 passengers (GEM 2013). The *Mexibús* project has been criticized for the opaque handling of the financial aspects and unresolved conflicts with the original transport concessionaries, many of which continue to operate along the same, or parallel, routes. Design faults and lack of pedestrian protection have caused accidents and inconveniences including increased traffic congestion both before and after construction completion.

The suburban train, running from the old train station in downtown Mexico City to the municipality of Huehuetoca to the northwest, is part of a federal government initiative to make use of existing railway routes. After a long and contested process of litigation, the concession to build, equip and operate the contract was won by the Spanish company—Constructores y Auxiliares de Ferrocarriles. In 2008, it started operating a limited service as far as Cuautitlán along a 27 km route with 7 stations, 20 four-car trains, a journey that takes 25 min. Its current ridership of about 140,000 is far below its projected capacity of 320,000. The suburban train has been criticized for its lack of connectivity with popular destinations and other modes of transport. The relatively high fares are also a deterrent for potential users.

[8] Eleven other cities in Mexico have implemented BRT schemes, with varied success.

5.4 Transport Provided by Private Concessionaires

This group of transport modes includes privately operated buses, collective taxis or microbuses, and individual taxis of various descriptions. Unlike those mentioned earlier, these modes of transport are not directly promoted or organized by the government beyond the concession regulations. These operators provide most of the transport in both Mexico City and the rest of the country while costing governments very little. However, this advantage is relative if infrastructure costs are considered, not to mention atmospheric emissions and other environmental impacts.

Peseros, *collectivos*, *combis*, and microbuses are the various names given to the collective taxis that dominate the transport system in Mexico. Seen by most observers as the scourge of the streets, some commentators praise their flexibility and dynamism (e.g., Cervero 1998). Critics and apologists agree that they have developed without government control. However, far from being independent of the government, the collective taxis have developed largely in response to government policies over the last 50 years.

The origin of the *collectivos* in Mexico City dates from 1952 when some sedan taxis began picking up various passengers along one of the main thoroughfares. Financially advantageous to the cab drivers and providing a speedier and more comfortable ride—albeit at 5 times the price of bus ticket—the system rapidly expanded into other areas of the city (Roschlau 1981). In various stages, the American sedan cars were replaced by larger vehicles: first Volkswagen *combis*, and later minibuses and ordinary buses, with the help of soft loans to the concessionaries provided by the government with World Bank financial backing. What was originally a middle-class alternative to crowded buses has transformed into a mass transport solution (Fig. 8.8). What has remained constant is the pyramidal structure governing this form of transport and its close political relation to the authorities (Bacelis 2003). This originates in the individual taxi concessionaires who, in order to operate, must be affiliated to the organization that controls their particular route.

Services of *collectivos* have no fixed timetable as it is more profitable to fill up the vehicle before departing. Drivers compete among themselves for passengers and work much more than 8 h a day, usually without any kind of social security benefits. In spite of these widely recognized faults, the system does provide some advantages to the passengers. The low-capacity vehicles can penetrate the otherwise inaccessible densely populated low-income settlements on the periphery, while the flexibility in the location of stops and even routes provides better security, especially at night (Fig. 8.9).

The system of collective taxis in Mexico State has followed more or less the same pattern as in the DF, including the programs for regularizing and upscaling vehicles. However, the process is generally less transparent. Unlike their counterparts in the DF, some transport leaders in Mexico State have other economic interests, such as formal and informal real estate development. In addition, they often occupy elected posts as mayors, municipal councilors or state deputies. The latest annual report of the Mexico State government reported a total of 13,356 microbuses

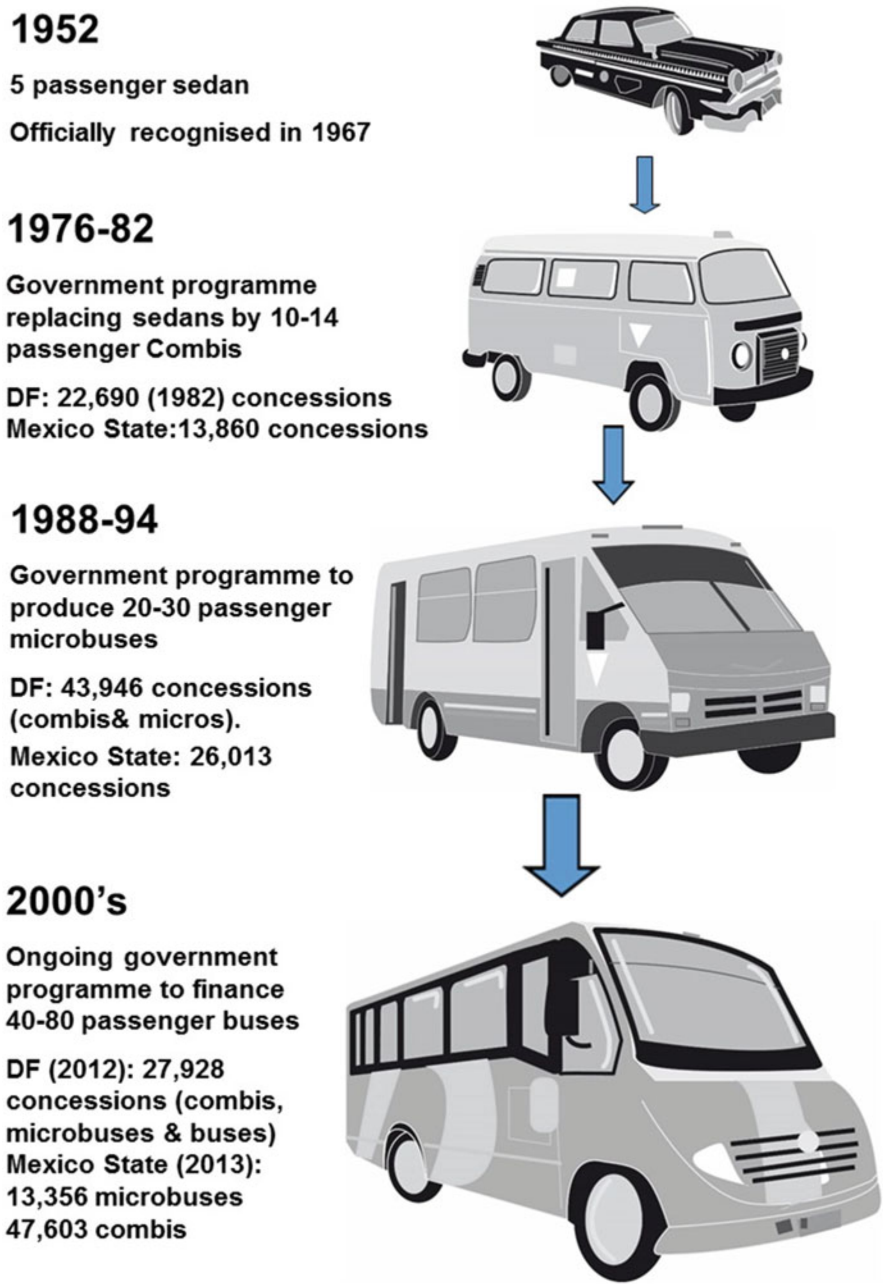

Fig. 8.8 The expansion of Mexico City's collective taxi system in four generations. Drawing by Elena Boils

Fig. 8.9 Older (left) and newer (right) "colectivos"; both types are in use. Photo by author

in the whole state, plus 47,603 *combis* (GEM 2013), though these figures do not include the thousands of vehicles operating illegally.

Concessioned buses provide collective transport services both in the DF and Mexico State, where they are known as "suburban buses." They differ from collective taxis in that the concession is granted to a company that runs a fleet of buses, rather than to individuals, although the actual vehicle may be identical in either case. Buses are considered such if they have a capacity of 30 passengers or more. In the DF 9 bus companies operated 97 routes with 1197 vehicles transporting approximately 1200 passengers a day: 70 % more than the government-run highly subsidized RTP buses.

In Mexico State there is even less information about concessioned buses. The State government annual report for 2013 states that there are 11,647 buses operating in the whole state (GEM 2013). However, other official sources recognize that the number of buses circulating illegally is much greater. For instance, in the first half of 2013, 4310 buses were removed from the roads but, after paying a fine, they returned to circulation. Like the GDF, the Mexico State government is attempting to create transport corridors by offering concessions with credit to acquire vehicles and guarantee initial financial viability. So far, only one route has been concessioned in this way.

Taxis, regulated or not, are a pillar of corporatist Mexico with a rapidly increasing share in total ridership. In fact, the individual service for hire, the horse drawn cab, predates any other form of public transport. Traditionally, there have been strong connections between the organizations of concessionaries for taxis and collective taxis. In 1999 the GDF created a separate government body to deal specifically with taxis with the aim of weakening these political alliances, thus facilitating separate negotiations with each. In any case, taxis concessions are always a political card to strike a deal with recalcitrant collective taxi organizations who resist transforming into BRT or concessioned bus companies.

According to government reports, there are 102,110 registered taxis in the DF (SEMOVI 2014) and a further 147,200 in the whole of Mexico State (GEM 2013). However, these figures underestimate the number of different types of taxi circulat-

Fig. 8.10 Authorized "bicitaxi" in shared streets in the historic center. Photo by author

ing in Mexico City, which include numerous variants including quality unregistered taxis, registered and unregistered battered old sedans, rural rickshaws, tourist bicitaxis and Uber services (Fig. 8.10).[9]

6 Proposed Urban Transport Solutions and Implementation Issues

6.1 From Transport to Mobility

The official policy document for transport in the DF is laid out in the Integrated Program for Mobility 2013–18 (PIM) drawn up in 2014 by the newly renamed Mobility Secretariat (SEMOVI). The Mobility Law for the DF was also approved in 2014 (APDF 2014). PIM will very probably be emulated all over the country. Like all programs, and even laws in Mexico, the document contains a lengthy diagnosis and expresses many good intentions in the form of strategies and goals. However, not all these objectives are attainable over the short term or are beyond the control of SEMOVI or even the GDF. Others are merely a continuation of current policies. Foremost among the unattainable goals seems to be the "metropolitan vision," which is repeated throughout the text as an ideal, but with very little concrete proposals of how this could be achieved.

[9] As in other parts of the world, Uber drivers have come into increasing conflict with all other taxi organizations (El Universal 2015).

The substitution of "transport" for "mobility" in the general vision is expressed in the diagnosis as a "change of paradigm" establishing a new hierarchy of priorities, or rather, reiterating the priorities already established in the Mobility Law and, before that, in the Traffic Code of 2003 (GDF 2003). According to this hierarchy, policies concerning the use of roads and distribution of budgetary resources should prioritise their beneficiaries in this order: (1) pedestrians and disabled people, (2) cyclists, (3) public transport passengers, (4) public transport providers, (5) goods transport providers, and (6) private motorists (SEMOVI 2014).

Associated with this, the program lays out ten mobility principles, most of which clearly respond to the main problems discussed earlier: 1) security, 2) accessibility, 3) efficiency, 4) equality, 5) quality, 6) resilience, 7) multimodality, 8) sustainability and low carbon emissions, 9) participation and social responsibility and 10) technological innovation. This new paradigm, directly inspired by the excellent studies published by the Mexican branch of the Institute for Transportation and Development Policy (ITDP), switches the focus from "moving vehicles" to "solving people's needs."

6.2 Strategic Objectives and Their Limitations

To achieve all these goals, the program proposes the following six "strategic objectives" (SEMOVI 2014):

An integrated transit system, defined as the physical, operational, fare collecting and informational integration of all the transport modes, is recognized as indispensable for sustainable mobility. However, most of the proposed actions are hardly new and offer only partial solutions to the extremely fragmented system described earlier. One proposed line of action is to transform the collective taxis into company-run buses, substituting the ramshackle microbuses for higher capacity vehicles: a strategy that has been pursued with only partial success for the past 20 years. Other actions include the installation of new information technologies and routine maintenance of the government-controlled transport systems. These are normal procedures and are severely limited by budgetary restrictions, especially in the case of the metro, where repairs to line 12 are absorbing vast resources. A further assortment of measures, such as expanding the *EcoBici* program, building more BRT lines and modernizing metro stations represent a continuation of current policies.

Streets for everyone is another "strategic area" that is branded as a means for achieving social equality through urban space, but for the purposes of this program includes a medley of actions ranging from revising the traffic code to building exclusive access urban toll roads. However, the program does commit to building more cycle paths, traffic-calming devices, exclusive bus lanes and multimodal "complete streets." These include the expansion of an ongoing project in the historic core, partially inspired by the "shared spaces" model, which has resurfaced several streets to allow combined use of pedestrians, cyclists and slow-moving vehicles.

More mobility with fewer cars is supposed to be achieved mainly by expanding the *EcoBici* and parking meter programs, promoting car share and employee buses, along with promoting studies to evaluate best practices elsewhere. The paucity of proposals here reflects the lack of political will to tackle the automobile. The problem is not considered to be car ownership in itself, but the "excessive" use of cars for daily travel that could be solved by other means.

Achieving a culture of mobility is even more difficult to pinpoint in concrete policy actions. Stricter procedures to obtain a drivers license, certification of driving schools, elimination of corruption among traffic police, conscience-raising campaigns and promotion of bicycle use are some of the proposed measures.

Efficient distribution of goods is a problem that has received little attention to date. One policy measure proposed is to update studies on this and design a plan to control the movement of goods vehicles. However, a problem is that most medium and heavy goods vehicles fall under the federal government jurisdiction, beyond the control of the GDF. As a vital cog in the city's day-to-day functioning, the goods vehicle sector, like its passenger counterpart, is difficult to regulate.

Transit-Oriented Development (TOD) has become a catchword adopted by all levels of government to contain urban expansion and, correspondingly, justify high and medium rise developments, independently of their connection to transport. In the case of the GDF mobility program, TOD is largely associated with the ongoing projects for converting the existing transport nodes into privatized spaces akin to down-market shopping malls.

7 Conclusions

The effectiveness of the most recent mobility policy for either reducing automobile dependence or improving transport conditions for the masses is highly debatable. Certainly, there have been some advances in nonmotorized mobility infrastructure in central areas, but these have mostly benefited the higher income resident population and tourists, not the perennial cyclists of the impoverished periphery. New BRT routes usually offer safer and more comfortable journeys, though these are both less flexible and more expensive than the collective taxis they replace. The expansion of high-capacity transit toward the outskirts has been fraught with technical and financial difficulties, as well as pushing urban growth into areas that are vital environmental resources for the city. Improvements of streets and other public spaces have restored life to the city center but have yet to reach anywhere else. Meanwhile, the governments of both the DF and Mexico State, like those of many other cities in the country, are committed to building more and more urban highways, many with access restricted to those who can afford to pay more than the daily minimum wage for a single journey. Above all, the government's capacity to change transport provision is limited by the interests vested in the status quo. From the automobile industries to the overworked taxi driver, from the motorist who expects to travel at 60 km/h and park 10 m away from her final destination to the transport organizations whose business it is to negotiate irregularities: these do not stand much to gain from sustainable mobility. The rhetorical shift from "transport" to "mobility" may help overcome some of these inertias by generating a real shift in values and priorities. If the politicians repeat the slogan that the “pedestrian goes first” enough times, they may eventually believe it.

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Chapter 9
Nigeria

Roger Gorham

Capital city	Land area	Total population	Urban population	GDP per capita	Passenger cars
Abuja	923,768 sq. km	174 million	51% (88 million)	$3,010	31 / 1,000 people

Data source: World Bank
Maps source: d-maps.com

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1 Introduction

Examining urban transport in the Nigerian context requires addressing three layers of complexity. At the most basic level, urban transport, as anywhere in the world, is inherently complex, involving numerous stakeholders, competing objectives, high investment costs, complex interdependencies with land and labor markets, and very unpredictable and hard-to-manage demand–supply interactions.

At another level, the characteristics that define (particularly sub-Saharan) African urbanism compound those complexities exponentially. These include limited ability by both households and governments to pay for, respectively, services and investments; limited capacity to manage and operate urban transport infrastructure services; and dominance of small-scale, informal provision of transport services in most urban contexts.

Distinct characteristics of the political economy of the nation add the third layer of complexity. These include the long-term dominance of the petroleum industry in the national economy, which, among other things, has led to a long-standing policy of petroleum subsidies as well as a decline in the manufacturing sector at precisely the moment when urban populations were growing; inconsistent and at times counter-productive involvement of the Federal government in urban transport; and increasingly persistent security challenges in urban environments, particularly in the Northern part of the country.

2 Urban Land-Use Patterns and Spatial Structure

Urbanization in Nigeria exhibits a few anomalies relative to conditions observed in other countries. International benchmarks suggest that urbanization is often correlated with rising per capita income and per capita GDP, increased manufacturing, and declining poverty rates. Yet Nigerian urbanization does not conform to these trends. In 2014, the urbanization rate in Nigeria was 47 %, the highest in sub-Saharan Africa. Figure 9.1 shows that comparator emerging economies had lower GNI per capita in the year they attained 46 % urbanization. This means that urban Nigerians and their governments have relatively less ability to pay for transport services and infrastructure than international benchmarks at the same rate of urbanization.

In addition, tradable sectors, such as manufacturing, have not developed outside of oil and gas—indeed, manufacturing declined from about 10 % of GDP to just over 2 % of GDP during the 30-year period between 1980 and 2010, while the urbanization rate grew from about 20 % to about 42 % over the same period. Similarly, poverty rates have not declined with urbanization as expected. Figure 9.2 shows Nigeria's urban poverty rate vs. its urbanization rate in relation to other developing countries. Overall poverty rates in Nigeria slightly increased and then stagnated during the period of substantial urbanization beginning in the 1980s, although urbanization processes in other countries are associated with a decline in poverty rates.

A great deal of academic debate rages about the causes of these kinds of anomalous urbanization phenomena—observed not only in Nigeria but also in a number of

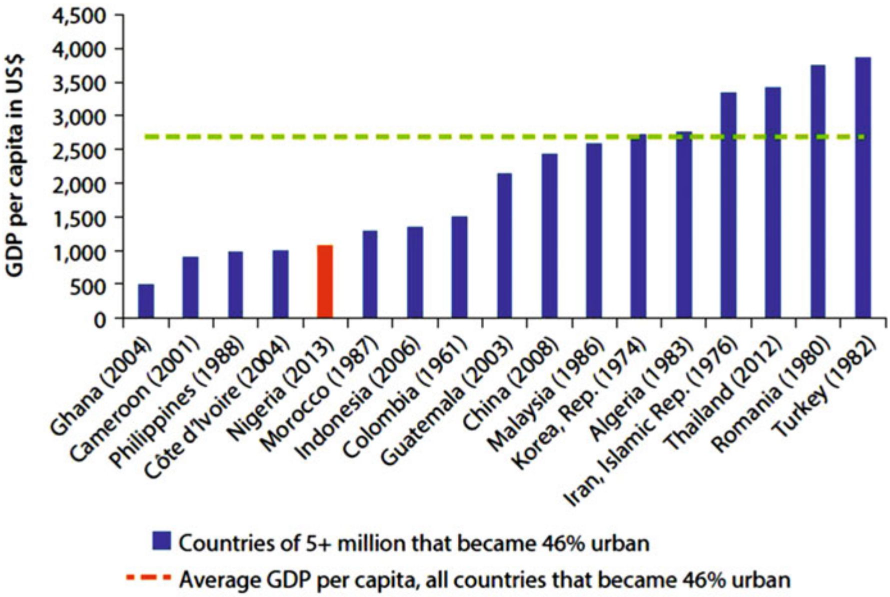

Fig. 9.1 Income at which a country became 46 % urban. Data source: World Bank

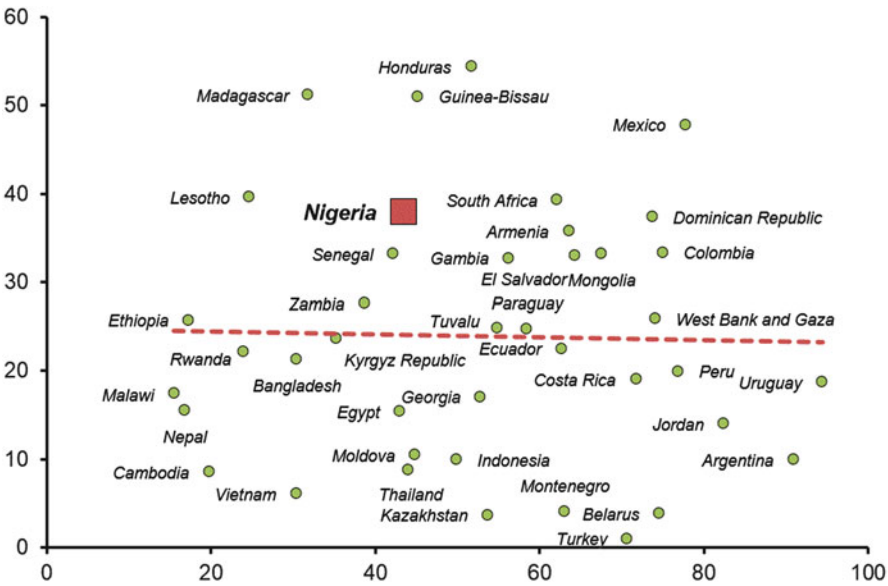

Fig. 9.2 Urban poverty (headcount ratio at national poverty lines as % of urban population) vs. urbanization rate (% of total). Data source: World Bank, 2010. Urban poverty data for Nigeria is from 2003

other sub-Saharan countries (Gollin and Jedwab 2013). However, one key outcome is a very high reliance of urban populations on nontradable services, often highly informal, as a source of livelihood. The Federal Government estimates that across Nigeria, 53 % of the active labor force works in the informal sector, and of these workers, fully 62 % are in business for themselves.

The spatial implications of this labor market phenomenon are important, since informal sector workers involved in the nontradable sector (i.e., domestic service, food service, education, retail, construction, equipment servicing, etc.) tend to carry out their income-generating activities in closer proximity to their homes than labor force participants in the formal or tradable services sectors. For example, a recent study in Lagos found that 40 % of income earners in households in the poorest quintile spent less than 15 min getting to work (New Nigeria Foundation 2012). Nonmotorized trip making in Nigerian cities is quite high in comparison with cities in other regions, and a likely key reason is that such a high proportion of the work force is involved in informal, nontradable service activities, and lives close to the workplace. Even in the gargantuan metropolis of Lagos, walking accounts for 40 % of all daily trips (Lagos Metropolitan Area Transport Authority 2015).

Historically, two distinct cultural traditions in what is now Nigeria have given rise to two distinctive urban patterns. In the north, Muslim Emirates developed walled cities with foundations dating back to the middle ages, drawing their livelihoods on the trans-Saharan trade and the larger Muslim world beyond the desert. These cities tend to be radial in orientation, with the street network emanating from a central Mosque flanking the Emir's palace. Kano and Kaduna are examples. In the south, cities tended to grow more organically, often as agglomerations of older Yoruba and Edo villages dating back centuries. Many cities in the Southwest (Ibadan, for example) grew rapidly beginning in the 1830s onward, when they served as military staging grounds during the Yoruba wars. Cities in the Niger Delta, such as Port Harcourt, grew exponentially in the post-Colonial period with the development of hydrocarbon extraction industries.

In both the North and the South, the more recent parts of the cities are characterized by an absence of sorting and spatial differentiation—that is, the emergence of differentiated and hierarchized land-use patterns cauterized by articulation or spikes in built density—observed in cities elsewhere. Nigerian cities are dense by world standards (Fig. 9.3), but this density is generally not articulated into hierarchical urban centers and subcenters. The two notable exceptions to this tendency toward nonspatial differentiation in Nigerian cities are Lagos and Abuja (the centrally planned, Federal capital, a "new town" on a greenfield site created by government fiat in 1979).

Of all Nigerian cities, Lagos has the highest proportion of workers employed in the tradable sector, including manufacturing, engineering, and finance. Combined with a steady program since the 1970s of road and, more recently, mass transport investments, these forces have driven more differentiation and articulation of mini-agglomerations than in other cities. Differentiated districts in Lagos include Lagos Island (the historic CBD), Victoria Island (the new center for the finance industry), Ikeja (the government center, and formerly the location of the Nigerian Federal government), Apapa (the Port area and surrounding industrial zone), and Lekki (the

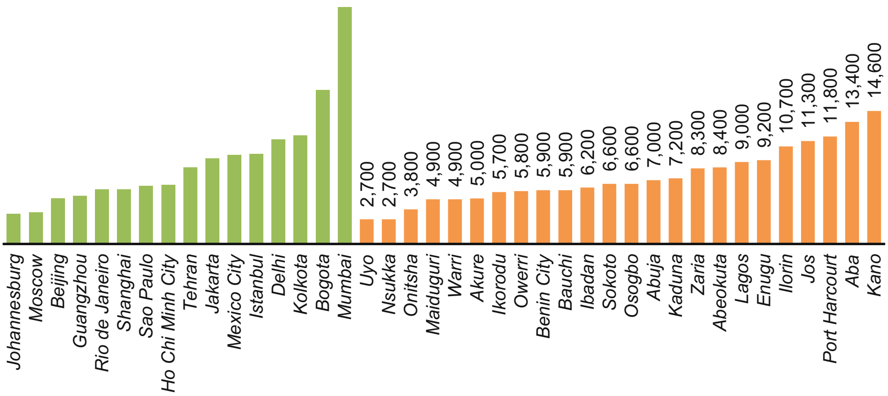

Fig. 9.3 Population density in Nigerian cities (right) compared to other megacities in this volume (left). Data source: Demographia World Urban Areas (2016)

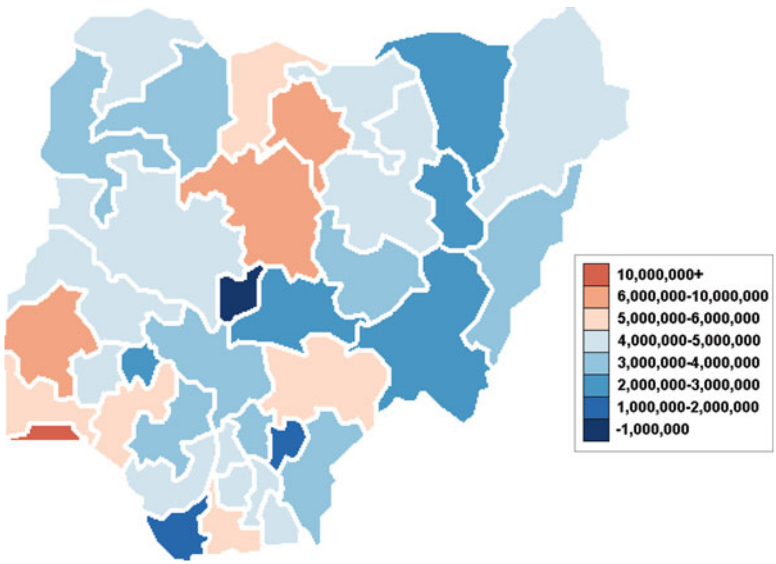

Fig. 9.4 Distribution of population in Nigeria, 2007. Source: Wikimedia

preferred bedroom community for the Lagosian elite). However, outside of these key areas, much of the rest of Lagos also follows the dense but undifferentiated settlement patterns of other Nigerian cities.

Four distinct clusters of population growth define Nigeria's city regions (Fig. 9.4). These comprise: (1) the area around Kano in the north with about nine million people; (2) the greater metropolitan Lagos region in the southwest with about 23 million people; (3) the Southeast Delta states, including Port Harcourt, with about four million people; and (4) the metropolitan cluster around Abuja with about eight million people.

3 Trends in Transport Use and Mobility[1]

Walking is an important mode in Lagos, and many other cities in Nigeria, both because of the structure of urban economies, as mentioned, and because affordability of public transport fares remains a challenge for many urban Nigerian (see later). Motorized urban transport in Nigerian cities is dominated by the small-scale, informal sector, that is, smaller vehicles (mini or midi-buses known locally as *danfo* and *molue*, respectively). These are usually owned by individuals who possess no more than one or two second-hand vehicles, which they rent out to drivers on a daily basis (Kumar and Barrett 2009). Drivers are organized into associations at the city or subcity level, which, in turn, are federated into national unions (Fig. 9.5). The largest and most powerful of these unions is the Nigerian Union of Road Transport Workers (NURTW), which can exert substantial force on politics at both the state and federal levels.

Informality in the delivery of urban transport services has grown exponentially since the collapse of formal, state-run public transport operations, such as the Lagos State Transport Corporation, in the 1980s, paralleling similar developments in cities all over sub-Saharan Africa (Table 9.1). The collapse of the formal bus systems in African cities has been attributed to a vicious cycle of disinvestment associated with nonexistent or stagnant subsidies, fare regulation that prevented fare increases, and growing operating costs, following the nationalization of many urban bus operations in the immediate postcolonial era. In this understanding, the resulting deterioration in service coverage and quality, as well as increased demand from urbanization processes then well underway, fuelled the increase in the use of informal sector operators, which rushed in to fill the growing void, and led to the collapse of the state-owned operations (Kumar and Barrett 2009). However, in the Nigerian context of rapid urbanization and labor market options primarily in the informal, nontradable service sector, it could equally be argued that the growth of small-scale informal sector transport services was inevitable, irrespective of the collapse of the state-owned companies.

Indeed, the three major cities in Nigeria—Kano, Lagos, and Abuja—all have transport operations run by state-owned entities (Kano Line, Lagbus, and Abuja Urban Mass Transport Company, respectively). These services operate alongside the informal services, and in most cases, are swamped by them. For example, in the Lagos metropolitan area (Fig. 9.6), *danfo* and *molue* combined account for about

[1] A note on data limitations. Empirical data on transport and mobility in Nigeria are scarce. Detailed travel demand and transport-use data have been collected over the last three years for Kano, Abuja, and Lagos but the survey results have not been published, and the survey datasets are not publicly available. An unpublished report (Wang 2015) purports to summarize the results of the household travel demand surveys in these three regions, but it has not been possible to independently verify the accuracy of the information reported in that report. Consequently, discussion in this section and the next section is based on whatever piecemeal information can be found, supplemented with cautious reference to Wang's (2015) findings.

Fig. 9.5 Mini-buses (*danfo*) in Lagos. Photo: satanoid (Flickr)

Table 9.1 Modal shares of selected African cities in 2008

City (country)	Large bus	Minibus	Taxi	Motorcycle	Private car	Walk	Other
Abidjan (Cote d'Ivoire)	11	19	29	0	18	22	1
Accra (Ghana)	10	52	9	0	13	12	4
Addis Ababa (Ethiopia)	35	20	5	0	7	30	3
Bamako (Mali)	1	10	5	56	19	n/a	9
Conakry (Guinea)	1	14	6	0	1	78	0
Dakar (Senegal)	3	73	6	6	11	—	1
Dar es Salaam (Tanzania)	0	61	1	1	10	26	1
Douala (Cameron)	10	n/a	13	12	2	60	3
Kampala (Uganda)	0	41	n/a	20	35	n/a	4
Kigali (Rwanda)	1	75	10	0	10	5	0
Kinshasa (DR Congo)	n/a	n/a	n/a	n/a	n/a	High	n/a
Lagos[a] (Nigeria)	10	75	5	5	5	High	0
Nairobi (Kenya)	7	29	15	2	n/a	47	0
Ouagadougou (Burkina Faso)	8	0	n/a	58	14	n/a	20
Average	7	30	8	12	12	37	4

[a]Reported mode shares for Lagos refer to motorized travel only
n/a, no information available
Source: Kumar and Barrett (2009)

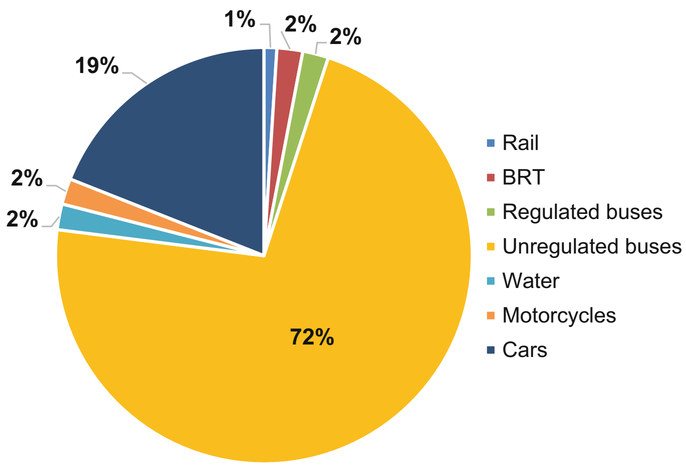

Fig. 9.6 Modal share in Lagos, 2012. Data source: Lagos Metropolitan Area Transport Authority

43 % of all daily trips taken (72 % of motorized trips). Regulated buses—including the full Lagbus network, the Bus Rapid Transit (BRT) line, and the Pilot Bus Franchise Schemes managed by the Lagos Area Metropolitan Transport Authority—together account for just 2 % of trips (4 % of motorized trips) (Lagos Metropolitan Area Transport Authority 2015, personal communication). Informal services account for about 54 % of trips in Kano and 15 % in Abuja (Wang 2015).

One study in Abuja suggests that the comfort level while inside the formal service vehicles is an important reason why ridership is low, at least in Abuja. The study examined services provided by Abuja Urban Mass Transport Company, a state-owned enterprise, and found that, of the four key factors contributing to passenger perception of bus services, comfort was substantially more significant than accessibility, bus stop facilities, or adequacy of services in explaining lack of satisfaction (Nwachukwu 2014).

High demand growth for motorized transport in Nigerian cities has also been accompanying the growth in urban populations generally. The motorization pressures are felt at two extremes of the transport system.

At the upper end of the income distribution, motorization rates are putting substantial strains on the urban road network as a whole. In 2013, private cars accounted for 19 % of all trips in Lagos, although the motorization rate for cars and motorcycles was only 55 % per 1000 persons. In Lagos, and probably many other cities across Nigeria (particularly Abuja), motorization has been growing substantially faster than either population or income (Leigh Fisher and FAO Consulting International 2015). The available data on motorization rates in Nigeria overall suggest it is growing at more than 6 % per year—nearly a doubling of the penetration rate over 12 years (Fig. 9.7).

At the middle and lower ends of the income distribution, there is tremendous pressure for expansion of public transport services, resulting in part from the physical

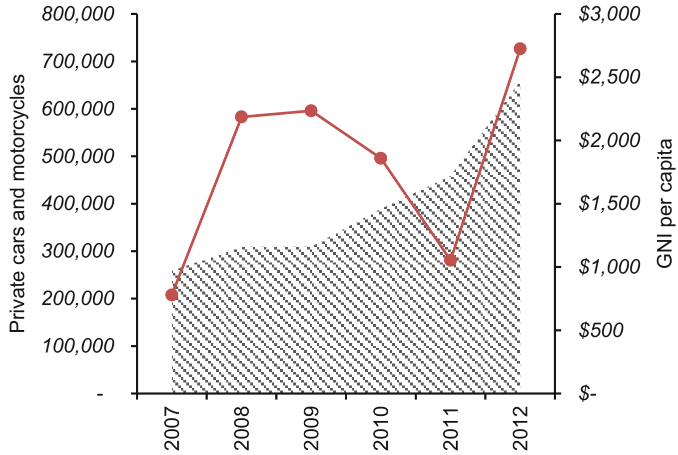

Fig. 9.7 Motorization rate vs. GNI per capita in Nigeria. Data source: World Bank (GNI per capita) and Nigerian Bureau of Statistics (private car and motorcycle licenses issued)

expansion of cities and increasing travel distances. This outward sprawl results in high pressure on the informal sector, which is the only mechanism available to meet this travel demand. Already in Lagos, informal transport accounts for about 43 % of all trips. Estimates in Kano, where motorization rates are substantially lower, suggest that informal transport constitutes more than 55 % of all trips (Wang 2015).

4 Urban Transport Problems

The range of challenges facing the urban transport sector in Nigeria is daunting, all the more so because there is little reliable information about the actual state of urban transport in most cities, and the impact of transport on economic growth, quality of life, or the well-being of the poor. For example, there have been no quantitative assessments regarding the cost of congestion to urban GDP (or GRP, gross regional product) in Nigeria, although anecdotal estimates suggest anywhere from 2 % to 10 % of GRP. Therefore, any enumeration of key urban transport problems results necessarily from a subjective perception, based on professional judgment and experience.

Some of the key problems in most Nigerian cities include: accessibility constraints resulting from a combination of ubiquitous congestion in many cities (particularly in the South); expanding metropolitan boundaries leading to longer trip distances; limited capacity of riders to pay for motorized transport services, thereby constraining the service offer; horrendous road safety performance, which particularly affects pedestrians and other vulnerable users; and deteriorating air quality.

4.1 Accessibility Constraints

Accessibility data for Nigerian cities (e.g., the number of people who can access a threshold amount of employment, social facilities, or markets) are nonexistent. Anecdotally, stories of horrendously long commutes in Lagos and Abuja abound in newspapers. The household travel demand surveys for Lagos, Kano, and Abuja have recorded average travel time by mode—the closest proxy to accessibility that may be available—but even such data may be biased toward longer motorized trips, and toward trips related to activities in the formal sectors (Wang 2015). Average journey times for car drivers in the three cities were reported as 36 min, 38 min, and 54 min, respectively, while journey times for public transport riders were somewhat higher, at 51 min, 51 min, and 56 min.

However, it is unclear whether these numbers reflect a response bias toward people most likely to be traveling. For example, it is plausible that, in Lagos, large proportions of households engaged in nontradable services outside of certain districts (e.g. Ikeja, the CBD, Victoria Island, Apapa, and Lekki) may not travel substantially on a daily basis at all but have not been captured proportionately in the surveys.

Two factors seem to contribute to these high travel times: high levels of traffic congestion (Fig. 9.8) and long distance commutes associated with urban expansion (growth of fringe settlements). A recent study focused on an important commuting corridor from bedroom communities in Nasarawa state to central Abuja found that, on average, congestion added nearly 25 min to the morning commute, with large variations from day to day (Biliyamin and Abosede 2012).

4.2 Public Transport Affordability

The capacity of riders to pay for transport services is limited. The average fare paid in Lagos is about 126 Naira per trip ($0.63),[2] corresponding to a monthly commuting expenditure of about 5400 Naira ($27). These fares are generally not affordable by the lowest quartile: in a survey, 77 % of respondents believed that transport fares were not affordable. About 84 % of commuters in the lowest household income quartile pay less than the average monthly commuting expenditure for the city as a whole. Many of these (38 %) choose to walk to work, either because the public transport fares are too high, or because they work in close proximity to where they live (New Nigeria Foundation 2012).[3]

[2] Author's calculations based on the average public transport distance reported in Wang (2015) and a distance-based formula developed by ALG Transportation Infrastructure and Logistics (2013).

[3] Author's calculations, based on information reported in a socioeconomic study of travel behavior by the poor along the Lagos BRT corridor (New Nigeria Foundation 2012). The most appropriate statistic—combined housing and transport costs as a proportion of total household income—is not available.

Fig. 9.8 Traffic congestion in Lagos. Photo: satanoid (Flickr)

4.3 Road Safety

Road safety is a substantial challenge across Africa, and particularly in Nigeria. In 2013, Africa as a whole had 2 % of global road vehicle fleet, but generated 16 % of road traffic fatalities (World Health Organization 2013). Official statistics on road traffic accidents and injuries are unreliable in Nigeria. However, estimates made by the Global Burden of Disease study found that, in 2010, Nigeria ranked third in absolute numbers of road traffic fatalities in the world, behind only India and China, and ranked fourth in the world in traffic fatality rates, at 47 deaths per 100,000 vehicle kilometers (Global Road Safety Facility and Institute for Health Metrics 2014). In fact, Nigeria had 26 % and 27 % of the amount of traffic fatalities in China and India, respectively, even though it has only 12 % and 13 % of their respective populations.

The majority of this road safety burden is most likely concentrated in Nigeria's cities, since most of the vehicle population is centered in cities, and the bulk of the country's vehicle kilometers traveled occur there. In fact, 44 % of the fatalities in Nigeria involve pedestrians and cyclists (whose concentrations are higher in cities), compared to an Africa-wide average of 38 % (World Health Organization 2013). Indeed, it is highly likely that these fatality rates would be even higher, but for the mitigating effect of very high levels of traffic congestion throughout the day in many Nigerian cities.

4.4 Air Quality

Anecdotally, the air quality in Nigerian cities is poor and deteriorating, but there are no reliable time series, spatially robust data. It is likely that particulate matter constitutes the greatest burden on human health. A study in Lagos in 2007 and 2008 reported that mean ambient concentrations of PM_{10} exceeded the recommended World Health Organization guidelines by substantial margins (during both the wet and dry seasons, though the exceedances during the dry season were particularly high). The largest share of ambient PM_{10} concentrations (about 43 %) were attributable to vehicular emissions (MDS Consortium 2010). A related and parallel study found that motor vehicles in Lagos emitted about 835 kg of PM_{10} per day in 2008, of which 29 % came from trucks and 56 % from buses (SEEMS Nigeria LTD 2010). Across Nigeria, the World Bank estimates that motor vehicle pollution was responsible for 297 deaths in 2010. Combined with road traffic fatalities, motor vehicles are estimated to be the third largest cause of premature death in Nigeria, and the second largest cause of disability-adjusted life years (Global Road Safety Facility and Institute for Health Metrics 2014).

One key driver of poor air quality in Nigeria is the continuing prevalence of two-stroke engines in two-wheeled and three-wheeled vehicles. Imports of two-stroke two-wheelers have been banned since 2011, but the rampant growth of these vehicles prior to 2011 for use in *okada* or *achaba* services—commercial two-wheeled moto-taxis—means that two-stroke two-wheelers will continue to be used for some time since the average age of two-wheelers in Nigeria is only around 5 years (Kaenzig 2013). Two-stroke three-wheelers are now undergoing an exponential expansion, particularly following the efforts of a number of jurisdictions—including Nigeria's three largest cities, Kano, Lagos, and Abuja—to restrict where two-wheelers can go or ban them outright.

5 Urban Transport Governance, Decision-Making, and Financing

The underlying policy and implementation issues that give rise to urban transport problems discussed include some core challenges that many sub-Saharan African countries are facing, not only Nigeria. They include weak local government institutions, a weak national enabling environment, inadequate technical capacity, the prevalence of powerful and, at times unruly, private sector transport operators, and an overreliance on second-hand, often very old cars, trucks, and buses because of weak management of vehicle imports.

5.1 Weak Local Government Institutions

Capacity for planning and implementing effective urban transport policy at local levels in Nigeria is weak, for a number of reasons. First, Nigeria's federal system does not have a level of government that corresponds to the city or the metropolis. The constitution recognizes, in addition to the federal government, 36 States and 774 Local Government Areas. With the exception of Lagos, state boundaries are generally substantially larger than cities or their catchment areas, and Local Government Areas are much smaller, often corresponding to parts of cities. Practically, this means that state governments must oversee the management of urban transport using State Ministries of Transport that are oriented to managing a statewide road network consisting mostly of rural and minor inter-city roads (major intercity roads fall under federal jurisdiction). In this context, much of the formal state urban transport "initiatives" and high-level policy attention tend to focus on extending infrastructure provision, mostly in the form of roads and, secondarily, on managing the formal and informal transit terminals known as "motor parks" which form the basis for the public transport "network."

Services operated on these networks, in turn, are "managed" by the state governments only in the loosest sense. Licenses are issued for routes that are largely developed organically by bus route operators—both formal and informal—on the basis of operator associations affiliated with specific motor parks. In Lagos, this fragmented and largely unregulated approach to bus service provision has unsurprisingly resulted in a bus network that largely fails to respond to the dynamic and complex movement of people within a polycentric city. However, it does respond to the operators' desire to maximize their revenue. As the bus network is largely managed by the informal sector, a bus network has developed that is highly duplicative, operationally inefficient, and presents the user with a disorderly and incoherent interface (Integrated Transport Planning Consultants 2014). This network fragmentation associated with organic, operator-driven, route networks is common all over Nigeria.

A second reason for weak local government institutions is the inability of state governments to attract and retain qualified professionals with specialization in urban transport. Since urban transport expertise requires a fair degree of education and specialization, government salaries are generally too low to be attractive for qualified staff who can find work in the private sector or abroad. The Lagos Area Metropolitan Transport Authority (LAMATA) is the exception which proves the rule. Much of its senior management was recruited from the Nigerian diaspora in London, and that was only possible because political leadership—recognizing the need to recruit highly qualified professionals—established LAMATA as an autonomous authority not bound by the traditional constraints of civil service practices. However, the political leadership in other states has been reluctant to set a similar precedent.

A third reason is a myopic focus on the need for building more transport (primarily road) infrastructure, to the exclusion of other concerns such as transport systems management (e.g., traffic and parking management) and asset management and maintenance. The African Development Bank estimates that, nationally, spending on routine and periodic maintenance for roads in Nigeria in 2013 was about 10 % of what was required even assuming that the roads were in good condition (African Development Bank 2013). A significant recent example of this focus on new infrastructure to the exclusion of maintenance and management, for example, is the election platform or manifesto of the All Progressives Congress, which won the Presidency, a majority in the Federal legislature, and the governorship of 19 of 28 states in 2015. The manifesto's discussion of transport essentially provides a long list of facilities the party intended to build if elected (with no suggestion of how these will be paid for), but little reflection on institutions, regulatory framework, or priorities (All Progressives Congress 2015). With the exception of one line acknowledging the need for, and committing to, rehabilitation and maintenance, the full focus of the party's efforts—which can be considered as a policy statement by the new ruling party in Nigeria—is articulated as building new infrastructure. Such an articulation conforms to the expectations of Nigerians. The opposition's manifesto was barely distinguishable in this respect (People's Democratic Party 2015).

The reasons for a focus on infrastructure provision are complex but can be related to three key phenomena. The first is the overwhelming prevalence of civil engineers in the professional cadres of state (and federal) level transport institutions. There is a relative dearth of transport planners, economists, and urban development specialists compared with civil engineers. As a result, there is a natural bias toward solutions that involve physical construction of infrastructure. Second, inexperienced political leaders facing constituency pressure to "do something" about urban transport problems such as rampant congestion and travel time variability, often lack the perspective to understand that urban transport challenges are enormous, and their causes are more complex than an inadequate supply of infrastructure. As a result, they put inordinate pressure on bureaucracies to deliver infrastructure. Third, the political economy of large infrastructure projects has a driving logic to it, where all actors pursue rational self-interest. Large infrastructure tends to involve large contracts, which are sources of both patronage and kickbacks for many of the actors involved, at both the political and administrative levels. Therefore, while the public good may best be advanced by emphasizing the maintenance and management of the existing infrastructure, the sum total of the individual interests involved in the sector tends to gravitate toward more and more infrastructure.

5.2 Weak National Enabling Environment

As weak as state governments handling urban transport are, there is even weaker support from the federal government. Indeed, at the federal level, there is somewhat of a "blind spot" regarding urban transport. The Federal Ministry of Transport developed a Nigerian Transport Masterplan in 2006, but this plan was almost entirely silent on the issue of urban transport. Other than a brief discussion of demographic changes and urbanization, the plan's focus was entirely oriented to national level infrastructure (roads, railways, seaports, inland waterways, aviation, and pipelines). Urban transport was not called out as a subject of national interest, or even as warranting further discussions. Policies governing the way the proposed national infrastructure should interface with urban areas were not included in the plan. Indeed, they were not even acknowledged as an area of further need.

Within the Ministry of Transport, the Ministry of Works, and the Ministry of Lands, Housing and Urban Development there are no units or departments that are tasked specifically with looking after urban transport in a coherent and comprehensive way. As a consequence, the Ministries' decisions can wreak havoc on local urban development. For example, the Transport Secretariat of the Federal Capital Territory had been working with counterparts in neighboring Nasarawa state for a number of years to develop a Bus Rapid Transit line to bring Nasarawa commuters to the Central Business District in Abuja along a heavily trafficked and dense corridor. A number of studies and designs had been completed, in the context of discussions with the African Development Bank for financing the corridor, when the Ministry of Works announced its intention to convert the corridor into a multilane expressway because it was part of the Federal network. If implemented, such a change could fundamentally transform the nature of the corridor and influence land development substantially, potentially putting at risk the viability of BRT service.

However, in the past the federal government has attempted to be involved in urban transport through a number of programs. The longest lived of these in recent experience was the Federal Urban Mass Transit Agency (FUMTA), which began as a program of the Federal Ministry of Transport in 1988, was transferred to the Presidency in 1993 in an effort to boost its effectiveness, but was eventually abandoned around 2002. It had been created in reaction to the collapse of public transport operations discussed earlier. This happened in the context of economic crisis associated with the drop in world petroleum prices beginning in 1986 and a Structural Adjustment Program introduced the same year. Car ownership became increasingly unaffordable, and public transport operators struggled to undertake fleet maintenance, replacement, and expansion. The total vehicle stock declined from 700,000 in 1983 to 350,000 in 1991, and new vehicle registrations declined from 244,000 in 1982 to just 50,000 in 1988 (Nigerian Federal Urban Mass Transit Agency 2001). In response, the federal government raised the price of petroleum (then, as now, controlled by federal government fiat) by 300 % in 1990 (Tayo and Elegbeleye 2014), and introduced FUMTA.

FUMTA's official mandate was intended to cover planning and advising on urban transport projects. However, it never fulfilled this mandate. It initially developed an ambitious mass transit action plan which covered road, rail, and water, but in the end, over its 13-year existence, it was only able to implement a series of bus funding schemes. These resulted in the purchase of just under 4000 buses nationwide. Also, it produced a National Urban Mass Transit Policy in 1998, but this policy was never adopted or implemented (Nigerian Federal Urban Mass Transit Agency 2001). Eventually, FUMTA was abandoned.

More recently, in the wake of civil unrest following efforts by the Jonathan administration to first remove entirely, then reduce, the amount of the petroleum subsidy, the government created the Subsidy Reinvestment and Empowerment Program, known as SURE-P, using resources saved from the total amount of subsidy payments made. SURE-P is meant to fund two strands of investments, namely, "infrastructure" investments, and "social safety net" investments. Railways, roads, and bridges (including the Abuja heavy rail scheme) are considered part of infrastructure, while bus-based public transport (referred to as mass transport) is considered part of the social safety net. This categorization and language choice is telling. As with the previous FUMTA experience, this effort lacks a coherent and strategic policy approach underlying the efforts. With FUMTA-style bus-funding schemes in mind, the resources dedicated to mass transport (about $54.8 million) were used to establish a Public Mass Transit Revolving Fund Scheme which has been used to purchase a little over 800 buses nationwide.

In the operating environment for public transport in most Nigerian cities, federal programs such as FUMTA and SURE-P amount to little more than a subsidy for rolling stock which, operationally, functions exactly like conventional *danfos* or *molues*. These programs—and similar ones implemented by various states and the Nigerian Urban Development Bank (now the Nigerian Infrastructure Bank)—have no transformational impact on urban transport whatsoever. At best, they marginally increase the supply of buses. More likely, they exacerbate the very problem they presumably are intended to address (although the SURE-P program documentation is such that it is not at all clear what problem it is meant to address).

5.3 *Inadequate Technical and Institutional Capacity*

An observation has been made that there are not enough bus services in Nigerian cities to meet growing demand. However, in most cities, the operational characteristics of bus networks are arguably as, if not more, significant impediments to having adequate service than the number of available buses per se. Poor road space allocation, inadequate traffic management and enforcement, and a regulatory and fare environment that encourages operators to wait until their buses are full before departing from terminals, increase bus round-trip journey times substantially. It is likely that, addressing these issues would be a more effective means to improve service—and, indeed, increase the likelihood that people with a choice might actually use buses—than just increasing the quantity of vehicles.

Addressing issues of traffic management, enforcement, public transport regulation, and related questions of public transport network planning and development, requires substantial professional capacity, for both planning and implementation. Certainly, Nigeria as a whole has very competent transport professionals capable of undertaking highly specialized and sophisticated tasks (though they may not be available in all markets where they are needed). However, professional capacity refers not only to individual technical capacities to undertake particularly pieces of work but also to institutional capacity, which is the ability of institutions to coordinate the work of professionals within and across public and private entities and organizations, in order to work efficiently toward a common goal. In the institutional arrangements in most Nigerian states, purchasing new buses is substantially easier to accomplish than managing and enforcing traffic and revising public transport regulations.

5.4 *Powerful and Unruly Private (Informal) Sector*

Another key challenge to the effective implementation of urban transport policy is the political economy associated with *danfo* operators. The most powerful association of these operators is the Nigerian Union of Road Transport Workers (NURTW), which exerts significant political influence. NURTW was established in 1978 by decree of the then-military government, with a requirement that all commercial drivers (except petroleum tanker drivers) must be members. This means that its membership is large and can exercise substantial political clout. This clout is expressed not only as loyalty to politicians who best reflect the interests of NURTW, but also through political thuggery. In a well-documented case in Ibadan (Oyo state), gangs of NURTW members were hired by rival politicians during the 2007 gubernatorial elections (Human Rights Watch 2008).

Often, this violence at the direction of politicians is linked with brutal conflicts over the control of motor parks—the staging areas from which public transport services are provided. For example, in 2015 Oshodi Motor Park in Lagos erupted in 2 days of gangland-style shootouts, followed by the assassination of a high-level NURTW official (Hanafi 2015; Udom 2015). Therefore, the political economy of these relationships is an enormous challenge to effective governance and regulation of the sector.

6 Proposed Urban Transport Solutions and Implementation Issues

Just as the Federal government lacks a coherent policy on urban transport, it also lacks a concerted policy on vehicle fleet management. Nigeria imports virtually all vehicles (though efforts have been underway for a number of years to boost the assembly of commercial vehicles), of which about two-thirds are second-hand (used) vehicles. While imports of vehicles older than 10 years are not allowed, many second-hand vehicles, once imported, can stay in use for years. The average age of private cars in four Nigerian cities (Ondo, Lagos, Kaduna, and Abuja) is 14 years, while the average age of light commercial vehicles (such as *danfoes* and *molues*) is 24 years (Kaenzig 2013).

The Jonathan administration, in an effort to boost "local production" of motor vehicles, released a National Automotive Industry Development Plan in 2014. The intention is to turn Nigeria into a major assembly hub for international automobile companies. A number of factors would be favorable, including existing manufacturing capacity, a large labor force, substantial local demand, and strategic location for exports (Federal Government of Nigeria 2014). The plan explicitly targets the market for used vehicles by focusing on low-end, domestically produced vehicles for the first 10 years (National Automotive Council 2014). Among other measures envisioned, importation of vehicles will be subject to an additional 35 % duty—bringing the total import duty to 70 % (National Automotive Council 2014).

If the National Automotive Industry Development Plan is successful, the average age of vehicles on Nigerian roads can be expected to decline over time but there are substantial challenges to the success of this plan, including limited purchasing power within the Nigerian market, and highly unstable electric power supply, which has been a strong deterrent against the development of a stronger manufacturing and tradable services sector in Nigeria in the past (Litwack 2013).

7 Other Country-Specific Issues

Many of the challenges that Nigeria's urban transport sector faces are not unique to Nigeria—they are shared by many sub-Saharan African countries. However, there are a few issues confronting urban transport in Nigeria which are distinctly Nigerian, and largely of the country's own making, through governance decisions taken in the past. The most prominent of these is the country's reliance on enormous fuel subsidies to the price of gasoline from the federal government. A second issue was the government's decision in 1976 to create a new, greenfield federal capital (Abuja) in the geographic center of the country, and subsequent planning and implementation decisions. The first of these affects all urban Nigerians; the second of these creates enormous and unique daily transport challenges for urban populations in and around the federal capital.

7.1 Fuel Subsidies

The federal government has subsidized the price of gasoline since the 1970s. Retail prices are set uniformly throughout the country, below international market prices. (The current price is 97 Naira—about 49¢ per liter.) The fuel subsidy is enormously costly to the Nigerian economy. One study estimates that the federal government spent about 2.7 % of the GDP on the fuel subsidy between 2008 and 2012 (Litwack 2013). The Central Bank of Nigeria and the Federal Inland Revenue Service report that the subsidy consumed 19 % of the entire federal budget in 2011 (Centre for Public Policy Alternatives 2012). Such subsidies are creating distortions by both inflating the amount of travel and the proportion travel that is performed by gasoline vehicles. For example, a 2013 field survey of vehicles in four urbanized states in Nigeria found that half of large buses run on gasoline. This appears to be an effect of gasoline subsidies, since one would normally expect to see large buses running on either diesel or compressed natural gas.

7.2 The Creation of Abuja

Nigeria's second most populous city exhibits a number of urban transport challenges resulting from the decision to develop a greenfield capital city in 1979. Prior to the founding of Abuja, Lagos had functioned as the capital of both Lagos State and the Federal Government of Nigeria. Between 1975 and 2000, Lagos was growing fast: its growth rate was more than 5 % per year in the 1970s, the fastest in Africa. In 1975, a national commission report concluded that Lagos was unable to play the dual role of state and federal capital due to space constraints, and that the city's association with the Yoruba ethnicity made it an inappropriate capital for a multiethnic federal state. The commission recommended the development of a separate capital in an ethnically neutral area in the center of the country (Chima 2012). The search for a new capital began.

Abuja itself was meticulously planned through study of international and Nigerian urban precedents, and attention to detail by an American firm, International Planning Associates, who articulated three principles for its development: (1) a contiguous urban form with a single center and residential and commercial subsectors; (2) local residential communities planned for 3500 to 5000 people, with an emphasis on multifamily housing; and (3) a central public place with large-scale public allocation for public gatherings.

However, the actual city was not developed according to these principles. Rather, it is characterized by intense sprawl and substantial reliance on informal squatter settlements scattered throughout the Federal Capital Territory and neighboring states (Zubair and Ojigi 2015; Chima 2012). There are numerous complex reasons for this sprawl, including: human error with respect to the initial land registry in Abuja; overly strict planning and building codes; unrealistic sequencing of transport infrastructure development vis-à-vis natural town growth rates by the Federal Capital Development Administration; and the siting of Abuja in the very northeast corner of the meticulously controlled Federal Capital Territory, which enabled large numbers of immigrants to the capital to settle in neighboring, less controlled states.

As a result, Abuja is characterized by a high degree of disjointed development. In 2006, nearly 75 % of its land was vacant and the entropy index[4] was 0.93 (Chima 2012). Property rents are among the highest in sub-Saharan Africa, and informal settlements in the neighboring states (and to some degree in the Federal Capital Territory as well, beyond the sight of major highways) have exploded (Zubair and Ojigi 2015). The road system is highly hierarchical, reflecting late twentieth-century traffic engineering sensibilities, and resulting in lack of redundancy, channelization of all traffic, even for short trips, onto a few key facilities. The consequence is arterial congestion (Kulash and Anglin 1990; Alba and Beimborn 2005).

The transportation patterns in Abuja are unlike those seen elsewhere in Nigeria, and, indeed, are quite unique for sub-Saharan Africa. Motorized trips dominate the metropolitan region, both because of the high number of workers involved in formal

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[4] A measure of the heterogeneity or fragmentation of land uses characterizing sprawl.

employment through the federal government and related services, and because of the enormous distances they must travel. Among motorized trips, large buses and cars carry nearly 75 % of passengers. The average car trip to work is more than 14 km, while the average public transport trip to work is just under 16 km. Fifty-five percent of all drivers, and 65 % of all public transport passengers travel more than 10 km for each trip (Wang 2015). Traffic congestion in this new city with ample road space is reportedly as bad as in Lagos.

Abuja's challenges reflect decisions taken by the federal government over the course of several decades. Notwithstanding its place as a greenfield city, the capital has not necessarily avoided the fundamental space and traffic constraints that Lagos has. Indeed, it is even more challenged in that there are no obvious ways to improve the traffic congestion situation in Abuja, since the causes are largely a function of land use, urban design, and road/street design. Over time, provision of more and better mass transport solutions, and better street space, traffic, and parking management, might improve the levels of congestion in other Nigerian cities such as Lagos or Kano, but it is unclear whether such measures would noticeably affect Abuja.

One of the ways that the authorities are trying to address the transport challenges in Abuja, which previous public decisions have created, is to invest in a greenfield rail mass transit line. This mass transit line is being developed by the Federal Capital Territory Administration's transport secretariat. The first phase is a 45-km, 12-station segment connecting the Abuja center with the Abuja international airport. Structurally, however, this line is prone to demand risks that are easy to foresee and will prove very challenging to mitigate. First, the Abuja "CBD" developed not as a dense core of walkable streets and contiguous high-rise buildings, as originally envisioned by the planning consultants, but rather as a scattered set of government buildings, hotels, and commercial buildings, each surrounded by extensive parking, and fenced off from the oversized, automobile-scale buildings. The built form of this center is more similar to an "edge city" (Garreau 1991) than a traditional downtown. Therefore, any solution to the question of distribution of rail passengers to their final destination from the CBD terminus will be expensive and likely off-putting for many potential riders.

Second, and more daunting, is the fact that the Abuja CBD functions only as an employment center for the broader metropolitan area. There are no activating uses outside of conventional work times. As a result, train services will be subject to very high peaking, and it is doubtful whether viable services could be run outside of high-frequency in-bound service in the morning peak, and the opposite in the afternoon peak, at least for the foreseeable future. If the train is to relieve congestion, very high volumes of rolling stock will be required to meet this peak demand, which will largely sit idle for most of the day and at weekends. Finally, the outlying communities that the trains are meant to serve are somewhat dense, but even so, most of the Abuja-bound population lives beyond walking distance of train stations, meaning that fares will need to be kept very low, and feeder services will need to be well integrated in order to attract passengers. All of these factors combined mean that the ongoing subsidy level for this rail service will need to be substantial, creating a high burden on public budgets.

8 Conclusion

Urban transport challenges in Nigeria reflect pressures faced by many sub-Saharan African cities. These include: local governments with weak institutions and limited technical capacity and resources to manage noncompliant; atomized, yet politically powerful private sector transport service providers; high demand growth for urban transport services; limited capacity of passengers to pay for services; rapid expansion on the urban fringe; and high rates of motorization, often involving second-hand vehicles imported from elsewhere in the world. The urban transport sector in Nigeria is also facing a range of stressors that are distinctly Nigerian: residual effects of a long-standing policy of petroleum subsidies; the policy choice in the 1970s to create a new greenfield political capital and the unsustainable urban travel patterns that have resulted; and inconsistent, and often incoherent and ill-advised, efforts by federal authorities to become involved in urban transport.

In addition, security disruptions and instability in the north of the country will also place great burdens on the introduction of new urban transport policies, for three reasons. First, the area with the most substantial disruption, the Northeast, already has large cities, such as Maiduguri, with important levels of urbanization. In the current environment, even if some of the institutional and capacity challenges discussed in this chapter could be overcome, it will be difficult to recruit competent transport professionals willing and able to provide services to these cities. Second, the insecurity is already creating a substantial internal refugee challenge, with cities such as Kano and Kaduna as destinations. The influx of populations is exacerbating the challenges these cities are facing. Finally, though development of mass transport must be a key part of the solution to challenges of urban transport, it is also likely to be a logical target of attention for those keen to disrupt civil life for political ends.

Despite the many difficulties of achieving policy change highlighted in this chapter, there are some hopeful, Nigerian-based solutions that could point the way toward more successful urban transport outcomes in the future. Lagos has had some success at building institutional social capacity to accomplish more complex urban transport management functions than it is possible in most other Nigerian states, or indeed, comparable cities elsewhere in sub-Saharan Africa. For example, some efforts have been focused on the creation of the Lagos Area Metropolitan Transport Authority (LAMATA), whose mission was to address weaknesses including, inadequate public transport, weak urban transport management, multiple sector agencies, low cost recovery, low road network density, low efficiency and road safety, environmental quality, and social concerns. A sister agency, the Lagos State Transport Management Authority, was also established to address traffic management and enforcement, but traffic management plays an important role in the thinking underlying LAMATA initiatives too.

LAMATA's accomplishments in a very difficult urban environment, including the development of a highly successful and contextually appropriate BRT line, have been well documented.[5] Among the factors that distinguish LAMATA from efforts

[5] See, for example, Mobereola (2009).

to govern urban transport elsewhere in Nigeria and sub-Saharan Africa are that it is established as a semiautonomous entity, not as a parastatal of a Ministry. It has high operational and organizational standards and operates on the basis of financial independence through a transport fund. It also has a formally defined role and clear vision as an institution established by law, which minimizes jurisdictional ambiguity and overlap with other agencies. LAMATA was given appropriate organizational arrangements with a governing board directly under the governor, to streamline decision-making process and prevent bureaucratic bottlenecks. The organization functions according to a purpose-driven and performance-based operation with a long-term transport master plan (20-year horizon), and key performance indicators and timeline to measure delivery. In addition, LAMATA was set up with the ability to identify and employ competent people to carry out the work through a mix of competitive recruiting process from the private sector and handpicking of competent personnel from ministries to be seconded to the agency. This was in part achieved through a market-competitive salary structure. As a result, it has benefited from leadership stability through several political administrations (World Bank 2016). In conclusion, while technical capacity for urban transport is generally weak in Nigeria, the country has also produced one of the most promising models for improving urban transport capacity in all of sub-Saharan Africa.

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Chapter 10
Russia

Jen JungEun Oh

Capital city	Land area	Total population	Urban population	GDP per capita	Passenger cars
Moscow	17,075,200 sq. km	144 million	74% (107 million)	$14,612	233 / 1,000 people

Data source: World Bank
Maps source: d-maps.com

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1 Introduction

Unlike other countries at a similar income level, Russia's urbanization rate plateaued more than two decades ago (Fig. 10.1). However, this does not imply a lack of dynamic. On the contrary, Russian cities have been undergoing critical economic, social, and demographic changes, which have produced new urban mobility needs and challenges. Since the breakup of the Soviet Union, the country has gone through a dramatic economic and political transition. Today, Russia's socioeconomic model is characterized by a mixture of the new market economy and the institutional legacy of the Soviet era, including a large footprint of the state and a generous social contract. These idiosyncrasies of Russia's model are also mirrored in the ways in which urban land is developed, infrastructure is built, and public services are provided.

Russian cities have been motorizing very rapidly since the early 1990s (Fig. 10.1).[1] Urban streets that had been built for public transport now have to accommodate not only high volumes of moving traffic but also a great number of parked vehicles. Given the high costs and practical difficulties associated with widening these roads in built-up areas, often of historic value, private cars have crowded out public transport. The economic transition to capitalism and consumerism has also manifest itself in changing land-use patterns in the urban cores, with the emergence of financial and service sector jobs. Meanwhile, demand for more spacious housing has led to the formation of suburbs, particularly in large cities, such as Moscow and St. Petersburg. In smaller cities, especially in those with stable or declining population, suburbanization has been evident but much less pronounced.

These urban form transformations took place with significant participation and initiatives by the private sector in development—an area which used to be the exclusive responsibility of local authorities. Therefore, traditional planning practices were no longer adequate but many local authorities did not have viable alternatives. As a result, urban land was often developed without a proper integration between transportation and land use, which then produced a shortage of transport infrastructure and services in many cities.

The private sector found a role in public transport operations, filling the supply gap left by municipal operators, which were plagued with financial difficulties and operational inefficiencies (see later). Private provision of public transport services is not negative in itself. However, as with the case of urban land development, the challenge in Russia has been the integration of privately provided services with publicly provided services, in order to achieve operational efficiency, road safety, and user convenience.

[1] The socioeconomic data reported in this chapter comes largely from the Russian Statistics Agency (Rosstat). This official source provides the most extensive data over extended periods. However, it must be noted that the data accuracy has been questioned by Russian scholars, due to changes in definitions and methodologies over time. The author has made efforts to avoid the time period during which there were significant changes of this type.

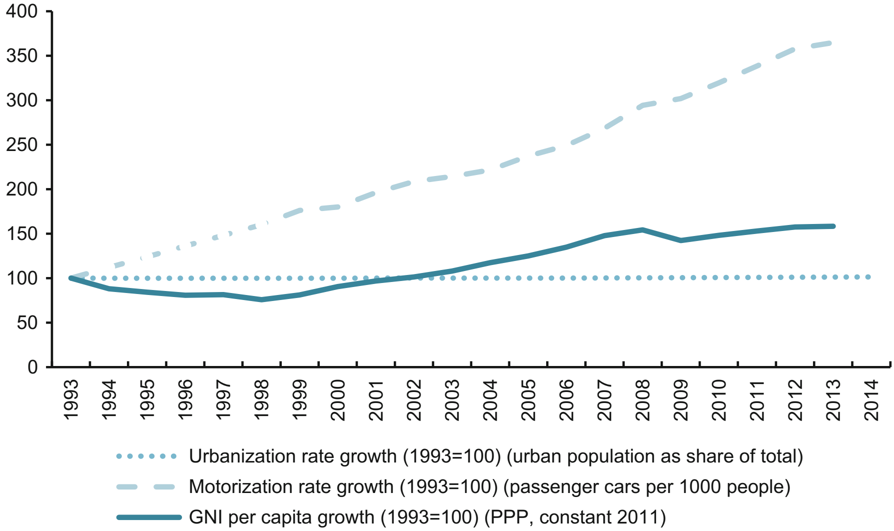

Fig. 10.1 Trends in urbanization, motorization, and per-capita income in Russia. Sources: Rosstat and World Bank

A combination of these factors—motorization, urban form transformations, private sector led urban land development, and private sector participation in public transport service delivery has had a profound impact in Russian urban transport.

2 Urban Land-Use Patterns and Spatial Structure

During the Soviet era, cities were typically built around their industrial base, which provided most of the employment and were very monocentric. Transport networks, particularly rail-based ones, were mostly designed to serve commuters between the industrial zones and the surrounding high-density housing estates. Former soviet cities still have much larger industrial areas within their borders than many Western counterparts (Fig. 10.2).

The past two decades have seen a significant decline in the manufacturing sector while the service sector has grown throughout the country, especially in urban areas. This trend has brought about gradual but likely irreversible changes in urban patterns. Unlike the earlier agglomeration of jobs in specific parts of the city, the current service sector jobs are spread around the city. In addition to the administrative and political city centers, new commercial hubs have emerged. These are often located away from the industrial zones, meaning that they are not well connected with the existing public transit systems. Cities now need to consider reorganizing the existing public transport network in order to better serve new urban areas.

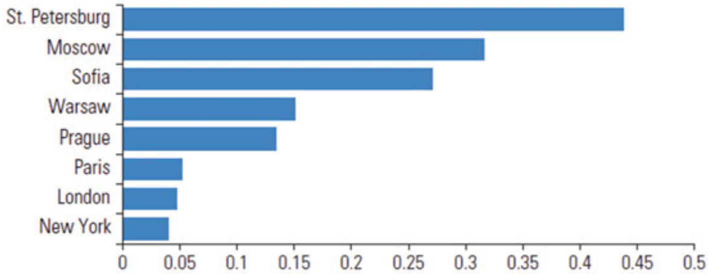

Fig. 10.2 Industrial area as a share of built-up areas in selected cities in 2010. Source: Coulibaly et al. (2012)

As the nature and location of urban jobs changed, so did urban housing options and choices. Socialist housing—typically five-story multifamily estates built from the 1960s through 1980s—was generally easily accessible by public transport. But as the quality of these estates deteriorated and the private sector began to participate in land development in the 1990s, larger Russian cities entered an era of suburbanization. The private sector targeted empty or underdeveloped lands, either filling gaps within built-up areas or spreading in urban peripheries. While the new suburbs were not as conveniently located in terms of public transport access, many of those who could afford to suburbanize did so, lured by ample living space and superior amenities of private suburban housing compared to socialist housing.[2] Significantly, the built-up area in Russia grew by 80 % (from 30,000 to 54,000 km^2) in the decade between 1990 and 1999 (Golubchikov 2004).

Russian suburbanization has been attributed to several factors. First, a planning vacuum was created when the soviet planning law was nullified.[3] In the absence of a proper law, makeshift development control mechanisms were adopted. Permits were not issued based on clear development or zoning plans, but through lengthy and costly procedures.[4] Ironically, this approach, meant to rationalize planning and contain development, was conducive to entirely uncoordinated projects (Golubchikov 2004; Coulibaly et al. 2012). Second, the available development space in traditional city cores was scarce. As a result, the suburbs of large Russian cities, Moscow in particular, were developed at much higher densities than in Western cities (Fig. 10.3).

Changes in land use and spatial structure have occurred unevenly across the country. In terms of population, 11 cities have one million or more inhabitants, 24 cities have 0.5–1 million inhabitants, and more than 120 cities have 100,000–500,000 inhabitants. Many of the largest cities, including Moscow and St. Petersburg,

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[2] For example, many dwelling units only had shared kitchens or bathrooms.

[3] The first postsocialist Urban Development Code was adopted in 1998. Since then, it has served as an overall planning framework.

[4] Obtaining a construction permit involves 54 different procedures in Moscow and 23 in Kazan. According to World Bank's "Doing Business" indicators, Kazan is one of the best performing regions.

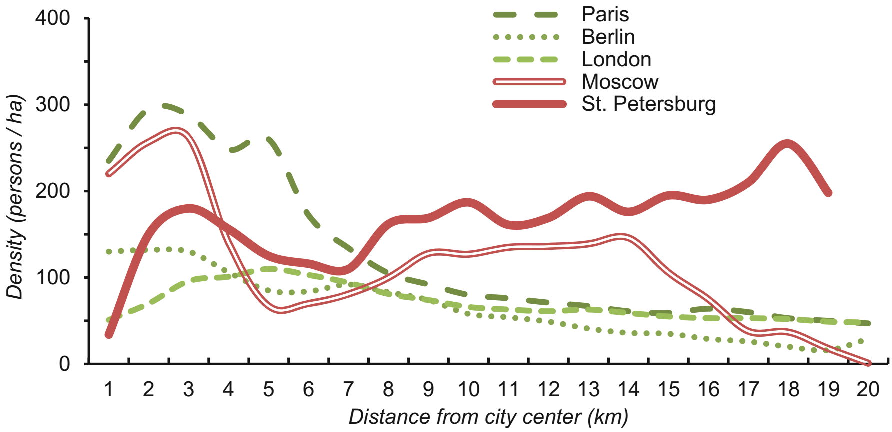

Fig. 10.3 Development densities of Russian and comparator cities. Source: Buckley and Mini (2000)

saw a slow but consistent population increase (0.1–0.5 % per year) due to in-migration and sustained economic growth. Suburbanization and suburban densification are more pronounced in cities which are gaining population. In many smaller towns and cities, the population is generally in decline, albeit a very slow one (0.2–0.7 % per year). The uneven population growth is linked to an uneven urban economic growth during recent decades. Now, Russia has one of the highest levels of regional inequality in terms of GDP per capita: the wealthiest 10 % of regions have a more than tenfold the per capita output than the poorest 10 % (Oxfam 2014).

Under the planned soviet economy, the spatial distribution of industries and other economic activities was centrally controlled. After the breakup of the Soviet Union, the comparative advantages of each urban agglomeration (based on climate, human capital, physical infrastructure, connectivity, etc.) played out to determine the fates of Russian cities. Some remote cities, which had earlier been assigned to perform a single industrial function (i.e., the so-called mono cities),[5] struggled to remain competitive and retain jobs. Eventually, many of their residents, particularly the younger ones, migrated elsewhere. These declining cities, both in terms of economic performance and population, experience a different set of urban mobility problems compared to growing cities. They struggle to deliver public services. Most of their remaining population is aging and thus experiencing geriatric mobility constraints. However, this chapter focuses on the urban mobility problems of growing cities, which often entail more complicated and resource-intensive interventions.

[5] A total of 467 cities and 332 smaller towns (roughly two-fifths of Russian cities with a population of 25 million) were classified as "mono-towns" (World Bank 2010, based on data from report "Monotowns and Core Enterprises," commissioned in 1999–2000 by the Russian Ministry of Economy).

3 Trends in Transport Use and Mobility

The desire and demand for private cars (and most other consumer goods) were artificially suppressed in the Soviet era, in disproportion with income levels. The fact that car ownership skyrocketed afterward, and much faster than the income growth, indicates that there was strong latent demand for automobiles. In fact, car ownership grew so fast that, in many medium-sized Russian cities, the motorization rates are now comparable to, or greater than, in wealthier Western European cities (Fig. 10.4) despite the fact that the cost of car ownership is higher in Russian cities than in Western cities (Fig. 10.5).

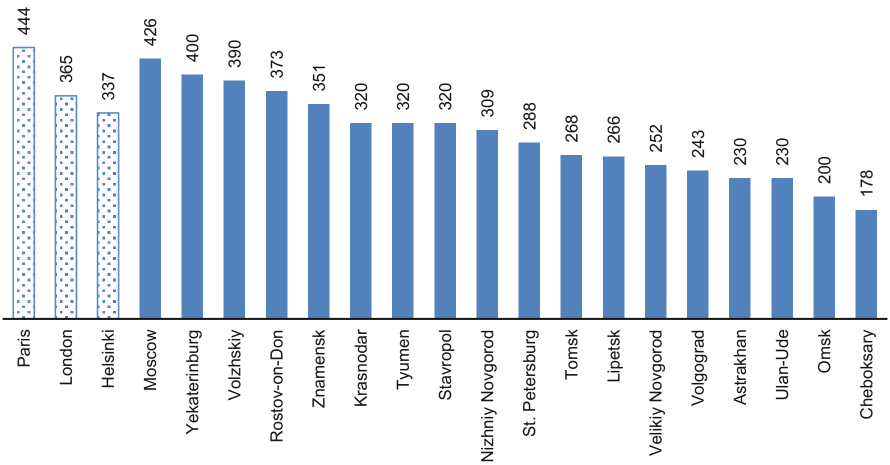

Fig. 10.4 Motorization rate (no. of registered cars per 1000 inhabitants) in selected cities, 2011. Source: Oh and Gwilliam (2013)

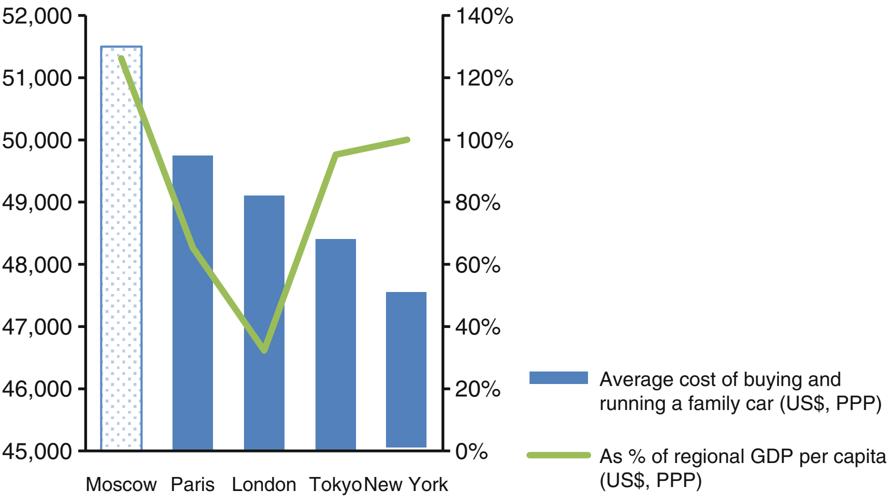

Fig. 10.5 Average cost of buying and operating a car and its share of GDP per capita in various cities. Sources: The Economist 2013; OECD 2011, and author calculations

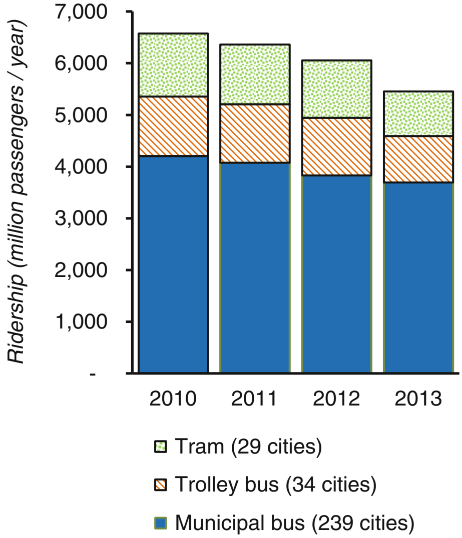

Fig. 10.6 Declining public transport ridership in Russian cities. Source: Rosstat (These figures do not capture the ridership on privately operated buses, which in some cities carry a significant and growing share of passengers.)

The combination of high and growing motorization rates and deteriorating public transport service and vehicles has had a direct impact on urban mobility patterns. With deteriorating public transport service quality and vehicle conditions, those with access to private vehicles have tended to use them more. Also, access to private transport modes has allowed people to choose residences in urban peripheries, which are less accessible by public transport. In other words, people have traded public transport connectivity for larger living spaces.

Most medium and large Russian cities comprise multiple public transport modes, including trams, trolleybuses, conventional diesel buses, and, in larger cities, metros. In many cities, bus services are also provided by private operators. Private fleet sizes vary but typically their vehicles are smaller. Given all these options, the modal share of public transport in Russia is still high, compared to the West. Nonetheless, public transport has been losing ground in recent years, in parallel with growing motorization trends (Fig. 10.6). Tram and trolleybus services in particular, which are provided by municipalities or other public enterprises, are downsizing. Their vehicle and service quality is deteriorating. As a result, many riders are turning to route-taxi or minibus services (*marshrutka/маршрутка*) provided by private operators. In the beginning, they operated along relatively flexible routes and stopped at passengers' request rather than at designated stops. More recently, their routes and stop locations have been more tightly regulated. Other issues remain, such as lack of regular schedules, poor safety records, little or no accessibility for mobility-impaired passengers, and insufficient training or qualification of operators. However, *marshrutka* are the only travel alternative for a segment of the urban population.

The legacy of the Soviet social contract[6] is still powerful after 25 years of transition. People consider it as a norm and a right to have affordable access to various

[6] The socialist concept that economic outputs should be evenly shared among the members of society.

public services, including public transport. Raising fares or eliminating underused routes are therefore unpopular political moves for elected officials. This strong sense of public service obligation has some positive impacts on the quality and quantity of public transport services. Most operators are reasonably well staffed with experienced technicians, although at times the latter are unfamiliar with newest innovations in the field. For instance, while GPS systems were installed in most municipal buses several years ago, advanced passenger information systems, which provide real-time information on bus arrival times at stops, have only recently been introduced in larger Russian cities and are yet to be introduced in smaller cities.

On the other hand, the cost of public transport operations has become prohibitive as operations continue on loss-making routes and fares are kept low. Unprofitable routes are continued especially where they serve people who would have no transport access otherwise. They are referred to as a "social service." These practices have weakened the income of operators and their ability to provide adequate services elsewhere.

4 Urban Transport Problems

4.1 Burgeoning Congestion

Commuting distances in large Russian cities have become much longer in recent years. Moscow is currently the fourth most congested city in the world after Istanbul, Mexico City, and Rio de Janeiro (based on 2014 data from "TomTom Traffic Index," which compares travel times during peak hours and nighttime). St. Petersburg, the second largest Russian metropolis, is seventh on the same list. In Moscow, travel times during the morning peak are on average 77 % longer than at nighttime; and during the evening peak 103 % longer than at nighttime. The figures for St. Petersburg are 67 % and 96 %, respectively. In other words, trips under congested conditions in these cities take almost twice as long as they would in free-flowing traffic (on average). The current level of congestion in Moscow is estimated to have external costs of at least 3 rubles (10¢) per vehicle-kilometer (Hovavko 2014).

Smaller cities are certainly not free from congestion. In Yekaterinburg (1.4 million inhabitants) and Krasnodar (0.75 million inhabitants), traffic speeds along main arteries are lower than 10 km/h during peak hours. Road-based public transport in Omsk (1.2 million inhabitants) operates substantially behind schedule, with delays of up to 30–40 min during peak hours.[7]

Many cities, most prominently Moscow, have responded to congestion by building more roads. Various traffic management measures have been introduced as well, including one-way streets, removal or replacement of at-grade pedestrian crossing with foot bridges or underpasses, and banning of left turns (and sometimes right

[7] Based on self-reported data collected by the World Bank under commission of the Russian Ministry of Transport in 2012.

Fig. 10.7 Congestion on Moscow's inner ring road. Source: Strober (Wikimedia)

turns), all aimed at maximizing traffic throughput on what have become urban highways. This approach has backfired. It did not take too long for widened avenues to become filled with more cars and reach the same levels of congestion as before (Fig. 10.7). No travel time savings were achieved because, with the introduction of measures such as one-way streets and limited turns, travel distances also became longer and travel routes more convoluted (Gayah and Daganzo 2012). As cities expanded their road infrastructure, walking was viewed not as a transport mode but rather as an impediment to smooth vehicular flows. Pedestrian accessibility, especially for the mobility impaired, was severely undermined by the elimination of at-grade crossings, which were replaced by underpasses or overpasses.

4.2 Deterioration of Soviet-Era Public Transport Systems

Public transport networks with fixed tracks and overhead cables, such as trams, trolleybuses, and metros, arrived in medium and large Russian cities in the early and mid-twentieth century. They were centrally planned and built with public resources. These soviet legacy systems are still largely operated by municipal enterprises. Typically, larger cities have a separate metro operator and another municipal

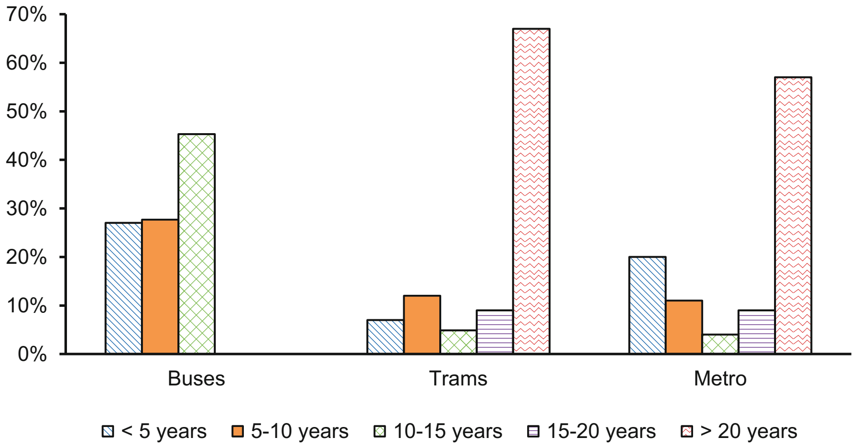

Fig. 10.8 Age of public transport vehicles, 2013. Source: Rosstat

transport enterprise, which operates all other above ground modes. Some cities, such as St. Petersburg, have a separate operator for electric modes (i.e., trams and trolleybuses). In most cities, these legacy systems have become obsolete, physically and/or functionally.

The routes for rail-based public transport, particularly for metros, were determined prior to 1990, in the context of different urban patterns and within monocentric cities with a more pronounced industrial base. The Soviet government policy was to provide metro systems for all cities with a population exceeding one million. Accordingly, metro systems (some very short) were built in five cities in addition to Moscow and St. Petersburg: Novosibirsk (16 km), Nizhny Novgorod (15.5 km), Samara (11.4 km), Kazan (10.3 km), and Yekaterinburg (8.5 km). These metros, built primarily to connect residential estates to industrial plants, are now poorly integrated with the rest of the transport system. Instead of performing high-speed trunk functions, they now carry just a small share of public transport trips: 16, 12, and 2.5 % in Novosibirsk, Yekaterinburg, and Nizhny Novgorod, respectively (Oh and Gwilliam 2013). Increasing the modal share of the metros in these cities is critical. This requires better integration with other modes, and in the longer term, a fundamental transformation of land uses in the urban cores.

Many tram systems have deteriorated since the early 1990s, largely due to a lack of financial resources for maintenance and repair. While there is a great deal of variety across cities, the rolling stock is generally older than in Western European cities (Fig. 10.8). The fixed infrastructure (tracks and overhead cables) is in poor condition, causing frequent derailment or forcing drivers to proceed at low speed. With the deterioration of quality, the ridership has decreased, although captive users and those who benefit from fare discounts remain.

Cities across Russia have responded differently to this situation. In some cases, they have allowed their tram networks to shrink by eliminating routes, partly to allocate more road space to cars and partly to do away with dilapidated infrastructure and vehicles. As a result, the total length of tram networks in Russian cities has decreased from about 3000 to 2500 km between 2000 and 2011 (based on Rosstat data). In other cases, cities have continued to provide tram services at concessionary fares, while unprofitable municipal bus services were replaced by private sector bus services. Much of their remaining tram systems are not financially viable and receive significant operating subsidies. In the longer term, the prospects for tram systems are that they either face being phased out and substituted with other modes, or being renewed through system modernization and upgrades.

While traditional modes were struggling to find a new role in the evolving Russian urban forms, the public sector was unable to meet the extra mobility demand generated by migration, economic growth, and changing lifestyle. In many cities, private operators stepped into the market where there were the supply gaps. They range from individual owner/drivers to sizeable enterprises with several dozen buses. Many of these operators, called route-taxis, employ smaller vehicles (13 and 18 seats, 7.5 m long) and provide services which are less safe and more expensive compared to municipal buses. Private bus services are not well integrated, physically or operationally, with the rest of urban transport systems. While some cities have introduced integrated ticketing systems for all municipal public transport modes, cash-based private operators are seldom party to such arrangements. Since there is little incentive to coordinate routing or scheduling with other modes, a high degree of duplication exists between municipal and private bus routes. Buses compete on the road for passengers. In the city of Lipetsk (0.5 million inhabitants), in 2013 about 8 out of 34 commercial routes entirely duplicate the municipal route network, and the routes of different private operators largely overlap with each other.

4.3 Free and Free-For-All Parking

Illegal parking on arterials and collector streets has become ubiquitous in Russian cities, large and small. For example, in St. Petersburg, it is estimated that about 20–50 % of the total road space in the historic core (about 8 km^2) is taken up by parked vehicles during peak hours (St. Petersburg Government 2012). Residential parking is also a major issue as many socialist-era residential blocks have been built without parking provisions. Not only do parked vehicles reduce traffic flows, drivers also spend a great deal of time in search of parking spaces (World Bank 2013).

Smaller cities are not free from this problem either. For example, in Lipetsk, free short-term on-street parking is allowed on almost all the main streets—with the exception of a few sections near junctions and public transport stops. Illegal parking constitutes an obstacle to traffic flow in the city center. Parking at, and in proximity of, public transport stops is prohibited but this rule is not effectively enforced and, therefore, often violated (World Bank 2013).

Most Russian cities have not yet applied the concept of parking demand management in their transport strategies. This is often a matter of ideology. Private car drivers are important constituents, and therefore local authorities are committed to accommodating their demands. Similarly to the addition of road capacity to increase vehicular throughput, municipalities regularly resort to providing more parking when faced with a mismatch between space supply and demand. The phenomenon is usually characterized as “shortage of parking supply” rather than “excess of parking demand” (World Bank 2013). However, the situation is slowly changing. Moscow and St. Petersburg have recently introduced parking charges and stricter enforcement. These measures were introduced partly because the two cities simply ran out of free parking spaces, especially in expensive central locations. They are also due to a changing attitude of both public officials and citizens, who are beginning to understand that parking demand management is a necessary urban transport policy tool. More generally, these Russian metropolises may be at a turning point in their “love affair” with automobiles. For example, St. Petersburg has embraced the notion of travel demand management in its 15-year urban transport strategy, adopted in 2011. The strategy recognizes the need for a shift from private to public transport, at least for center-bound journeys, and acknowledges that both supply- and demand-side measures must be applied.

Notwithstanding some improvements in Moscow and St. Petersburg, most other municipalities lack the appropriate instruments—land-use controls, regulatory frameworks, and pricing mechanisms—to develop comprehensive parking strategies. The legal provisions of the Urban Development Code, the Federal Law, or the Traffic Rules preclude effective parking policies for several reasons. First, off-street parking minimums are required in residential areas but the standards are outdated and do not match the current motorization levels. While, in the long term, providing excessive parking spaces encourages greater reliance on private cars, soviet housing estates allocated hardly any space for parking. As a result, drivers park anywhere they can, taking over public spaces, streets, and sidewalks. Second, no time limits or parking space maximums apply in the case of on-street parking. This omission is especially problematic in congested city centers. Third, municipalities are in charge of parking policies only for municipally owned roads, not regional or federal roads (see later)—although recent changes in federal legislation allow more freedom to municipalities to manage urban land devoted to transport and parking (Russian Federation 2007, 2011). Finally, the enforcement of penalties for parking infractions is limited and there are legal restrictions on the employment of civilian parking inspectors.

5 Urban Transport Governance, Decision-Making, and Financing

5.1 Transport Planning and Strategy Building

During the soviet period, urban planning was carried out by central institutions which applied standard norms to meet the collective economic needs (e.g., to keep the industrial zones functioning). Most urban land was in public ownership and, therefore, planning amounted to little more than a technical exercise. After the Soviet period, rational planning principles and practices were challenged. The rise of private land ownership required major shifts in the role of public institutions and the skills of planning practitioners. In the new market economy, with private property rights and decentralized land-use decisions, planners had to learn how to regulate, facilitate, harmonize, and incentivize private parties, rather than to allocate and command. However, this kind of change could not be introduced overnight. Unsurprisingly, Russian cities went through a period of planning vacuum in the early 1990s (Golubchikov 2004). The vacuum was gradually filled, first by new regional planning legislation, and then the federal Urban Development Code—adopted in 1998 and still in power. However, these laws, which also concern urban transport, did not solve urban planning problems.

For example, land use and transport planning are poorly integrated. The former shapes mobility needs and the latter respond to those needs. The reasons for this lack of integration, by no means unique to Russia, are numerous, and include legal and institutional aspects. First, the Urban Development Code does not have adequate provisions for developing transport infrastructure and services which are responsive to mobility needs in terms of capacity and structure. For example, a traffic impact assessment is not required for new large-scale developments (residential or commercial) which are expected to generate significant travel demand and traffic volumes.

Second, a silo mentality at both the federal and municipal levels, built around regulatory responsibilities, further contributes to the lack of land use and transport integration.[8] At the federal level, there is little collaboration between the Ministry of Regional Development, which is responsible for enforcing the Urban Development Code, and the Ministry of Transport, which prepares regulations on urban transport planning and traffic management. At the municipal level, traditional land use and development controls remain the responsibility of the architecture and planning departments, while road construction and public transport operations are carried out separately by infrastructure and transport departments. Their activities, especially in large municipalities, are often poorly coordinated. This silo effect is partly a legacy of the soviet era, during which the municipal departments of architecture and planning exercised a great deal of power. They compiled the General Plan (so-called genplan), which determined the physical location and size of all activities, including transport, with little involvement by transport or infrastructure departments. The latter were viewed as executers rather than signatories of the plans, that is, responsible solely for construction and operation.

Even within the current transport sector itself, functions and responsibilities are often split among different departments. Traffic management is a responsibility of the police, road construction carried out by infrastructure departments, and municipal public transport services are planned and managed by a separate municipal enterprise. This fragmentation impedes a strategic and comprehensive approach to

[8] A silo mentality is an attitude found in some organizations, which occurs when several departments or groups do not want to share information or knowledge with other individuals in the same company.

transport planning. Even when the various transport functions are combined in a single department, poor technical capacity presents another barrier (Oh and Gwilliam 2013).

Additional difficulties in integrating land use and transport planning arise from jurisdictional conflicts. While architecture and planning departments once had great powers to determine what to build and where, they only did so for municipally owned land. Urban land in regional or federal ownership was planned by its respective owners. The case of regional and federal roads that run through city boundaries is a prime example of the conflict that this mixed ownership produces. Projects to upgrade or widen these roads are prepared and implemented by regional or federal authorities with little consideration of the plans for the rest of the city.

Additionally, while urban catchment areas have transcended the legal boundaries of many cities, there is no formal provision for the creation of metropolitan authorities, with designated planning powers and financial resources, which could coordinate transport operations and investments across jurisdictions. Currently, in case of adjacent municipalities within same region, coordination occurs through public hearings organized by regional authorities. Only the metropolitan areas of Moscow and St. Petersburg have recently formed coordinating bodies, which consist of the respective municipal governments and regional authorities, and the federal Ministry of Transport. However, it will take some time for these bodies to be tested and come to perform to their full functions.

Under these circumstances, Russian urban transport planning is limited in its scope, depth, and practicality. Many genplans are concerned with little more than the urban physical structures and do not address crucial aspects of public transport provision and traffic management. Even with respect to physical interventions, typically genplans do not fully reflect the long-term, strategic objective of improving the urban quality of life. On the contrary, they tend to focus on short-term solutions to immediate problems (e.g., widening roads at bottlenecks). Moreover, it is not uncommon to see transport plans which do not correspond to the city's fiscal realities.

5.2 *Fiscal and Financial Capability*

Many municipal public transport operators are in a difficult financial situation. In a recent survey (Oh et al. 2012), most medium-sized cities reported operating deficits, some of which are substantial, with the fare revenues covering less than half of the operating costs (Table 10.1).

Low fares are the core cause of the low cost recovery rate. Public transport in Russian cities is more affordable relative to income than in many other countries (Fig. 10.9). Moreover, the actual fares are even lower than nominal fares due to a large number of beneficiaries who are eligible for exemptions or discounts.[9] Federal,

[9] Nominal fares are published rates, whereas actual fares take into consideration of the share of passengers that benefit from exemptions.

Table 10.1 Financial performance of bus systems in 2012. Source: Oh and Gwilliam (2013)

City	Operating costs (million dollars)	Operating revenues (million dollars)	Cost recovery ratio (%)	Average age of bus fleet (years)
Yekaterinburg	56	40	73	9
Omsk	93	83	89	9
Krasnodar	70	73	105	5
Tyumen	17	20	122	16
Tomsk	20	15	74	
Kemerovo	46	40	88	8
Lipetsk	35	12	35	8
Cheboksary	29	26	91	6
Ulan-Ude	10	9	92	Municipal 12; private 7
Stavropol	10	7	74	6
Volzhskiy	15	5	32	12
Velikiy Novgorod	20	19	95	17

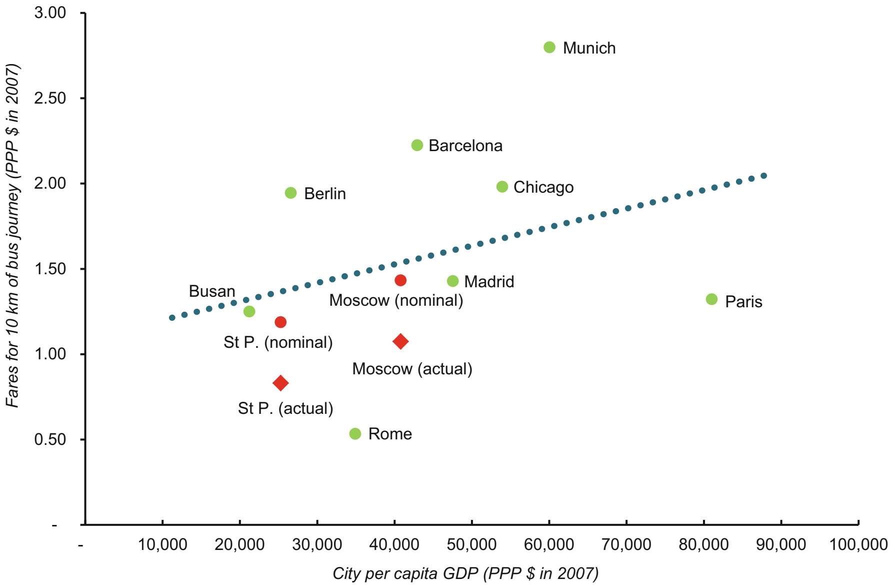

Fig. 10.9 Affordability of public transport services expressed as the ratio of bus fares to GDP per capita in selected cities. Sources: World Bank, UNDP, and author's calculations

regional, or municipal laws define many beneficiary categories, which cover a range of social groups, and are not always based on income.

As of 2014, federal laws and government decrees recognize seven beneficiary categories. Each regional authority adds its own categories to this list. For example, St. Petersburg has 27 additional categories. Some of these include "former underage prisoners of fascism," "citizens exposed to nuclear radiation at the Semipalatinsk test site," and "persons who have suffered from political repression" (St. Petersburg Government 2014). As a result, it is estimated that 40 % of public transport users in the city are eligible for fare exemptions or discounts.[10]

Subsidizing public transport in this manner is a widely used policy in many cities worldwide and is rooted in the recognition that public transport generates economic and social benefits to both users and nonusers, which exceed ticket revenues. However, in the case of Russia, two issues are salient. First, low fares and the resultant low cost recovery ratios must be products of deliberate policies in support of public transport but are rather the result of planning inertia. Second, public transport subsidies do not extend to the timely and adequate maintenance and replacement of capital assets but only cover daily operations. These two issues create problems for the long-term viability of urban public transport.

Current practices in many Russian cities do not appear to have been driven by any conscious policy favoring public transport. Vehicle repairs and replacements take place in a sporadic and unplanned manner, as money becomes available from municipal budgets or other sources.[11] Many cities are not committed to a more sustainable and cost-efficient public transport. Not only do they not have replacement reserves, but they do not even maintain proper accounts of vehicle depreciation.

Given the poor state of public transport, the federal government occasionally steps in, providing financial support through targeted programs. However, these programs are ad hoc, rather than based on clear rules or criteria. Ironically, the precedents set by the federal government, which imply a potential for future subsidies, have further undermined the local motivation to use municipal resources for system maintenance.

The chronic underfunding of public transport operation and maintenance is a product of various factors. On the one hand, this phenomenon reflects a lack of long-term fiscal planning and asset management in municipal governments. On the other hand, it points to broader administrative issues: the limited local taxation powers and the fiscal dependence of municipalities on upper tiers of government.[12] Cities claim to rely on transfers from regional governments for the majority of their budgets. Local income sources include land taxes, a portion of personal income taxes, and municipal trading revenues (Oh et al. 2012).

Meanwhile, the transfers from regional governments, especially for capital investments, do not take place regularly and reliably but are rather unpredictable

[10] Information obtained in a meeting in 2010 with public officials from the municipal transport committee.

[11] Personal interviews with municipal officials in the framework of a World Bank project (Oh et al. 2012).

[12] The Russian taxation laws are complex. According to Article 104 of the Constitution, new taxes can only be introduced by the federal government upon approval by the State Duma (parliament). Meanwhile, Article 132 of the Constitution assigns local governments the right to introduce local taxes. However, Article 132 of the Constitution allows regional or municipal governments to only adopt taxes at a rate that is equal to, or lower than, the stipulated rate in the Tax Code.

and require negotiation on a case-by-case basis.[13] Consequently, municipalities find it impossible to formulate meaningful medium- and long-term investment programs. The situation is more difficult for poorer regions with a limited tax base where most of their budgets are used for social programs, such as pension schemes, leaving little money for public transport.

5.3 Public Transport Regulation

In a number of cities, private operator vehicles (large buses and route-taxis combined) constitute a large share of the total vehicle fleet.[14] Also, their vehicles are generally newer than those operated by the public sector (Oh et al. 2012). As such, they play an important role in providing mobility for many urban residents. As mentioned earlier, private services are poorly integrated with municipal services and often compete for passengers along similar routes. From the users' perspectives, there is a strict distinction between private and municipal operators, in which the former does not offer fare exemptions and discounts to beneficiaries. This is because private operators are not obliged to honor the obligation of offering concessionary fares, as long as they do not receive municipal subsidies.[15] This distinction between what are called "commercial services" and "social services" is a product of the current enterprise laws and procurement practices. Most Russian cities started with a large public supplier, offering affordable services for many citizens. Under federal law introduced in 2002 (No. 161-FZ of 2002; Russian Federation 2012) publicly owned fleets are mostly operated by "municipal unitary enterprises." These enterprises are legally independent from their owners (i.e., municipalities), do not own transport assets (e.g., vehicles and depots), and are obliged to return any profits to their owner authority. The municipal unitary transport enterprises therefore rely on uncertain municipal funds for vehicle replacement. As a result, the municipal unitary enterprises have not been very successful in sustaining vehicle and service quality, and the fleets of unitary municipal enterprises are generally in a poorer state than their private counterparts. According to their contracts with municipalities, the private operators are responsible for their own vehicle provision and replacement and often required to maintain the fleet age under certain limits.

This unequal treatment of municipal and private operators is partly motivated by a social policy to provide affordable bus services for lower income citizens and

[13] Information obtained through a meeting with officials from several cities.

[14] For example, in St. Petersburg there were 789 trams, 684 trolleybuses, 1100 municipal buses, and about 4300 private buses (2011 data).

[15] Federal Law no. 94 requires that a competitive tender be held for any public service contracted out to a private supplier, which then receives some form of compensation from the government. Private suppliers that offer reduced fares for certain beneficiaries must receive compensation and are therefore required to enter competitive tenders. Some cities avoid the obligation to hold tenders by waiving the requirement to offer fare discounts for private operators.

vulnerable social groups. While the municipalities lacked the regulatory and financial means to ensure that private operators provide subsidized fares to certain users, it continued to provide them through their own municipal unitary enterprises and municipally owned fleet. The artificial separation of essentially similar services results in less than desirable outcomes from social and fiscal points of view. The present two-tiered public transport system provides higher frequency service to those users who can pay the full fares while excluding those who pay concessionary fares (e.g., students and pensioners). This poses a problem for poorer passengers who can only use municipal buses (with less convenient schedules) in order to obtain free or discounted fares. Additionally, this leads to a situation where private buses make inefficient use of their vehicle capacity and fuel, as well as of public road space, while municipal buses and trams are unnecessarily overcrowded.

There are additional issues associated with tendering and contracting practices through which private operators are invited to compete and selected for providing services. First, municipalities typically tender out profitable routes in order to avoid public subsidies for private operators. Municipal enterprises are thus left operating along loss-making routes, further burdening the public budget. Second, very small operators (i.e., owner/drivers) are commonly permitted to bid for individual routes or at least as subcontractors to a larger company. These micro enterprises tend to perform poorly with regard to vehicle condition, safety, and service reliability. Third, bids are evaluated, and contracts are issued, on the basis of technical norms and inputs (i.e., firm age and size and fleet type and age) rather than outputs, such as service reliability, safety, and comfort. Once a contract is issued, municipalities rarely revoke the contracts of poorly performing private operators because of the administrative burden involved in retendering the routes. These approaches, combined with weak public performance monitoring, make it difficult to ensure quality services delivered to users.

6 Proposed Urban Transport Solutions and Implementation Issues

6.1 Embracing Travel and Parking Demand Management

Some Russian cities are beginning to embrace the notion that they cannot "build their way out of congestion." Many cities, especially those suffering from major traffic congestion, such as Moscow and St. Petersburg, are realizing that they should manage and control traffic and road space demand rather than accommodate them through supply measures.

A turn of attitude is most evident in parking policy. Until recently, the prevalent approach was to increase the number of parking spaces in city centers for the convenience of motorists. However, after realizing that this approach is counterproductive and only leads to more congestion, both policy makers and citizens are now more willing to consider different strategies. In St. Petersburg, for example, the population is increasingly in favor of parking charges in the center. In a survey in 2012, 67 % of the respondents viewed parking fees positively provided that a parking place is guaranteed (St. Petersburg Government 2012).

However, other parking issues remain unsolved. For example, parked cars often encroach dedicated bus lanes and even bus stops, as mentioned earlier. Therefore, parking needs to be treated as a critical element of strategic transport plans at the municipal level. Regional governments already have the power to establish their own laws on curbside parking. They can impose spatial and temporal parking restrictions, introduce parking fees, and penalize violators (Russian Federation 2007, 2011). Currently, a well-developed conceptual and policy framework is missing, within which to exercise these powers.

Comprehensive parking plans need to become part of their strategic transport plans. Parking plans must include consideration of issues such as parking standards in new developments, management strategies of existing parking areas, appropriate fees for on-street and off-street, and enforcement measures. The recent success in introducing on-street parking fees and a cell phone-enabled payment system in Moscow, followed by a similar, smaller scale one in St. Petersburg, is a promising development that could be implemented in other Russian cities. The merits of IT technologies in parking management go beyond the convenience in collecting fees. They enable experimentation to understand car users' willingness to pay for parking in order to inform policy.

6.2 Maintaining and Upgrading Existing Public Transport Systems

A critical challenge facing many Russian cities is the future of their aging, functionally obsolete, public transport systems, particularly those with fixed infrastructure. Given the size and diversity of the country, this problem has no universal solution. Individual cities will have to carefully assess which parts of their network still serve local mobility needs and then focus on repairing and upgrading those. The costs of building new mass transit systems are high. For example, the new tram system in Moscow is estimated to cost about $22 million/km. This amount is prohibitive for most other cities. A more fiscally prudent strategy would be to catch up on the maintenance backlog, rather than scrap the entire legacy system and build a new one. High priority investments include the replacement of old tram vehicles and the rehabilitation of dilapidated tracks and cable lines (Fig. 10.10).[16]

[16] The rehabilitation of existing tram infrastructure costs between 14 million and 30 million rubles/km ($283,000–$606,000), new cable and power supply systems cost between one million and three million rubles/km ($20,000–$61,000), and new rolling stock costs less than 20 million rubbles/tram ($400,000) (figures based on the procurement notices published in the Procurement Portal of the Russian Government).

Fig. 10.10 Trams negotiating poor track conditions in Ufa. Source: Mark Selin (2012)

Across the country, the public transport systems need to be integrated across modes and operators. One way to achieve this could be via an umbrella department within municipalities which prepares a strategic and comprehensive public transport masterplan, to override current mode-based planning by separate departments. This masterplan could define the backbone of the public transport network, both by planning upgrades to the legacy system, and where this does not serve well, by planning its replacements. The rest of the network could be built around the backbone in a trunk-and-feeder structure. This would require a reconfiguration (and possibly extension) of existing bus routes, including those run by private operators. Physical design reforms could accompany operational integration, including multimodal tickets and coordinated schedules. (Many Russian cities have already introduced integrated ticketing systems, but private buses and route-taxis are largely left out.) To function properly, the system could be further supported by roads maintenance, traffic management, and travel demand management, and parking policies. These could be developed coherently in the citywide strategic transport plan.

The physical and operational integration of public and private operators is very challenging since the current tendering and contracting practices undermine the municipalities' power in regulating private operators and their efficiency. In order to improve the overall efficiency and achieve integration across modes and operators, a level-playing field could be created for both municipal and private operators so that the most qualified and cost-efficient ones are selected to provide services and are remunerated based on their performance. This would require a total overhaul of municipal enterprises and a major revision of the current tendering and contracting regulations. Market-based approaches to competitive tendering (e.g., gross-cost tendering, price-based tendering, and system-wide concessions), which have been successfully tested in Europe and elsewhere, would be worth exploring—all the while considering local conditions and market structures, as well as the relationship with, and performance of, existing operators.[17]

7 Other Country-Specific Issues

Russia is a vast and diverse country, with substantial regional disparity. Its effects are felt in the urban transport sector. Technical, professional, and institutional capacities are also highly uneven across the country. Urban transport problems not only require technical solutions but also legal, managerial, and financial skills. Because state universities traditionally tend to strongly emphasize technical education, transport administrations, especially those in smaller cities, are often staffed with highly trained and experienced engineers and technicians, but lack planners, managers, lawyers, and financial analysts. Moreover, professionals in local administrations are relatively immobile during their careers and, with no younger staff currently being recruited, the older generations are insufficiently exposed to new knowledge, trends, and approaches in urban transport planning (Oh et al. 2012).

This issue could be addressed by facilitating knowledge sharing and diffusion across regions and cities. The positive and negative lessons learned through a few innovative cases, such as Moscow's recent introduction of parking fees, could be showcased. Given the great number of cities in Russia, a national-scale knowledge-sharing scheme might be feasible due to economies of scale. A federal institution or a self-organized community of regional and municipal transport directors could lead to knowledge-sharing efforts.

Additionally, postuniversity training of the existing municipal staff and an accreditation/certification system may be instituted in the areas of traffic engineering, urban transport planning, and public transport regulation and procurement. Such training could support the career development of local professionals, and ultimately strengthen the capacity of municipalities to address their growing and evolving mobility challenges.

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[17] Under the price-based tendering, winning bids would be selected based on financial criteria (e.g., bids would be preferred that require low subsidies from the municipal budget), while the technical norms on inputs to operation (vehicles, staffing, and facilities) would become minimum requirements in the service contracts (rather than bid evaluation criteria). Under the gross-cost contracting method, it would be easier to apply integrated fares and ticketing as revenues would be collected by the municipality and all operators would be paid according to the services they provide.

8 Conclusion

Unlike other emerging economies, the urban population of Russia has been relatively stable. On the other hand, urban mobility patterns have been anything but stable. Four aspects of the economic and social transition from socialism to a local version of capitalism have had profound impacts on urban transport: (1) motorization, (2) urban form transformations, (3) private sector-led development, and (4) private sector participation in public transport service delivery.

Rapid motorization, coupled with the deterioration of the public transport systems inherited from the soviet era, has radically altered the Russian cityscapes. Once filled with trams and trolleybuses, cities are now choked with cars stuck in slow-moving traffic. Urban form transformations, including the formation of new commercial hubs and vast suburban areas, were triggered by a structural transformation from an industry-based economy to a service-based one. As a result, trip patterns have completely changed. The rise of private land ownership and decentralized land development decisions have rendered traditional urban and transport planning obsolete. Meanwhile, private operators have entered the public transport market while municipal operators are closing off parts of their tram networks.

The new situation demands new solutions. If the "in-transition" approach was to replace past scarcity with newfound abundance (reflected, for example, in the switch from trams to cars), "posttransition" solutions involve a delicate balance between old and new. Russian cities could take advantage of their legacy public transport systems by selectively repairing and upgrading those parts which are still useful. The important social value which is still attached to public transport services could be sustained as it acts to balance to motorization trends. At the same time, municipalities have to deal with the increasing role of the private sector in shaping cities and providing necessary public transport services. Providing urban public transport systems increasingly involves both public and private sectors. These circumstances require close planning and regulation by public authorities, while commercial entities deliver transport services. More recently, new urban mobility visions and strategies are being tested in some of Russia's more innovative cities,[18] from where important lessons for other cities need to be learnt.

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[18] In May 2016, the International Transport Forum's Transport Achievement Award was awarded to the city of Moscow in recognition of some recent progress in improving in urban traffic conditions. Recent measures put into place in Moscow include paid car parking, new public transport infrastructure, innovative ticketing, reform of public transport governance, new cycling infrastructure, car sharing and taxi reforms, and new environmental controls on goods vehicles (ITF 2016).

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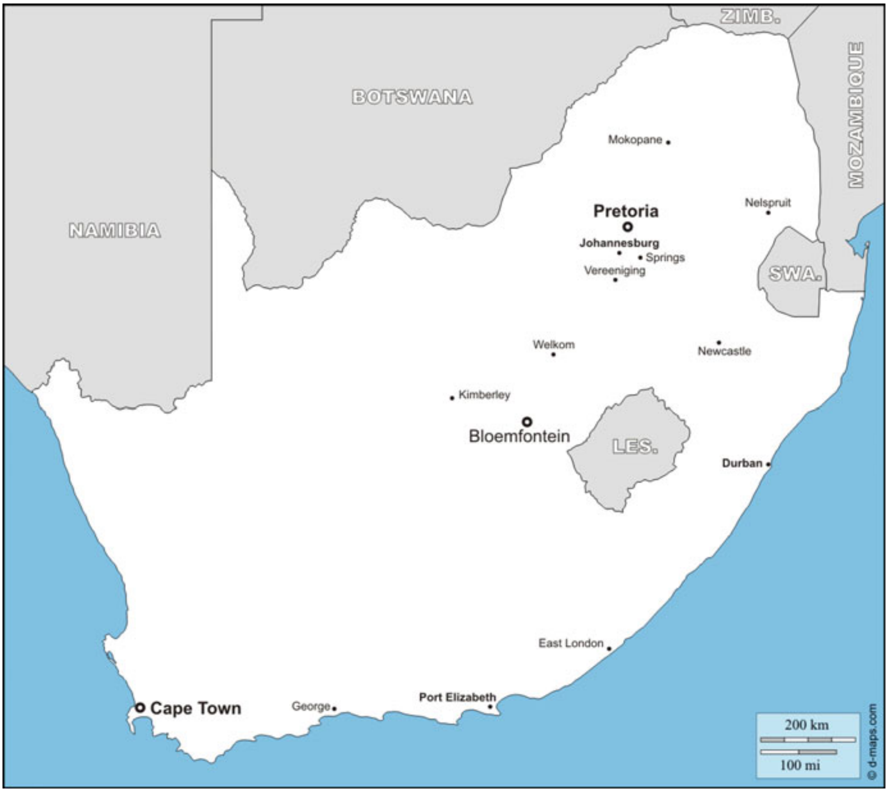
Chapter 11
South Africa

Fabio Todeschini and David Dewar

Capital city	Land area	Total population	Urban population	GDP per capita	Passenger cars
Pretoria	1,219,912 sq. km	53 million	63% (33 million)	$6,618	112 / 1,000 people



Data source: World Bank
Maps source: d-maps.com

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1 Introduction

South Africa is the most urbanized country on the African continent, with about 65 % of the population living in towns and cities. This percentage is increasing steadily (at a rate of about 2.6 % per year) because of relatively high (but declining) birth rates, continuous rural–urban in-migration, and immigration from other countries in Africa (CoCT, 2011).

As an emerging economy, it faces many developmental challenges. These include high population growth, particularly among the poorest households; high levels of poverty and inequality; high levels of unemployment (officially 25 % of the workforce is classified as unemployed, but regionally the figure is much higher); low levels of education and literacy; a severe housing shortage; and high, and increasing, levels of informality, both economically and in terms of settlement. Setting it apart from many other developing countries are the very high levels of inequality and a strong correlation between race and class, with the largest racial group (the Africans) making up the majority of the poor. The United Nations Review of the World Cities (2008) concluded that South African cities are among the most inequitable (and by implication, inefficient) in the world.

In terms of transportation, there are both similarities and differences between the major metropolitan areas of South Africa. All are strongly car based and their public transport systems are weak. Cape Town, Johannesburg–Pretoria (Tshwane), and Durban have significant overground heavy rail train systems, while Cape Town's is the most developed with 914 km of passenger rail (CoCT and TCT 2013). Port Elizabeth, East London, and Bloemfontein, on the other hand, do not have extensive rail networks. Cape Town and Johannesburg are in the process of implementing Bus Rapid Transit systems (since 2009 and 2011, respectively), and Johannesburg–Tshwane are rolling out a high-speed overground train system (the Gau-Train).

The main focus of this chapter is Cape Town—South Africa's legislative capital as well as its second largest city—a city which illustrates many of the general characteristics of urban transport in South Africa. References to other cities in the country are made when there are significant differences in transport trends or policies.

Cape Town is a port city. It was founded in 1652 as a revictualling station for ships of the Dutch East India Company traveling between the Netherlands and the Far East, and its anchorages and port have always played an important role in the economy of the settlement. It enjoys a benign Mediterranean climate and has a stunning setting at the foot of the iconic Table Mountain range. Covering an area of more than 2400 km^2, metropolitan Cape Town has a population of about 4 million and, typical of many cities of the global south, it is growing relatively rapidly. Its socioeconomic characteristics are broadly similar to those of the rest of the country, with the exception of a few important aspects: the single largest segment of the population is of mixed-race origin (*Colored*), Afrikaans speakers are in the majority, and the provincial and metropolitan governments are currently Democratic Alliance led (the official national opposition party).

2 Urban Land-Use Patterns and Spatial Structure

Although the first permanent settlement on the site of Cape Town was established in 1652 (its initial layout was based on the "Laws of the Indies" of King Phillip II of Spain), most urban growth occurred in the second half of the twentieth century. This is significant since it has meant that the main structural and land-use patterns of the city were shaped primarily by two forces: city planning and design ideas; and the political ideology of *apartheid*, or separate development. These same two forces have had significant and similar effects on the growth and structure of all other major cities and towns in South Africa.

2.1 Planning Ideas

The most influential planning ideas affecting the structure and form of the city were largely imported, primarily from continental Europe, the United Kingdom, and the United States of America. The most influential of these have origins in the modernist movement. First, beliefs about spatial separation—keeping the four main urban functions of "living," "working," "playing," and "moving" apart—have had a significant impact on planning policy and practice (Conrads, 1964). Second, access to sunlight and open space have also influenced thinking about urban form, with the consequence that residential densities developed in the twentieth century were often relatively low. Third, the suburban model of free-standing buildings surrounded by open space has also shaped the form of the built environment, even though, for economic reasons, plot sizes for the poor have reached a point where, in large parts of the city, there is very little private green space. Fourth, urban nodes were preferred over "corridor streets" (traditional mixed-use "high streets"). Fifth, the belief that technology would set society free was strong in almost all post-WWII urban developments in the country. For example, the lateral spread of the city was related to the introduction of modern transport technologies in the twentieth century (i.e., the automobile) and the development of standardized mass housing schemes was based on the use of industrialized capital-intensive building technologies, utilizing standardized materials and components.

The spatial planning system that was set up in South African cities, including Cape Town, was a rational-comprehensive model promoted by the modernists. Two other ideas, drawn from other, but related, planning movements such as the Garden City movement, also fell on receptive ears. The one was the belief that the "good urban life" was to be found in the suburbs (Jacobs 1962). The other was the "neighborhood unit": the belief that a city should be made up of a collection of villages or "cells," bounded by arterials or open space with the movement network of each cell oriented inward on community and local commercial facilities at their centers (Perry 1927).

These ideas were embodied in the first Metropolitan Cape Town planning scheme of the 1940s (Fig. 11.1) and were entrenched in planning codes which were being

Fig. 11.1 Cape Peninsula regional diagram from the 1940s: the first Joint Town Planning Scheme for Metropolitan Cape Town. Source: Cape Town Foreshore Joint Technical Committee (1948)

formulated at the time. Conceptually the scheme conforms to Le Corbusier's ideas of urbanism, with the spatial separation of the four urban functions and his dictum "we must kill the corridor-street" (Le Corbusier 1930). (Even the graphics used in the figure include the distinctive stencil lettering designed by Le Corbusier).

2.2 Apartheid

The second major force shaping South African towns and cities from the 1940s onward was *apartheid* or separate development. Although instruments of spatial separation on the basis of race had been in existence since colonial times, the policy was formally codified under the Nationalist Party of Daniel François Malan, when it came into power in 1948. The Nationalist Party found that the spatial ideas of the modernists provided the instruments it needed to give effect to its ideology of apartheid.

Various mechanisms were used to control the access and movement of non-whites. One was influx control. All Africans were required to carry a pass (*dompas*), certifying that they were legally allowed in the area. Without it, they were immediately repatriated to their rural area. A time curfew was imposed and any Africans found in "white" areas at times that contravened the curfew were arrested. A second mechanism came from the Group Areas Act of 1950. This Act required all race groups (Whites, Africans, Coloreds, Indians, and Malays) to reside in areas that were specified for occupation by that group. Large numbers of households were forcibly moved to achieve these ends. A third mechanism was in the form of housing policy. The state and large employers of migrant labor provided accommodation for African males in single-sex hostels. No African family accommodation or land ownership was allowed. Similarly, local authorities were largely responsible for the provision of accommodation for Colored, Indian, and Malay groups, mostly (but not exclusively) in the form of rented accommodation. The authorities determined the location of these settlements based on the principle of separation. Informal settlements were not tolerated and were forcefully removed when they sprang up.

Some of the central tenets of the modern movement accorded well with the requirements of apartheid but these ideas were grotesquely distorted on a number of fronts. The concept of the separation of land uses was extended to include separation on the grounds of race and (because of the high correlation between race and class in South Africa) class. This was not part of the modernists' ideology in other parts of the world.

The scale of separation was massively distorted. People were moved very large distances away from places of employment and other urban opportunities. One-way commuting of more than 3 h was not uncommon in some parts of the country. It was primarily people of color who were forced to move to the urban peripheries and had the furthest to travel. Trains and buses, carrying heavily subsidized commuters, were a central part of operationalizing apartheid.

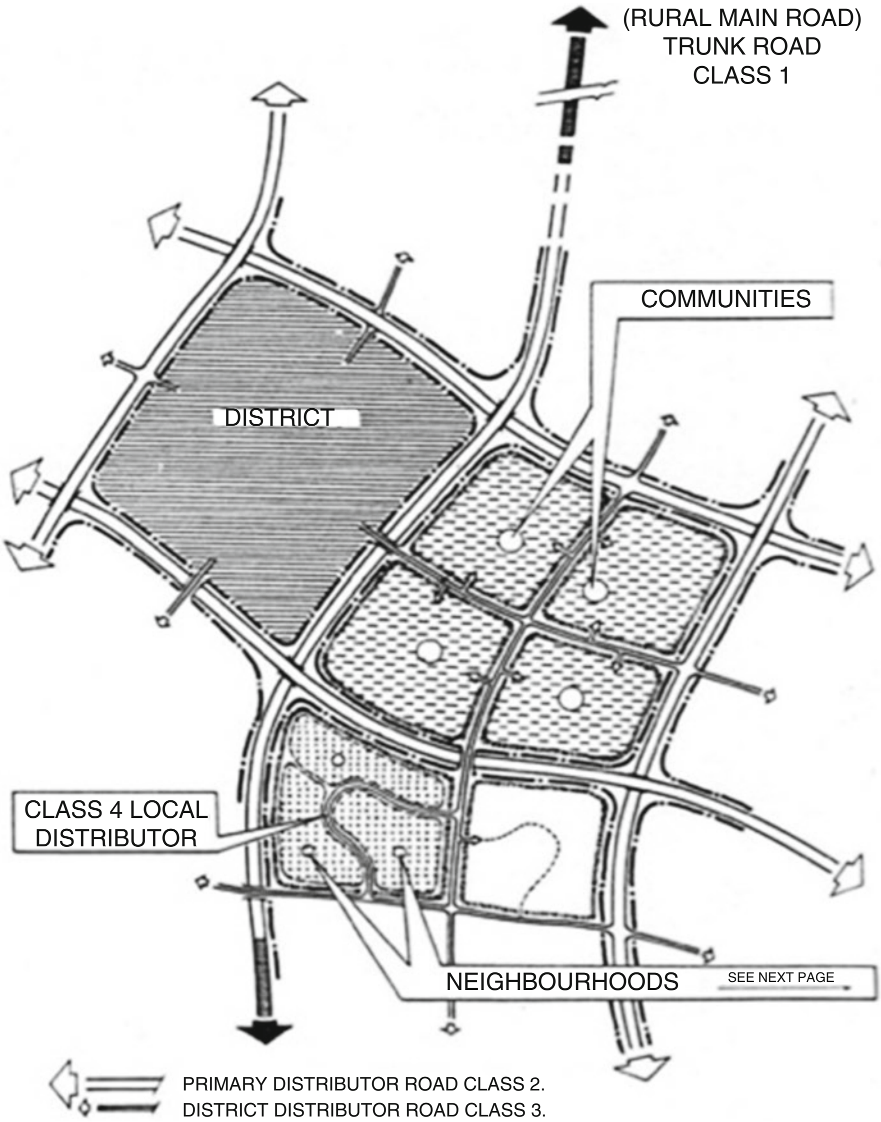

Fig. 11.2 The officially promoted functional movement hierarchy serving districts, communities, and neighborhoods: a literal interpretation of the modernist model. Source: Department of Local Government and National Housing (1993)

The distorted model of the "neighborhood unit" or "urban village," not bounded by integrating arterials as proposed by the early modernists, but by the "fences" of railway lines, limited access highways, and "buffer-strips" accorded with the apartheid model in the sense that access to, and egress from, these cells occurred at a limited number of places only and could be relatively easily controlled and secured in the event of social unrest (Fig. 11.2). The suburban model of development prevailed, not only in the private sector but also in public housing, even though, for cost reasons, cuts occurred to the point that units were small and there is no private green space. The image of the free-standing village in the countryside was perverted into pockets of development (almost exclusively housing) surrounded by sterile, unproductive, and underutilized buffer strips of land. Rather than being a positive asset, green spaces became desolate wastelands—frequently dangerous places and dumping grounds for waste. The city is largely divided in terms of land uses into a series of mono-functional zones, with the majority being suburban residential. Within the residential sector, there are high degrees of separation along racial and class lines.

Following the democratic election of 1994 and the formation of the Government of National Unity led by Nelson Mandela, all of the legislative pillars of apartheid were repealed. Despite this, the low density, fragmented, and separated patterns of urban development have continued. This is because the primary drivers of urban form since that time have been threefold: (1) speculative land development, driven primarily by a desire of wealthier people to privatize amenity, rather than any integrated urban logic; (2) informal settlement formation, in terms of which the main locational factors are the availability of (largely public) land and the desire to avoid harassment from the authorities, as opposed to an urban logic; and (3) government emphasis on large, heavily subsidized mass housing schemes for the urban poor, based on a low density, single-story suburban model. These mass housing schemes are dependent for their viability on large tracts of cheap land. This land, in turn, can only be found further and further out on the urban periphery.

In combination, these factors have resulted in South African cities that are characterized spatially by a number of dominant patterns: low-density sprawl, fragmentation, separation, and a strongly radial movement network of both road and rail, where the latter exists. Although there are pockets of higher density development, average urban densities are among the lowest in the world. For example, Cape Town has a net average density of somewhere between 32 and 39 dwellings/ha, and despite rapid urban growth, its average density today is in the order of a third of what it was a century ago (Figs. 11.3, 11.4, 11.5 and 11.6).

The dominant radial movement pattern is true of all South Africa's port cities (Cape Town, Nelson Mandela Municipality, East London, and Durban). The original settlements grew around the port functions and became the city centers. As the settlements grew laterally, the response of transportation planners was to tie new growth back to the city center to the greatest degree possible. There was no attempt to use the movement network structurally, in order to create a more neutral grid-like system that would take pressure off the center. Two distinct distributional patterns of work and other higher order activities can be observed.

Prior to the 1940s urban growth was incremental and largely followed the alignments of the more continuous arterial routes that carried public transportation. These alignments emerged as a consequence of the geography and topography of mountain, seashore, inland rivers, and small lakes. Higher order activities (such as retail and commerce) were able to respond directly to movement flows along these routes. As a result, urban development corridors emerged. The pattern of activities

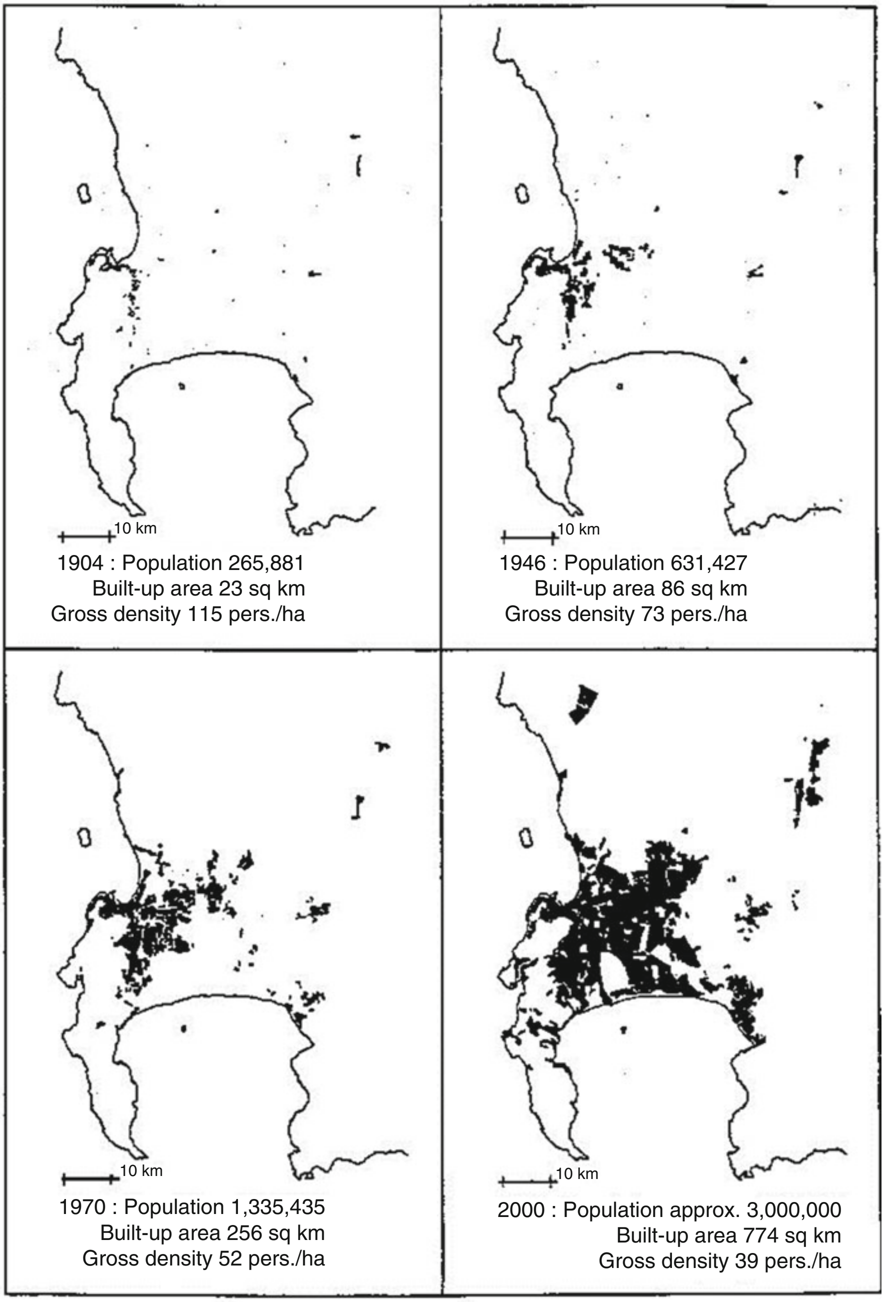

Fig. 11.3 The spatial growth of Metropolitan Cape Town 1970–2000, with enormous lateral spread and significant decrease in population density. Sources: Gasson (2000), Dewar and Todeschini (2004)

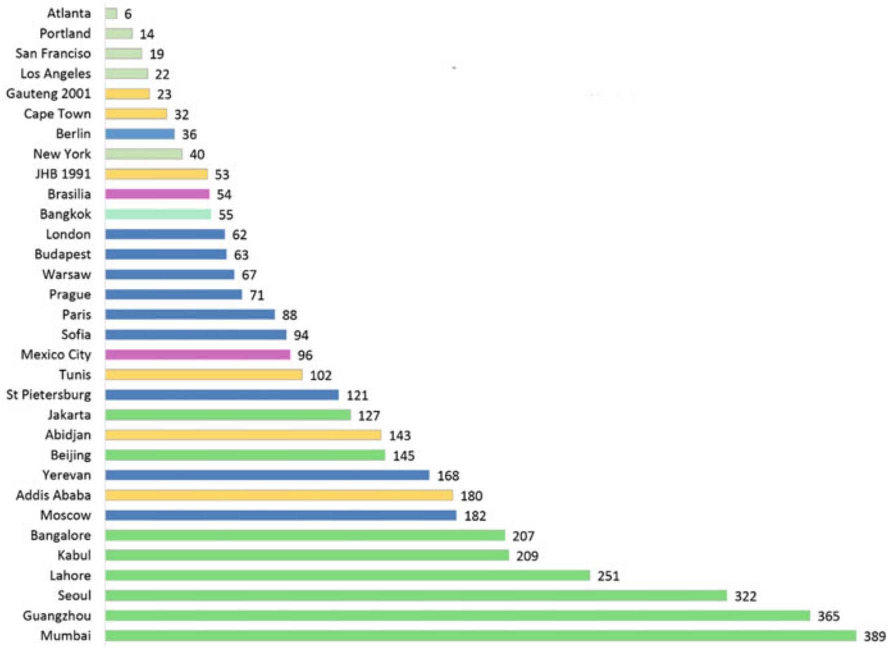

Fig. 11.4 Population density of selected world cities (color coded by continent). Source: Van Ryneveld (2015a)

Fig. 11.5 Low density housing in the typical Cape Flats township of Khayelitsha. Photo by Fabio Todeschini

Fig. 11.6 Low density housing in the typical Cape Flats township of Mitchell's Plain. Photo by Fabio Todeschini

was by no means equal along these corridors. Higher order activities were concentrated at points of higher accessibility along them (e.g., at junctions), and the resulting development pattern resembled "beads on a string".

After the 1940s, the pattern of urban development shifted to one of almost exclusively car-based nodal development. Three factors contributed to this shift. First, the growth in private vehicular traffic enabled developers to break away from the pull of the urban corridors and existing employment concentrations. The search for amenity and cheap land became increasingly important for both wealthier residential households and for economic enterprises. Second, the modernists, in combination with a strong City Engineering tradition (brought in by the British colonizers), introduced a rational comprehensive form of planning, of which zoning was a primary instrument. This was expressly aimed at the separation of land uses. Third, the Advertising on Roads and Ribbon Development Act (Act 21 of 1940), based virtually verbatim on the UK Prevention of Ribbon Development Act of 1935, was formulated specifically to prevent rural interurban routes from being transformed into urban corridor extensions outward from existing settlements. However, in South Africa the concepts embodied in the British Act were also applied to intraurban structure. Thus, from that time, naturally occurring "high streets" were expressly prevented from taking root and “arterial routes” came to mean something akin to limited access routes flanked by feeder routes, cutting through the urban fabric (Todeschini, 1991).

Beginning in the 1940s, the development of large highways changed the structural geometry of the city. These routes do not allow access directly along their length but only at limited points of access and egress along their length. As a result, new nodal forms of activity such as car-based shopping centers, industrial estates, and office parks became more prevalent. Because the distribution of shopping centers is determined by the spatial pattern of the discretionary income of residents, the location of these was skewed toward the more wealthy (white) areas, thereby increasing inequality of accessibility to services and facilities.

The external costs of these development patterns are large. Urban sprawl is destroying large amounts of productive agricultural land and other land of high amenity at a rapid rate. The development patterns are also generating enormous amounts of movement, particularly private vehicular movement, at great cost in terms of productive time, household incomes, infrastructure investment, energy expenditure, air pollution, and greenhouse gas emissions. Traffic congestion is increasing and conditions of gridlock are becoming commonplace. The structure and form of the city are directly and significantly contributing negatively to the primary socioeconomic problems of poverty, inequality, and unemployment. Development densities are too low to create significant local markets for many goods and services, a prerequisite for small-scale, self-generated economic activity (a necessity in the face of increasing structural unemployment) and adequate social service provision. Densities are also too low to allow for the provision of viable, affordable, and efficient public transportation.

3 Trends in Transport Use and Mobility

Since its beginnings, the city of Cape Town, along with other South African cities, has seen the use of a wide range of movement modes: walking, nonmotorized transport (NMT), the horse and mule, the horse and carriage, the horse-drawn tram, the electric tram, heavy rail, the electric trackless bus, the standard bus, and the private motor car. Some of the modes have been superceded over time and some have been added more recently: minibus-taxis, Bus Rapid Transit (BRT) and, in the case of Johannesburg–Tshwane (Pretoria), the Gau-Train (an inner city overground rapid train service). Table 11.1 presents the prevailing modal split in the 6 major cities of South Africa. Most journeys are made by private cars, foot, and taxis, accounting for 34 %, 25 %, and 24 % respectively, across the six largest metropolitan authorities (Table 11.1). Total bus and train journeys account for 8–20 % of all journeys in these metropolitan areas—Cape Town has the highest ridership while Nelson Mandela Metropolitan Municipality has the lowest. Shifts in the modal share patterns over the past decade are presented in Table 11.2. Figure 11.7 reflects the shifts for most modes for Cape Town since 1990.

Table 11.1 Modal shares in the six larger metropolises (Johannesburg, Tshwane, Ekurhuleni, Cape Town, Ethekwini, and Nelson Mandela Metropolitan) in 2013

	JHB (%)	TSH (%)	EKU (%)	CCT (%)	ETH (%)	NMB (%)	Total (%)
Train	4.8	5.3	7.7	13.0	3.7	0.6	6.6
Bus	5.4	7.4	3.3	7.0	7.6	7.4	6.2
Taxi	27.3	24.6	29.7	14.2	32.3	21.8	25.1
Public transport total	**37.4**	**37.4**	**40.8**	**34.2**	**43.6**	**29.9**	**37.9**
Car	36.5	38.1	32.6	37.7	24.8	33.5	34.2
Walk	24.5	22.3	24.9	25.4	30.0	33.5	25.8
Other	1.7	2.2	1.7	2.8	1.6	3.0	2.0
Private transport total	**62.6**	**62.6**	**59.2**	**65.8**	**56.4**	**70.1**	**62.1**
Total	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**

Source: Van Ryneveld (2015a)

Table 11.2 Overall modal split: daily travel for work and educational purposes in 2003 and 2013 for all six metropolises

Mode		Modal share 2003 (%)	Modal share 2013 (%)	Change 2003–2013 (%)
Public transport	Train	7.1	6.6	–0.5
	Bus	7.5	6.2	–1.3
	Taxi	22.5	25.1	2.6
	Total	37.1	37.9	0.8
Private transport	Car	28.5	34.2	5.8
	Walk	32.3	25.8	–6.5
	Other	2.2	2.0	–0.1
	Total	62.9	62.1	–0.8
Total daily trips		100.0	100.0	100

Source: Van Ryneveld (2015b)

3.1 *Nonmotorized Transport*

Although employment and other urban opportunities are widely spread in South African cities, many of the urban poor cannot afford the costs of more formal modes of transport and have no option but to walk in order to access the opportunities of the city. Table 11.2 shows that walking in the six largest cities in the country accounts for more than a quarter of trips, but that this mode has decreased by 6.5 % over the past decade. Reports of people (particularly women) walking over 6 h a day in search of employment are not uncommon. Similarly, people in the informal economic sector spend long hours walking, seeking waste materials for recycling (Fig. 11.8).

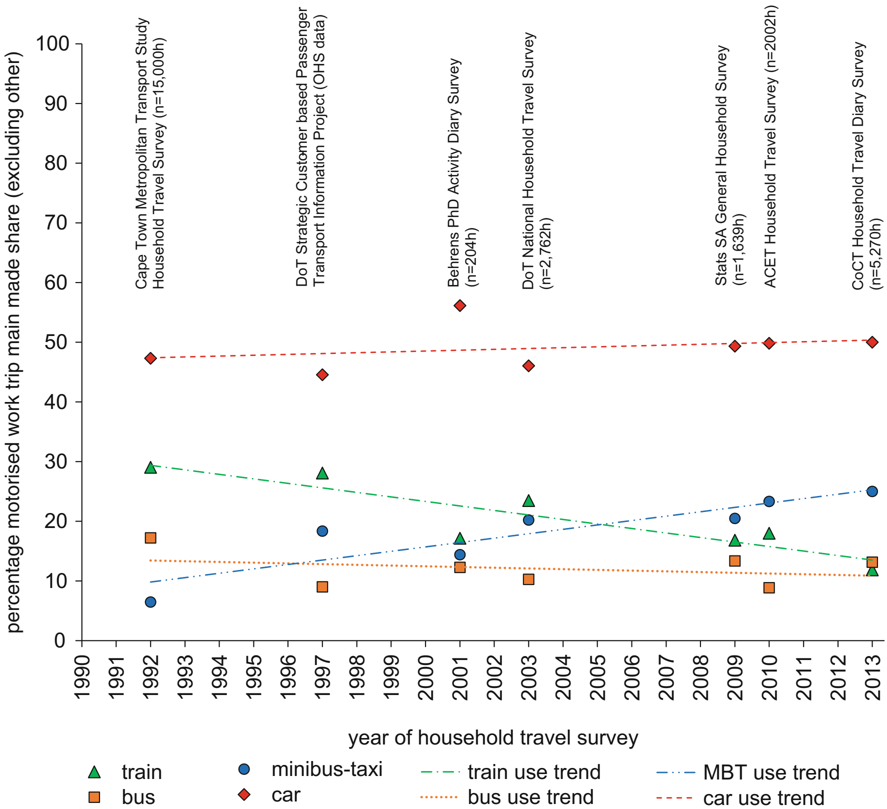

Fig. 11.7 Cape Town: modal split and change between 1990 and 2013. Source: Adjei et al. (2014)

Fig. 11.8 Poor and unsafe walking conditions. Photos by David Dewar and Fabio Todeschini

Somewhat surprisingly, the use of two- and three-wheeled modes of transport, such as the bicycle, the scooter, and the "tuk-tuk," which are so common in Asia, is very small, despite the fact that the southeast of Cape Town, where the majority of the urban poor live, is relatively flat. Some reasons for its lack of use include safety and the lack of investment in dedicated nonmotorized transport infrastructure: cycling and other forms of nonmotorized movement are unsafe. There are a number of NGOs actively promoting the use of bicycles but the impact of these has been very small to date. Motorcycles and scooters are used but mainly by up-market users and as delivery vehicles for businesses delivering small parcels (e.g., pharmacists).

3.2 Cars and Taxis

As evident in Tables 11.1 and 11.2 and Fig. 11.7, car use remains very high in Cape Town, as in all South African cities. This is a consequence of the large daily commuting distances (because of extensive sprawl) and the inefficient nature of the public transport system (also, in part, a consequence of sprawl and of the fragmented urban form).

Numerous private taxi companies exist in all South African cities and provide short-haul services, including Uber. They do not, however, form an important part of the transportation system.

3.3 Overground Intracity Rail

Cape Town has one of the longest above-ground city rail networks in the world. In the mid-nineteenth century, rail systems in the Cape were private: they were owned and used by private property development syndicates to open up land for speculative development. Later, the rail system became a central government function and service.

Under the apartheid regime, the highly subsidized rail urban transport system was heavily utilized. Indeed, the implementation of the apartheid system (via the Group Areas Act) would have been almost impossible without it. However, the total share of overall movement by rail has significantly reduced over the last two decades. There are a number of reasons for this. One is that trains were targeted for violent attacks in the 1990s, as part of the United Democratic Front's campaigns to make the city ungovernable. The pattern of crime and vandalism (in particular, the theft of copper cables from the network) has continued ever since 1994. A second reason is that the metropolitan rail network configuration, which takes the form of an incomplete figure 8, often necessitates mode changes and is inconvenient for travelers (Fig. 11.9). A third is that central government, which is responsible for the maintenance and management of the rail system, has increasingly distanced itself from its responsibilities.

3.4 Buses

In Cape Town, as in other major South African cities, there has long been a private citywide bus system which emerged from the nineteenth century tram companies. Although privately owned since the 1950s, the system was appropriated into the

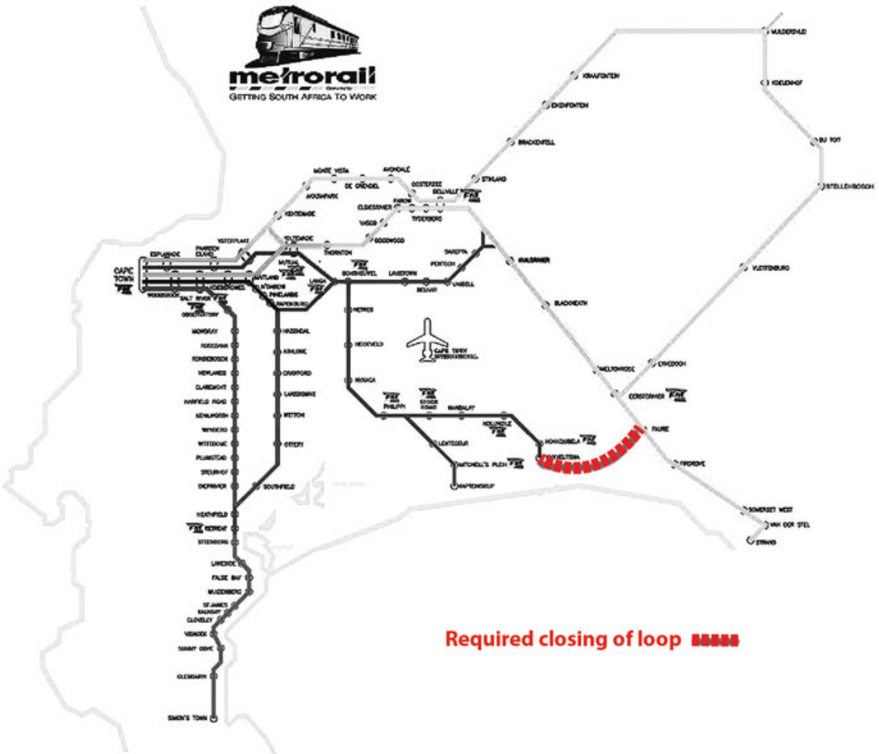

Fig. 11.9 Missing rail link (based on Metrorail Map)

implementation of the system of apartheid. The service was split on racial grounds. City Tramways was the parent company while a subsidiary, Golden Arrow, served nonwhite areas. Significantly, the emphasis in bus routing was on long-distance commuting—often in direct competition with train services. The entire service was underpinned by large government subsidies: it would not have been viable without them.

In the 1970s there were experiments with exclusive bus lanes on some of the limited access highways in Cape Town. From 2000, such lanes for both buses and minibus-taxis have become a more common feature between outlying working class residential areas and the central city.

3.5 Minibus-Taxis

In the late 1980s, a new coalition of organizations against apartheid, the United Democratic Front, was formed. The executive had strong connections to the African National Congress. A central slogan of this organization was to make

South African cities ungovernable. A municipal rates boycott began, alternative informal government organizations were forged, and the key instruments of apartheid were targeted for civil violence. Both the train and the bus system were targeted and services were badly disrupted. To fill the void, a new industry arose: the minibus-taxi industry. Private minibuses (vans), theoretically carrying 8–12 passengers but often actually moving a far greater number of people, formed themselves into organizations to negotiate routes for members. There are no timetables: minibus-taxis wait until they are full before moving. While this system filled a public transportation void, violent conflicts over routes arose from time to time.

After 1994, when violence against bus and train services theoretically ended, the minibus-taxi industry continued to thrive, often in direct competition with train and bus services. Conflicts over routes have not gone away, and acts of aggression, violence, and willful damage to property still occur. This mode of transport is a dominant public transport mode in all major South African cities (Tables 11.1 and 11.2). Moreover, the minibus-taxi share has rapidly increased over the past two decades in Cape Town (Fig. 11.7).

3.6 Bus Rapid Transit (BRT) Systems

Starting in Johannesburg as recently as 2009, and followed by Cape Town in 2011, the rollout of Bus Rapid Transit (BRT) systems is progressing steadily across South African cities. The system takes the form of buses running on dedicated lanes, in some cases running on both sides of a median. Infrastructure includes waiting areas and low barrier walls to prevent pedestrians crossing these routes for considerable distances around stops.

In Cape Town the first phase of the system comprised a 16 km route intended to serve some 30,000 passengers every weekday on 267 buses, with stations at 800 m spacing. A second phase was initiated in 2013. The system is the second largest investment ever in urban infrastructure in Cape Town (exceeded only by the 2010 FIFA World Cup).

In part, the system is a response to the rapidly growing minibus-taxi industry, which is regarded as anarchic by the public authorities. The intention is to absorb as many of those involved in the taxi industry as possible into the BRT, as drivers, mechanics, and so forth. However, the new system cannot absorb all operators and employees and, as a consequence, the rollout has been met with considerable resistance from the taxi industry. This has led to a situation where the first routes were introduced in areas of least resistance in terms of the taxi system (i.e., the wealthier areas), rather than those where the potential demand is greatest. This has increased the politicization of transport policy.

The performance of the BRT system to date has not been positive according to some criteria. From an urban perspective, the infrastructure associated with the system has created a new set of barriers, thereby significantly worsening the accessibility and permeability for pedestrians. Financially, the system in Cape Town is subsidized (mainly by the central government) to the level of 75 % and even higher in the case of Johannesburg–Tshwane. The National Treasury is now arguing that the cities themselves will have to bear the costs to a much greater degree (Department of National Treasury, 2015). At the heart of the matter is the fact that transportation planners have not recognized or dealt with the essential difference between South African and Latin American cities (where BRT began)—that of densities. In essence, a technological solution has been implemented in a context where the preconditions are not yet in place to make it successful. The problem lies with the structure, form, and density of the city, rather than the technology.

3.7 The Gau-Train

A unique initiative in Gauteng Province, centered on Johannesburg–Pretoria (Tshwane), has been the introduction of a high-speed overground rail system known as the Gau-Train. Funded by the Provincial Government of Gauteng, with some assistance from the Central Government, only three lines are operational: from Sandton to the Oliver Tambo International Airport, from the airport to Pretoria, and from Pretoria to Sandton. The intention is that the system will be self-funding in the longer term. It is currently too early to evaluate the scheme but performance reports to date are encouraging, particularly in terms of user satisfaction and growing passenger numbers.

4 Urban Transport Problems

4.1 Heavily Car-Based Movement System

Despite the increasing rhetoric about the importance of public transport, the patterns of transport-based public expenditure illustrate that decision-makers are committed to expanding and maintaining the road networks and vehicular movement. In part, this is a direct consequence of an urban structure that underpins a vicious cycle of increasing lateral spread pressurizing households to purchase a car, even though they cannot really afford one.

The cars owned by poorer households travel further and are of lower quality. Breakdowns are frequent and energy consumption is high. The problems which result include increasing traffic jams, a growing loss of productive time, an increasing incidence of traffic accidents and fatalities, increasing air pollution and respiratory-based illnesses, increasing greenhouse gas emissions, with negative consequences for global warming and climate change, and an increasing proportion of household budgets spent on transport.

4.2 Overemphasis on Limited Access Routes

With an increasing culture of car use, there is ever greater strain on road infrastructure. Transportation planners in South Africa have been, and are, heavily influenced by the North American model (the American Highway Code remains their standard source). Many transportation planners working in South Africa have been trained in the USA since the 1960s and their central concern remains mobility, as opposed to accessibility. The perception that problems of access can be solved by increasing mobility remains widespread among transport planners in South Africa.

In 1941, the state agreed to fund national intercity routes, including sections that were within cities. This practice soon spread to provincial governments, which built and maintained provincial routes. Understandably, municipal governments were taken by the idea of other spheres of government funding routes that would otherwise need to be financed with local funds and they eagerly sought to maximize this form of additional funding for urban infrastructure. However, a condition of this funding was that usage of the routes should be restricted to faster modes, thereby favoring car mobility.

From an urban structural perspective, these national and provincial routes through the urban fabric are not unlike building walls across the city (similar to building an overground railway line through the city). Effectively, in combination, these transportation networks divide the city into a series of isolated "boxes." In Cape Town, similar to other South African cities, the average box size is in the order of 2×2 km.[1]

4.3 Ongoing Reinforcement of Skewed Patterns of Demand

A feature of Cape Town's movement network, along with other port cities in South Africa, is that the primary pattern of movement is radial or fan shaped, focusing on the initial port-based city center or CBD. As the city has grown, the CBD has become increasingly eccentric in relation to the total urban area. The consequence has been a cycle of increased congestion, substantial investment in road infrastructure to increase capacity, further clogging and further investment. Currently, conditions of gridlock for traffic trying to access or egress the city center are increasingly common, with significant implications for loss of productivity. Additionally, there are no direct links, public or private, between the south and north of the city. In essence, the problem is structural. As a city with a radial pattern of movement grows, a point is reached where it is necessary to create a grid-like structure to encourage a more polycentric pattern of activities. However, this has not occurred in Cape Town. The issue also reflects an even deeper problem. The South African

[1] By way of comparison, in Shanghai, China, there is approximately 12×7 km between parallel limited access roadways.

transport planning system is strongly demand based and rooted in distorted patterns of development that occurred in the past, such as those introduced under apartheid. The current approach only reinforces some of these distortions. The central issue of how to utilize movement structure to address past structural inequities is almost never raised in policy discourses.

4.4 Lack of Integration of Public Transport Modes

A long-term problem facing the city has been an almost total lack of integration between different modes of public transportation. Historically, the train and bus have competed with each other to meet the needs of the same long-haul commuters. With the expansion of the minibus-taxi industry in the 1980s and 1990s, taxis competed with the other two. Then, the taxi owners organized themselves into different umbrella bodies, in part to allocate routes. Frequently, these organizations have been in conflict with each other. To worsen the situation, the new BRT system, currently being rolled out, is competing for precisely the same routes as the train and bus systems. The potential role of the rail system, which should represent a great asset, is largely being ignored. Rather than being used in the first instance to fill gaps in the rail service and to complement the mobility system, the BRT system has almost totally ignored the rail network and is establishing routes to compete with the rail system. An integrated transport system requires an interdependent system in which each mode of transport plays the role it is best suited to do. This is far from the case in Cape Town. At the heart of the current malfunctioning public transport network is a fragmented decision-making system (see later).

5 Urban Transport Governance, Decision-Making, and Financing

5.1 Transport Within the Broader Decision-Making System

A feature of the local government decision-making system in Cape Town, and in other South African cities, is that decisions are made within disciplinary “silos” (a system which in itself is a response to the rational comprehensive planning system promoted under modernism). Different departments (frequently staffed by different disciplines or professions) make decisions about different elements of the city, frequently without interdepartmental dialog. As a result, budgets have been determined departmentally, often based on historical allocations. One consequence is that local, provincial, and national government budgets have become a “turf struggle” between different departments seeking to increase their share of the budget. In this struggle, transportation planning, which is promoted as a quasi “scientific” discipline, but which is concerned with one element of public structure only, has emerged on top and has certainly outgunned planning departments which are ostensibly concerned with the performance of the urban whole. Consequently, over the past five decades, major transportation decisions have been made in relative isolation from urban structural issues. The issue of using transportation to fundamentally address structural inequities has never been seriously tackled.

The problem of institutional fragmentation has been recognized nationally. Recent national legislation—the Spatial Planning and Land Use Management Act (Act 16 of 2013)—calls for local authorities to produce Integrated Development Plans, supported by a budget to be reviewed every 5 years. It is a requirement that spatial development frameworks are formulated to give direction to these budgets. These are required to consider all elements of public structure (green space, movement of all modes, public institutions, urban or "hard" public space, utility services, and emergency services) in association with each other. It is a far-sighted piece of legislation but to date it has had little impact: in general, the "business as usual" approach remains.

5.2 National Legislation with Unintended Consequences

There are two national decisions that historically have had negative consequences within South African cities. Both occurred in the early 1940s.

The first was the introduction of the concept of National Roads: high-speed freeways connecting major cities. These had two types of negative impacts. One was that the limited access nature of these routes was retained, even when they entered the urban fabric. In effect they fragment the cities. The other is that the move introduced a new precedent, in which higher order tiers (now spheres) of government funded specific routes, but with conditions (e.g., restricted to faster modes of transport). This practice soon spread to provincial routes, with highly negative consequences in terms of urban fragmentation.

At a national level, the issue of funding national routes has gone full circle. The central government is now attempting to introduce a tolling system on those parts of national routes that fall within cities. The measure has been opposed in the courts by both the City of Cape Town and the City of Johannesburg. In Johannesburg, the system has been imposed but is meeting considerable consumer resistance. In 2015, the High Court ruled in favor of the city of Cape Town, but the issue is far from closed.

The second measure was the Advertising on Roads and Ribbon Development Act (Act 21 of 1940) that fundamentally misinterpreted legislation from the United Kingdom, from where it was derived. The UK legislation was aimed at interurban routes and was concerned with uncontrolled sprawl (and related billboards and so on). In South Africa, the same logic was simplistically applied to intraurban routes. In effect, from then on, the emergence of activity "high streets" was expressly discouraged and a restriction was imposed on the distribution of commercial and other higher order activities. As a consequence, the car-based nodal system was skewed toward higher income (white) areas.

5.3 Fragmented Decision-Making Within the Transport Sector

A key factor underpinning the lack of modal integration is the lack of a coordinated, integrated decision-making structure in relation to transportation.

In the early 1990s, Greater Cape Town was made up of 53 municipalities. Most of these had transportation departments. There was a metropolitan transport unit but this was attached to the weakest of the organizations—the one charged with overseeing rural areas—and therefore had little power. This pattern was common in all the major metropolitan areas of the country.

Subsequent to 1994, a single metropolitan authority was created in Cape Town, with 7 subcouncils. Although this strengthened the hand of the metropolitan transport authority, each of the ward-based subcouncils retained their own departments of transport, which kept responsibilities for road-based transportation within their area of jurisdiction. Similarly, the metropolitan authority has no control over rail travel (although there is currently talk of transferring metropolitan rail travel from central to metropolitan government). Furthermore, the metropolitan authority has no control over bus transport routes (which are the responsibility of a private company) or over minibus-taxi route alignments.

6 Proposed Urban Transport Solutions and Implementation Issues

There are many areas of potential improvement in transportation. These include the introduction of electrically powered vehicles, extended nonmotorized transport networks, and the use of apps to promote vehicle sharing. Two points are made about opportunities for improvements. The first is that there is little innovation occurring in the field of transport in either central or local government circles. The second is that transport cannot be perceived in isolation, as an end in itself. By far the most pressing issue is putting in place the preconditions for viable and integrated public transportation systems to come about. Two measures outweigh all others: promoting transportation-based land-use intensification and achieving an integrated transport authority. These are discussed in turn as follows.

6.1 Promoting Corridor and Nodal Transit-Oriented Development (TOD)

It has been argued that many of the urban problems of South Africa are generic, resulting from the spatial patterns of low density sprawl, fragmentation, and separation which make viable public transportation unachievable and which deny large numbers of the urban population access to urban opportunities. A primary precondition for improved urban performance in Cape Town, as in other South African cities, is to increase net densities significantly and to restructure the city to make it more intensive and mixed use, to promote efficient and viable public transportation and to decentralize social and economic activities. Clearly, intensification cannot occur everywhere. It must be structurally driven. There are two nonmutually exclusive ways of making cities more efficient: taking people to opportunities or the inverse—taking opportunities to people. This suggests the use of three urban instruments.

The first is making urban corridors the center of attention in urban planning. Corridor planning is an approach that seeks to promote urban intensity, to encourage the use of nonmotorized and public transportation, to stimulate a mix of activities, to promote small business, to pursue urban integration vigorously, and to improve equity and convenience. The concept of an urban corridor is not new. Corridor formation—the tendency for more intensive activities (those activities which require public support) to agglomerate in liner formations, in association with more continuous transport routes—can be observed in most parts of the world, particularly where there has been freedom for activities to respond directly to patterns of access. However, in many parts of the world, including South Africa, it has been discouraged in the past.

A concern with the promotion of corridors is not, in the first instance, a transport-driven idea, although the promotion of public transport is an important part of any corridor project. The term "corridor" as used here is an urban term. It refers to a broad (commonly at least two km wide) band of increasingly mixed-use activity, continually intensifying along one route, or more commonly, an hierarchically interlocked system of transportation routes or spines of different degrees of continuity.

The idea of linear corridor development does not exclude nodal or more point-related urban development. More intensive activities almost never occur equally along the spine of the corridor. They tend to agglomerate or cluster according to the relative accessibility of points along it (e.g., at cross-over points). The common pattern, therefore, is one of "beads on a string," with different clusters tending to grow toward each other over time. A major advantage of making corridors the focus of urban planning attention is that corridor initiatives commonly involve a wide range of different types of projects (housing, retail, commercial, cycling, recreation, and so on). Corridor planning is therefore a useful tool to coordinate the budgets of different sectors and departments and different spheres of government.

The importance of this way of thinking is being recognized in transportation circles in Cape Town (Fig. 11.10). A far-sighted transportation plan (the 2013–2018 Integrated Transport Plan for Cape Town, 2013) calls for the intensification of the urban fabric around interlocking corridors. It is one of the few transport plans that have raised issues of urban structure and form but, to date, it has had limited impact (Fig. 11.11).

The second planning instrument is nodal TOD. At the neighborhood level, TOD is centered on a rail and bus transit station and extends to a walking distance of 400–800 m. The urban fabric is developed at relatively high densities but remains

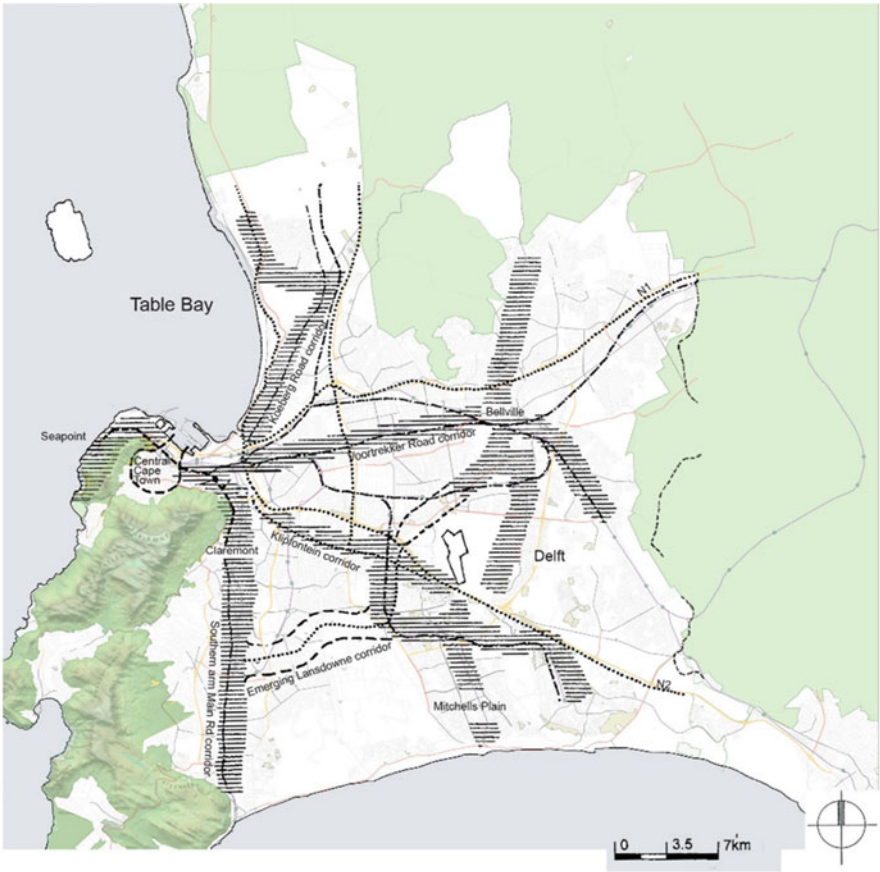

Fig. 11.10 Incipient and emerging urban corridors in Cape Town. Source: Dewar et al. (2004)

humanly scaled (primarily in walk-up forms) and includes a significant provision of public and civic spaces, mixed-use residential, commercial, and retail activities, particularly in the immediate station precinct. A street layout which is based on a "topologically based grid system" provides for extensive pedestrian and cycling movement, combined with traffic calming measures. TOD increases the viability of public transportation by increasing thresholds close to the transit links. It also promotes convenience (through mixed use and clustering) and can result in healthier settlements (e.g., through an increased propensity to walk and cycle) (Wilkinson 2006).

To date, TOD planning has largely been developed in terms of "smart growth" in the North American context. Very little attention has been given to the application of TOD in the third world. However, it clearly holds considerable potential for restructuring in Cape Town and other South African cities (Wilkinson 2006).

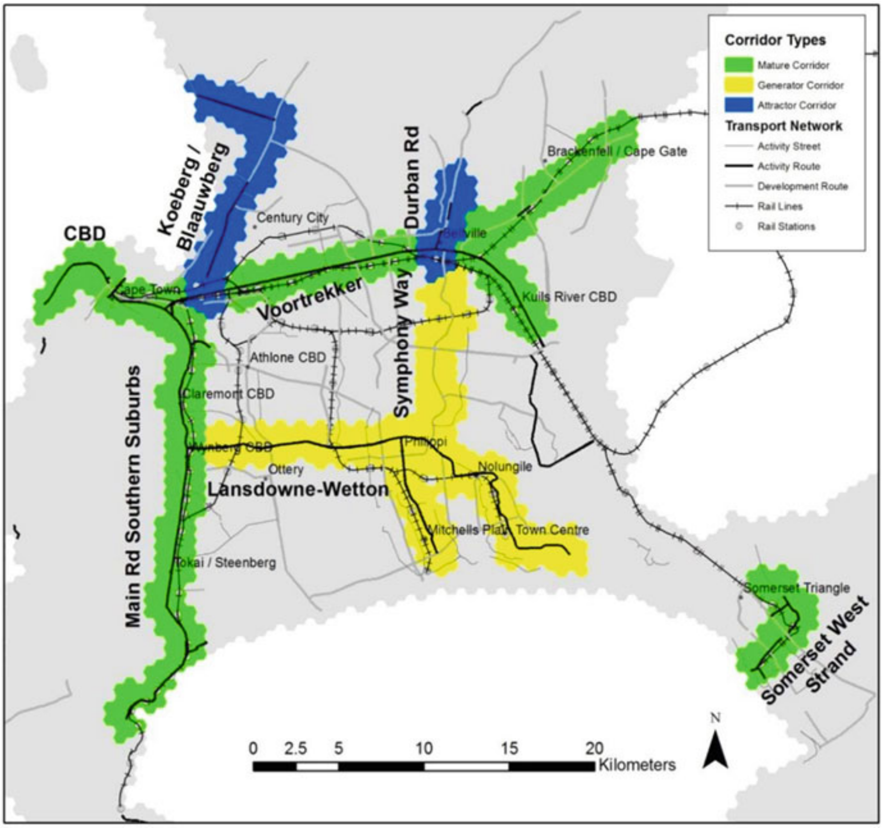

Fig. 11.11 Types of corridors proposed for Cape Town. Source: City of Cape Town and TCT (2013)

The third planning instrument involves taking people to opportunities: the promotion of high density housing infill projects on relatively small parcels of land around existing clusters of urban opportunities, such as inner-city areas. There is a considerable amount of vacant or underutilized land in all South African cities, including Cape Town, for projects of this kind.

6.2 Achieving an Integrated Transportation Authority

A second critical action to achieve a significant improvement in the transport systems of South African cities is to ensure that each city has an Integrated Transport Authority which has control over all modes of movement (particularly public transport modes) and which works closely, in an interdisciplinary way, with spatial planning around an agreed objective of promoting a much more convenient, just, sustainable and efficient city. At present, decision-making authorities are fatally fragmented and flawed.

Talks about this issue have been held from time to time in Cape Town among the different agencies involved in transport. The formation of Transport for Cape Town has resulted in the 2013–2018 Integrated Transport Plan (see above). Given the complexity of the problem, the number of actors involved (central and provincial governments; the private sector) and the considerable amount of turf protection, it is highly unlikely that integration will result from bottom-up negotiations. National legislation may be required to achieve results on the ground.

7 Conclusion

South African cities are not alone among emerging economies to be characterized by urban sprawl, fragmentation, and separation. Nor are they alone in having transport authorities that do not have the coordinating powers or the financial resources to create integrated movement systems. What is unique to South Africa is the scale of the problem and the lack of progress toward improvement.

It is now 20 years since the achievement of democracy and majority rule but South African cities remain just as inequitable, unjust, inefficient, and nonsustainable as ever. As levels of poverty and inequality increase with economic globalization and increasing structural unemployment, the cost imposed by the structure and form of the cities is biting deeply into household budgets and life opportunities.

Problems of urban structure, form, and the movement network are inextricably interrelated. One cannot be improved without the other. Despite this, the disciplines of spatial planning and transportation planning continue to be pursued in virtual isolation from each other. Until this changes, it is almost impossible to see how the radical improvements in urban performance that are required in South Africa will be achieved in the near future.

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Chapter 12
Turkey

Ela Babalık-Sutcliffe

Capital city	Land area	Total population	Urban population	GDP per capita	Passenger cars
Ankara	780,580 sq. km	75 million	73% (55 million)	$10,946	110 / 1,000 people

Data source: World Bank
Maps source: d-maps.com

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1 Introduction

Turkey has witnessed rapid urbanization over the past 30 years. Today, more than 77 % of the population lives in urban areas, compared to just 38 % in 1970 (TURKSTAT 2015). Urbanization was mostly fueled by rural-urban migration, which in turn was due to diminishing government investment and support for agriculture and an expectation that urban centers would provide better job opportunities. The population growth in certain urban areas has led to the formation of many so-called “metropolitan cities” which have a population in excess of 750,000 and are governed by a “greater city municipality.” Currently, 30 urban agglomerations are defined as metropolitan cities. Of these, Istanbul has a population of 14 million; Ankara five million; Izmir four million; Bursa almost three million; Antalya, Adana, and Konya just above two million; the remaining metropolitan cities range from 750,000 to 2 million.

Urban transport demand and related infrastructure and traffic problems are significant in cities with such large populations. Istanbul, for example, which has both a large population and a high rate of population growth (2.2 % annually compared to the national average of 1.4 %), features megacity characteristics: very high-density development in certain areas and large travel distances. These features reinforce automobile dependency and cause severe traffic congestion in Istanbul. Inadequate transport infrastructure, traffic congestion, and low accessibility are major urban problems in all metropolitan cities, regardless of size.

The growth in urban mobility is driven by a combination of factors, including income growth, increase in female labor-force participation, and spatial growth of urban areas. The growth in household income levels has been attributed to multiple factors, including higher government spending, internationalization of the Turkish economy, increase in qualified labor force, growing female participation in the labor force, ameliorated health services and education, and falling birth rates.[1] In parallel to income growth, private car ownership and usage is increasing rapidly producing traffic congestion and parking space shortages. These trends in mobility necessitate a major restructuring and modernization of public transport services as well as effective controls and restrictions of car use in certain urban areas.

2 Urban Land Use Patterns and Spatial Structure

Turkish cities have tended to grow in a compact manner. Development densities have been high while travel distances have been relatively low. A lack of private cars for the majority of people in the past, and the absence, or late arrival, of rapid transit modes have resulted in a reliance on walking and public buses, both of

[1] The annual average growth in per-capita GDP was 2.4 % in the 1970s; 2.3 % in the 1980s; 1.6 % in the 1990s; and 1.9 % in the 2000s (TURKSTAT 2015).

which are relatively slow modes, supporting compact urban form. This is still the case for most small- and medium-sized cities in the country. However, the picture has been changing in metropolitan cities, particularly since the 1990s. Here, a rapid population growth in the 1950s and 1960s, fueled by rural-urban migration, initially resulted in further densification. Informal housing sprang up to fill the void in affordable urban housing for poorer rural migrants. Population growth led to overcrowding, air pollution, and traffic congestion. In response, local authorities in metropolitan cities, including Ankara, Istanbul, and Izmir, started adopting spatial planning models—such as linear or radial urban expansion—to deconcentrate housing and workplace development. These models of planned deconcentration resulted in the creation of new urban corridors and subcenters. Plans often featured an urban rail component. A well-known example is the corridor plan of Ankara in the 1970s (Babalık-Sutcliffe 2013). However, growing car ownership and car use, particularly since the 1990s, resulted in unplanned sprawl in the urban fringes. This trend has been further reinforced by the development of out-of-town shopping centers since the 2000s.

While low-density sprawl has become common in urban peripheries, metropolitan cores have retained their high density. In fact, they are undergoing further densification through vigorous real estate development efforts. The public sector is currently implementing urban redevelopment projects of informal housing and earthquake-prone areas—referred to as "transformation" projects. The common argument is that redevelopment will provide legal, safer, and more convenient housing units for urban households. However, to help finance the projects, these new housing estates typically have a massive scale. The existing infrastructure (roads, parking, public transport, electricity, water, sewage, etc.) is often inadequate to accommodate the additional demand created by these projects. Plan amendments are other frequently used planning tools, which, in most cases, serve to change the existing zoning of an area, whether privately or publicly owned land (e.g., industrial sites and ports), in order to build housing estates, office complexes, shopping centers, private hospitals, etc. They result in significant increases in population and building density.

This urban development duality—urban sprawl at the periphery and urban densification at the core—results in longer travel distances for a portion of urban residents and the exacerbation of traffic congestion across the network.

3 Trends in Transport Use and Mobility

Overall, mobility and the amount of time spent travelling have increased over time in Turkish urban areas. In Istanbul, for example, the total trip rate increased from 1.44 trips per day per capita in 1987 to 1.54 in 1996, and 1.79 in 2006. The average travel times for motorized journeys increased from 41 min in 1996 to 49 min in 2006. The average trip length in 2006 was 7.2 km for all trips and 11.2 km for motorized trips, and changed little since the mid-1990s (Gerçek and Demir 2008).

Due to a compact and high-density development pattern, which is prevalent in most medium- and small-sized cities, walking is an important mode of urban transport in Turkey. Even in large metropolitan cities, such as Istanbul and Ankara, a high share of journeys are by foot. Walking represents 29 % of all trips in Ankara (2013 data) and 49 % of all trips in Istanbul (2006 data).

On the other hand, cycling as an urban transport mode is rare in Turkey. Only a few cities, such as Konya and Kayseri, which have a flat topography, have nurtured a tradition of cycling. However, even in these cities, urban expansion and rising income and car ownership levels have prompted a decline in the use of bicycles. Meanwhile, the growing popularity of bikeshare programs in Turkey may help reverse this trend, and may promote cycling in other cities too. Bikesharing is also helping eliminate the traditional gender bias in cycling. This has not necessarily been a countrywide issue but rather more evident in a few cities, such as Konya, where traditionally women did not cycle as much as men (Greater Konya Municipality 2001). Socioeconomic development and the presence of university campus sites in cities are also likely to help diminish gender bias in cycling.

Public transport is popular in Turkish cities and accounts for 60–80 % of all motorized trips (Fig. 12.1). Buses are the most common form of public transport (Table 12.1) although more and more metropolitan cities have been investing in urban rail systems (see later). Some metropolitan cities have also introduced privately operated buses since the 1980s, where the routes, schedules, fares, and vehicles are publicly regulated.

Paratransit (*dolmuş*)[2] in the form of minibuses is also widespread (Fig. 12.2). This type of public transport service, typically run by private individuals rather than companies, has been in existence since the 1940s in large cities. It started informally at a time when public transport services provided by municipalities were unable to meet the demand in the face of population growth. Over time, *dolmuş* services became more organized and subject to public regulation in terms of routes, schedules, fares, vehicles, and vehicle quotas per route (see later).

School and workplace buses are also highly significant in Turkish cities, accounting for a large share of commuter trips. Most schools, from elementary through to high school, make use of minibuses to collect students from their homes in the morning and drop them off again after school. Parents pay a fee for this door-to-door service. Similarly, large employers, such as universities, ministries, and some private companies, run bus or minibus services to certain districts for their employees, often free of charge.

Car ownership and use is relatively low in Turkish cities in comparison to Western European and North American cities. However, the rates of increase are significant. In 1990, there were only 25 cars per 1000 inhabitants in Turkey. By 2013, this figure increased almost five-fold to 121 cars per 1000. Car ownership levels in metropolitan

[2] Some cities use the term *dolmuş* to refer only to smaller, 8-passenger vehicles while the term minibus applies to other vehicles. In this chapter, the term *dolmuş* refers to all paratransit vehicles.

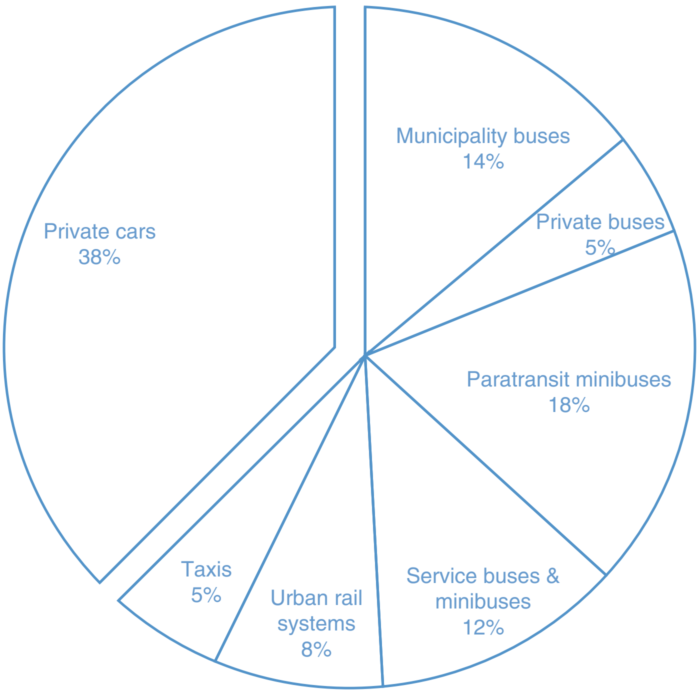

Fig. 12.1 Modal split of motorized journeys in Ankara (2015). *Source*: Greater Ankara Municipality (2015)

Table 12.1 Modal split of public transport (%) in Ankara and Istanbul

Public transport modes	Ankara (2015)	Istanbul (2014)
Municipal buses[a]	24	25
Private buses (individual operators)	9	14
Paratransit	31	21
School/employer buses/minibuses	22	23
Rail systems	14	16
Ferries	–	1

Sources: Greater Ankara Municipality (2015) and Istanbul Transit Authority IETT (2014)

[a]Including BRT (Metrobüs) in Istanbul. Metrobüs serves 7.76 % of trips

cities are much higher than the country average. In Ankara, private cars were used in only 18 % of all motorized trips in the mid-1990s. Today, this figure is 38 % (Greater Ankara Municipality 2015; Table 12.2). One of the most obvious drivers of car use is the growth in car ownership, which in turn has resulted from increased incomes. Other contributors to car dependency include sprawling land use patterns, as well as poor transportation planning and management (see later).

Fig. 12.2 *Dolmuş* vehicles in Ankara. Photo by author

Table 12.2 Car ownership and use in Ankara, Istanbul, and Izmir

	Ankara	Istanbul	Izmir
Car ownership (cars/1000 people) (2000)	166	98	101
Car ownership (cars/1000 people) (2007)	184	136	122
Car ownership (cars per 1000 population) (2014)	223	158	149
Modal share of private cars in motorized transport (2006/2007)	23 %	26 %	20 %
Modal share of private cars in motorized transport (2015)	38 %	n/a	n/a

Sources: Gerçek and Demir (2008), Greater Ankara Municipality (2007), Greater Izmir Municipality (2007), and TURKSTAT (2015)

4 Urban Transport Problems

4.1 Emissions, Energy Consumption, and Traffic Safety

Increases in mobility and car ownership and use have had dramatic impacts on air quality, greenhouse gas emissions, energy consumption, and traffic safety. Air pollution is becoming severe in most metropolitan cities, and is intensified due to their compact urban form. In Turkey, greenhouse gas emissions per capita stood at 3.4 tons (CO_2 equivalent) in 1990. By 2009, they had increased to 5.13 tons, which is much below the OECD average of 9.8 tons but above the world average (Ministry of Environment and Urbanism 2013).

In Ankara, urban traffic and the burning of coal for heating have exacerbated pollution while the corridor development plans implemented since the 1970s have helped alleviate this problem. With the advent of natural gas for heating, the air quality has improved; however, CO_2 emissions due to urban traffic remain high. Nationally, the transport sector as a whole is responsible for 17 % of all CO_2 emissions, 85 % of which come from the road sector (Ministry of Environment and Urbanism 2013). There are no national statistics for urban transport, but estimates suggest that in Istanbul CO_2 emissions from road transport increased by 37 % between 1990 and 2007—from 6.5 million to 8.9 million tons (Gerçek and Demir 2008).

In terms of energy, the transport sector is responsible for 17 % of the energy consumption in the country. This share appears low because the energy sector is dominated by manufacturing. However, it should be noted that transport consumed less than 10 % of the national energy in the early 1990s (Ministry of Environment and Urbanism 2013). While several interventions throughout the country have sought to eliminate old vehicles from the roads and to encourage the use of energy-efficient vehicles, the growth in mobility is offsetting the gains made through such interventions (Ministry of Environment and Urbanism 2011).

As for traffic safety, accident rates have been on a steady rise. In 1990, there were 31 accidents per 1000 vehicles but this figure increased to 60 in 2000 and 76 in 2012.

4.2 Nonmotorized Transport: Accessibility, Quality, Safety

A significant share of walking in urban trips offers great potential for the creation of a sustainable and pedestrian-oriented transport system. However, transport planning and management in urban areas is far from pedestrian-friendly. Cars parked on sidewalks, obstacles such as trees or road signs blocking already narrow pedestrian paths, and low-quality infrastructure and paving materials are common problems in Turkish cities, which detract from the pedestrian experience. Disabled access is often overlooked or inadequate (Figs. 12.3, 12.4, and 12.5).

In city centers, where pedestrian circulation is the highest, priority is often given to motorized vehicles. Sidewalks are narrowed in order to provide more capacity for vehicular traffic, making walking unsafe and inconvenient (Fig. 12.6). Ankara stands out as one of the most car-oriented cities. To facilitate vehicular flow, at-grade pedestrian crossings have been removed altogether in the center, forcing pedestrians to use subway tunnels or bridges, or move through traffic and risk being hit by moving cars (Fig. 12.7). There are however some exceptions. Some cities have recently created car-free zones and boulevards with large sidewalks although these pedestrian schemes typically cover only a very limited area and thus have little impact on overall pedestrian accessibility.

While cycling is uncommon, the few people who use bicycles in cities do so in a relatively unsafe urban environment due to a lack of cycle lanes and paths, or any provisions for cyclists to cross at intersections. There are also very few bicycle parking spaces available in Turkish cities.

Fig. 12.3 Cars parked on sidewalks in Ankara. Photo by author

Fig. 12.4 Parked cars blocking narrow roads in Ankara. Photo by author

4.3 Public Transport and Paratransit: Quality, Capacity, and Service Fragmentation

Most motorized trips in Turkish cities take place on public transport. The majority of riders are captive, having no access to private cars. With growing income levels, car ownership has grown too, leading to a decrease in public transport use. Investments in public transport are urgently needed in order to improve the travel experience of captive riders and re-attract car drivers.

Fig. 12.5 Pedestrian and disabled access hampered by plantings on narrow sidewalks in Ankara. Photo by author

Fig. 12.6 Sidewalks narrowed to accommodate a tunnel in Ankara. Photo by author

Fig. 12.7 Pedestrians ignore crossing bridges in the center of Ankara. Photo by author

Buses form the basis of public transport services in most cities. With the exception of the Bus Rapid Transit system in Istanbul, buses operate in city traffic which reduces the reliability of services and makes journey times very long in peak traffic. Poor travel conditions on overcrowded buses have sparked a debate on gender-segregated vehicles. While some female users favor the idea, there is strong opposition from feminist platforms.

Paratransit modes (*dolmuş*) present problems for transportation planners but also offer advantages to users. On the one hand, *dolmuş* contribute to traffic congestion due to their low carrying capacity. When local authorities invest in rapid transit systems along high-demand corridors, *dolmuş* often continue operating on such corridors, competing with rapid transit systems. Reorganizing their routes and operations is very difficult as this requires agreement of a myriad of vehicle owner-drivers. Fare and route integration are major challenges too as *dolmuş* conductors require payments in cash, and do not accept citywide public transport tickets or smartcards. Consequently, any new fare policies (e.g., transfers) or vehicle standards do not apply to *dolmuş*. One noteworthy example is the legal requirement for all public transport vehicles to provide disabled access. *Dolmuş* owners claimed that upgrading or remodeling their vehicles would impose excessive costs and, therefore, the law was amended to postpone its enforcement in the case of *dolmuş* vehicles, thus affecting accessibility levels for the whole transit system.

On the other hand, certain service characteristics of *dolmuş* are highly valued by users (Özbilen 2015). *Dolmuş* offer frequent service and stops, thus minimizing walking distances compared to bus and rail stations. While required to follow predetermined routes, they are also known to change their routes to avoid congested corridors, resulting in time savings for passengers (but undermining transit and traffic management). Smaller vehicles can maneuver more easily in congested conditions, and spend shorter times at stops as there are fewer passengers boarding or alighting. In addition, cash payments allow for easy fare adjustments based on distance. This is generally not the case for other public transport modes in most urban areas in Turkey. As a result of these factors, the modal share of *dolmuş* in public transport remains quite significant and is as high as 31 % in Ankara.

Similar to paratransit, transport services provided by employers and schools have both advantages and disadvantages. They improve work and education access for their users, and the cost savings are significant compared to private car use. However, they contribute to traffic congestion as they employ low-capacity vehicles and operate during peak hours.

Small vehicles cannot fully satisfy the high mobility demand of urban areas, especially in metropolitan cities. Clearly, high-capacity rapid transit systems (either bus- or rail-based) are needed to accommodate large numbers of passengers along main urban corridors. A number of cities have invested in such systems over the past three decades. The oldest system was built in Istanbul in the late 1980s, while most others came into service in the 2000s (Table 12.3). At present, the network coverage of both urban rail transit and Bus Rapid Transit (BRT) is still limited.

Table 12.3 Urban rail and BRT systems in Turkey

Urban rail and BRT systems	Opening year	Length (km)	Annual ridership (million)	Ridership/km (million)
Ankara M1 Metro	1997	14.7	53	4
Ankara M2 Metro	2014	16.6	9	.5
Ankara M3 Metro	2014	15.4	5	.3
Ankara Light Metro	1996	8.5	35	4
Istanbul Metrobüs (BRT)	2007	52	324	6
Istanbul M1 Light Metro	1989	26.1	112	4
Istanbul M2 Metro	2000	23.5	113	5
Istanbul M3 Metro	2013	15.9	10	.6
Istanbul M4 Metro	2012	21.7	70	3
Istanbul T1 Tram	1992	18.5	121	7
Istanbul T4 Tram	2007	15.3	37	2
Izmir Light Metro	2000	20	86	4
Izmir IZBAN Regional Rail	2010	80	61	.7
Bursa Light Rail Transit	2002	39	66	2
Antalya Tram	2010	11	14	1
Adana Tram	2009	13.5	n/a	n/a
Konya Tram	1992	22.5	25	1
Kayseri Tram	2009	17.4	35	2
Eskişehir Tram	2004	16	34	2
Samsun Tram	2010	16	18	1
Gaziantep Tram	2011	21	n/a	n/a

Sources: Municipalities' and operators' webpages
Notes: Most data is for 2014. Ankara's M2 and M3 lines opened in March 2014 and ridership data is available only for 9 months. Izmir ridership data is for 2013, and the annual ridership per km is calculated by using the 2013 system length. Ridership data for Antalya and Eskişehir are also for 2013

Fig. 12.8 The urban rail and BRT systems of Istanbul. *Source*: Maximilian Dörrbecker (Chumwa) (Creative Commons Attribution)

Istanbul's Metrobüs is the only BRT system in the country. Opened in 2007, and extended since to reach 52 km, it provides access to the Central Business District (CBD) and, most importantly, connects the two sides of the Bosphorus Strait, a major barrier for urban transport. The system is mostly segregated except for about 3 km on the Bosphorus Bridge. Design factors, such as off-board fare collection and high average distance between stations (more than 1 km which is much higher than most other international BRTs), ensure a high operating speed, up to 38 km/h (Babalik-Sutcliffe and Cengiz 2015). The headways between consecutive buses are as low as 14 s. On average, the travel time savings afforded by Metrobüs are 52 min/passenger/day (Alpkokin and Ergun 2012). As a result, Metrobüs has been attracting high numbers of passengers: its ridership levels are much higher than in most of the rail lines in Istanbul and many other BRT systems around the world (Babalik-Sutcliffe and Cengiz 2015).

Because of high ridership levels, Istanbul's BRT system was already operating at capacity just 4 years after opening. To some extent, this is due to a lack of a system-wide planning approach. Metrobüs was planned as a single line rather than a BRT network, and was poorly integrated with Istanbul's existing bus and rail systems (Babalik-Sutcliffe and Cengiz 2015). Its first section paralleled and competed with one of the metro lines (M1). By providing a much more direct access to the CBD (Fig. 12.8), it diverted passengers at the expense of the metro. On the positive side, Metrobüs proved much cheaper and faster to build than rail lines. The capital cost per route kilometer was $6 million as opposed to $10 million for Istanbul's T1 Tram, $34.5 million for M1 Light Metro, $95.1 million for M1 Metro, and $80 million for M4 Metro (2013 prices) (Babalik-Sutcliffe and Cengiz 2015).

Notwithstanding these advantages, most metropolitan cities in Turkey have opted for rail-based systems (Table 12.3), not all of which carry enough passengers to justify their high construction costs. In Ankara, for example, ridership on the new metro lines is extremely low (even after accounting for the limited 9-month data available). Ankara's older M1 metro line also carries much fewer passengers than other metro systems in Turkey. The low ridership level of the M3 metro line in Istanbul is also problematic. Similarly, the tram systems of Antalya, Konya, and Samsun carry substantially fewer passengers per route kilometer than tram systems elsewhere in the country. There are various factors at play, which contribute to low rail ridership, but the two major factors are inadequate route and fare integration, and a lack of a coherent public transport policy framework.

A major challenge facing the cities that invest in rapid transit systems is the integration of services. This has implications for reorganizing public bus transport systems to feed the rapid transit systems, as well as the routes of *dolmuş* services and privately operated buses. This is not an easy task, as private operators are keen to remain working on high-demand corridors in order to maximize profits. Fare integration is also a challenge in cities in which *dolmuş* services and privately operated buses operate, since they only accept cash payments and do not accept public transport tickets or cards.

The presence of *dolmuş* services and privately operated buses in such cities as Istanbul and Ankara has led to a fragmentation in transit delivery as coordination with these private operators is difficult. However, even in cases where services are planned and operated by the same transit agency, problems of integration exist. Both Istanbul and Ankara have urban rail lines without proper passenger transfer facilities, which require passengers to walk long and inconvenient distances, sometimes over busy roads, when transferring between lines. In some cases, these problems have been eliminated after a few years by constructing proper transfer stations.

In addition to problems of transit system integration, the lack of a coordinated transport policy approach is another reason for the poor performance of urban rail systems. There are few policies that encourage public transport and discourage the use of private cars. On the contrary, ongoing road investments often seek to create favorable conditions for car users.

4.4 Automobiles: Free Flow, Free Parking

While car use is still relatively low in Turkish cities it is increasing relatively quickly, and traffic congestion is already becoming severe in many cities. Owing to a lack of traffic regulation and management, particularly in relation to private transport, combined with the limitations of public transport, congestion is set to worsen as mobility and car ownership levels grow.

Currently, local authorities are reluctant to introduce physical measures or pricing mechanisms to restrict car use. Motorists can park cheaply in central locations, or park for free on public sidewalks. In many cities grade-separated junctions have been built—with tunnels and flyovers—in order to accommodate an uninterrupted flow of cars. Urban boulevards have been transformed into major arterials and motorways, many of which cut through city centers. In addition, bus stops are located in underground tunnels, forcing passengers through narrow, unsafe, and inconvenient paths. In short, the transport infrastructure provision reflects the car orientation of most municipalities, whereas pedestrians and public transport users are marginalized.

5 Urban Transport Governance, Decision-Making, and Financing

In Turkey, most responsibility for urban transport planning and management rests with local governments. By law all greater city municipalities (metropolitan city governments) are required to prepare a transport master plan. This is either prepared in-house with the assistance of universities, or the work is contracted out to consultants. Greater city municipalities are also in charge of public transport planning and provision, control of vehicles and fares of paratransit and privately provided public transport, traffic planning and management, and parking management. In smaller cities too, municipalities are responsible for transport planning, delivery of public transport services, and traffic management. Most municipalities have a specialized transport department. In metropolitan cities there is often a separate transit authority that plans and operates public transport services.

In the 1980s, new legislation allowed local authorities to establish quasi-governmental companies tasked with the delivery of certain services, including public transport. Hence many greater city municipalities, most notably those of Istanbul and Izmir, set up a number of companies, which operate their urban rail systems, ferries, and some bus services. This approach has increased the cost-efficiency and productivity in some cases but, at the same time, has resulted in a fragmented government structure and transit network as transit authorities no longer have overall control (Babalik-Sutcliffe 2015). Paratransit and privately operated buses contribute to the further system fragmentation. To tackle the coordination issue, Transport Coordination Centers have been created by law in metropolitan cities. However, these centers are unable to address several challenges presented by a fragmented government structure.

Public participation in transportation-related decision-making is limited. By law, the public, professional chambers, universities, and NGOs must be consulted during plan preparations. While such consultations do take place, practice has been subject to criticism on the grounds that it is limited to presenting information to public rather than facilitating active participation. Consequently, professional chambers often go to court to reverse certain plans and transport schemes, while public demonstrations have been organized to protest against certain projects. The violent Gezi Park protests in Istanbul are a notable recent example. Demonstrators were opposed to a government plan for the central area to move vehicular traffic and public transport stops underground, while pedestrianizing Taksim Square and building a commercial center in an adjacent park. Similarly, the construction of a third bridge over the

Bosphorus Strait, which will have a significant impact on Istanbul's forests and greenbelt, also met with resistance and public protests. In short, public involvement often takes the form of negative reactions after plans have been approved.

The national government is also involved in transportation decisions in certain cases, such as megaprojects. The third Bosphorus Bridge, for example, was introduced by the national government entirely bypassing municipal transport plans. Similarly, a road tunnel crossing under the Bosphorus Bridge and a highly controversial canal project to the west of the Bosphorus Bridge are projects initiated directly by the national government without being part of any urban or regional plan. Similarly, high-speed rail investments are planned and implemented by the Ministry of Transport, Maritime Affairs and Communications, which then requests the lines and their stations to be included in local transport plans. In some cases, this approach also results in disputes with local authorities.

In order to fund urban rail transit investments, local governments sometimes resort to international loans. The national government is typically involved in the loan agreements as it partakes in the loan consortium or acts as guarantor. Municipalities are expected to fund some transport projects through their own budgets, and they are also expected to cover the operating costs of the public transport services that they provide. However, local budgets are also partly funded through transfers from the national government. To date, no examples of Public–Private Partnerships (PPP) exist for urban rail construction (Alpkokin et al. 2015).

6 Proposed Urban Transport Solutions and Implementation Issues

Most local authorities are aware of the strategic importance of public transport in meeting the increasing travel demand. As a result, public transport investments have increased in many parts of the country. In both small- and medium-sized cities, schemes to integrate individual private operators into publicly run services are being introduced. Segregated bus lanes are being considered in a number of medium-sized cities although none have been implemented as of 2015. There is also growing interest in Intelligent Transport Systems, not only for the management of traffic, but also to assist in the provision of an effective transit service. Smartcard ticketing for public transport is spreading. Smartphone applications are used by passengers in a number of cities to plan public transport journeys and track public transport vehicles and taxis. Web-based car-sharing arrangements are available in many metropolitan cities although no data is available yet on their use and overall impact on transport and traffic.

Smartcards are helping to address transit fare integration. In Izmir, smartcards offer an unlimited number of free transfers on buses, light metro, regional rail, and ferries within 90 min. In Istanbul, smartcards provide discounts on five consecutive transfers within 120 min of the first boarding, and are valid on almost the entire public transport system including privately operated bus services. The municipality of Istanbul has ongoing projects to include *dolmuş* services into the smartcard fare integration.

Notwithstanding achievements in transit fare integration, overall coherent transport policies are often missing. While municipalities introduce schemes to improve public transport services, they simultaneously support road expansions, underpasses and flyovers in city centers, and underpriced car parking. These create extremely car-oriented urban environments that jeopardize the efficient operation of public transport.

Cities that plan on investing in urban rail systems are required to prepare a comprehensive transport master plan as a basis for the rail system. Almost always, these plans include traffic restraint measures, schemes to improve and integrate public transport systems, and the development of cycling networks and pedestrian areas. In practice, only the rail component of the plan is built. Fearing a reaction from the electorate, municipalities are very reluctant to implement any car restraint measures. Instead, they implement road programs to ease vehicular traffic through city centers; such schemes are in clear contradiction with urban rail investments.

The quality of the road infrastructure is often substandard in terms of paving, drainage, safety signage, and pedestrian crossings. Road programs do not target these issues but rather focus on easing vehicular traffic flows in the hope that this will relieve congestion. In practice, most road expansions, tunnels, and flyovers have been ineffective in alleviating congestion. Ankara has invested in more than 100 grade-separated junctions over the past 20 years, in parallel with the construction of the first metro and light metro lines. These schemes have had a clear effect of encouraging car use in the face of ongoing rail investments. At the same time, they have provided no lasting relief for congestion. The initial impression of congestion relief as a result of increased road capacity has encouraged drivers to divert trips to newly built grade-separated junctions, translating into more traffic (Fig. 12.9). Ankara's transport plan of 1993, which is the basis for the current urban rail system, proposed the conversion of a long stretch of the main boulevard into a pedestrian area, and discussed the option of congestion charging. Nevertheless, neither idea came to fruition.

Until recently, projects to promote cycling have been limited to just a few cities, such as Konya and Kayseri, both of which have a tradition of cycling. Recently, bikesharing schemes have been introduced in other cities including Antalya, Eskişehir, Istanbul, Izmir, Kocaeli, Konya, Muğla, Samsun, and Yalova. Among these, the Kayseri scheme is noteworthy because the bicycle stations are well integrated with the tram system. In many of the other cases, bikesharing is not organized around the public transport system. Sometimes it is conceived solely as a form of recreation rather than as an urban transport mode. Once again, this highlights a lack of coherent citywide vision, in which cycling complements other modes.

An incoherent vision and a preference for road investments are partly due to a lack of education and awareness among decision-makers on the paradigm shift that is taking place in urban transport planning in some parts of the world. Supply-side policies, such as road-widening and construction of overpasses and tunnels, are still considered to be the solution to urban transport problems in many Turkish cities.

The city of Izmir (the third most populous in Turkey, after Istanbul and Ankara) is an exception, and a showcase example of how a clearly defined planning framework can lead to transport sustainability. One year prior to the opening of the first metro line,

Fig. 12.9 Traffic congestion in newly built grade-separated junctions in Ankara. Photo by author

the greater city municipality launched a project entitled "Transformation in Transportation," with the purpose of reorganizing bus routes to serve metro stations and ferry piers; improving the ferry capacity and service quality; introducing park-and-ride facilities; and setting up one of the first integrated smartcard systems in the country. The metro opened in 2000 within a transit environment that was already integrated in terms of routes and fares. In 2010 the existing commuter service was upgraded into a modern regional rail system by replacing tracks, introducing new rolling stock, and significantly increasing service frequency. The regional rail system was also integrated with existing bus, ferry, and metro lines. *Dolmuş* lines were rerouted to serve only the urban periphery as early as 1992. As in Istanbul, there are plans to include *dolmuş* in the fare integration scheme. A bikesharing project has also been recently introduced. In addition, the city plans to extend the currently limited network of bicycle lanes, and to provide bicycle parking facilities in all metro stations. Recently, cyclists have been allowed to carry their bicycles on the metro at off-peak times, a policy which is unique in the country. However, Izmir's case is by no means perfect: no car restriction schemes are in place, a number of controversial road expansion schemes are on the agenda, although not as extensive as in Ankara.

7 A Need for Countrywide Urban Transport Guidance and Legislation

There is no law on urban transport in Turkey. The Law on Municipalities assigns local government with the responsibility to manage and invest in the urban transport network, draft transport plans, and operate public transport. A bylaw on energy efficiency provides for energy savings in transport, the employment of alternative fuel technologies in public transport vehicles, the adoption of schemes that favor rail options in public transport (which, however, may be controversial in low-demand corridors), and travel demand management (although no guidance is given on how to do this). This bylaw has been criticized for making no specific mention of pedestrian transport. There is no additional legislation to guide local governments on other urban transport issues including public transport planning, travel demand management, and parking controls. Furthermore, no traffic impact assessments are required for proposed large-scale developments, such as shopping centers, housing estates, and office buildings.

Over recent years, a variety of policy documents have been prepared at the national government level, which consider urban transport and traffic issues. In 2005, the Ministry of Transport (now Ministry of Transport, Maritime Affairs and Communications) prepared a transport strategy for the entire country. In the urban transport section, it criticized local authorities for adopting short-term and ineffective solutions that create car dependency, and called for sustainable, people-centric urban transport policies. In 2009, this Ministry held a major transport congress and, in the year prior to the congress, numerous committees worked on preparing a declaration, which outlined policies for sustainable, accessible, affordable, and energy-efficient urban transport systems. In 2010, the Integrated Urban Development Strategy and Action Plan (*KENTGES*)—a countrywide document—was adopted, which defined numerous actions in support of sustainable urban transport. In 2011, Turkey's Climate Change Action Plan was prepared and approved. Transport was one of the many sectors that the plan addressed. Various actions to mitigate climate change were recommended, such as encouraging the use of public transport and nonmotorized modes and discouraging the use of the private car through travel demand management. In 2013, the Ministry of Transport, Maritime Affairs and Communications prepared the Intelligent Transport Systems Strategy Document and Action Plan, which again contained policies and actions aimed at improving public transport and managing car parking in city centers. In addition to these documents, national development plans are produced on a regular basis, which set forth policies for interurban and urban transport amongst other sectors of the economy. For more than two decades, these development plans have advocated public transport improvements, safe and accessible pedestrian and cycling conditions, and measures to restrain car traffic and parking. These documents indicate that the national government discourse is turning in favor of urban transport sustainability. However, very little knowledge has filtered down to the local level. The documents mentioned above contain policy recommendations which rarely become operational since they are not binding for local governments. In fact, it is unclear whether decision-makers in municipalities are always aware of the existence and/or content of these documents, as they are rarely circulated to the local level.

This information bottleneck between the national and local governments is partly due to the absence of a national body with a clear responsibility for urban transport. The Ministry of Transport, Maritime Affairs and Communications has departments for road, rail, air, and maritime transport, but not for urban transport. The Ministry of Environment and Urbanism, given its focus on urban affairs, is involved in the preparation of urban planning laws, but these do not extend to urban transport planning.

Local government operations are overseen by yet another national government body, the Ministry of Interior Affairs, but its reach is strictly limited to financial auditing.

In sum, there is a lack of nationwide laws and guidance on urban transport, and a national-level body in charge of coordinating urban transport issues. Moreover, a top-down approach alone will fall short of bringing about change. It is important that public members participate in decision-making, voicing their demands for safe, accessible, and high-quality transport. At the same time, the general public is not always well informed about transport and sustainability issues. Awareness raising campaigns in urban transport are paramount if the public at large is to comprehend the causes underlying contemporary transport problems and come to own potential solutions to those problems, which tackle root causes.

8 Conclusion

Public transport and walking still serve a significant portion of trips in Turkish cities. These modes offer significant potential in terms of transport sustainability. Nevertheless, car ownership and use are on the increase, transit systems are often fragmented, and the built environment is suffering the consequences of car domination, whether moving or parked. There are some good-practice examples of public transport investments, fare integration, and to a much lesser extent, nonmotorized transport planning (i.e., bike-sharing) but, in many cities, these are accompanied by extensive investments in favor of car-based transport. In view of high transit and nonmotorized transport use, many opportunities exist to create or improve transit-oriented and pedestrian-friendly urban environments, which have so far been missed.

Continuous, safe sidewalks for pedestrians are needed. So too are pedestrian zones that are free from parked cars and other barriers, safe bicycle lanes and paths, and segregated infrastructure for transit vehicles. Transit investments do not have to necessarily target rail-based systems, as the trend has been so far. The Istanbul BRT system clearly demonstrates the potential of bus-based schemes. In addition to full BRT systems, simple bus-only lanes can also be considered in smaller cities.

The advantages of paratransit to users indicate that this mode has a role to play in public transport. Due to its flexibility and coverage, it may become an effective solution for the "last-mile" needs of transit users. However routes and fare collection systems need to be radically reorganized and integrated with the rest of the network. Without such reorganization, paratransit will remain an obstacle in the formulation and successful implementation of citywide transport policies.

Car traffic and travel demand management are other priority areas for Turkish cities. Any benefits accrued from investments in transit and nonmotorized transport are likely to be offset if the current car orientation in infrastructure development and management continues unabated. Behind flawed transport policies and investment targets lies a lack of national urban transport legislation and guidance. While national-level transportation planners are well versed in sustainability discourses, decision-makers in local governments, as well as the public at large, are unaware of contemporary approaches in urban transport. Educating decision-makers and the public requires vigorous actions on the part of civil society, nonprofit organizations, universities, activists, and the media.

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Chapter 13
Vietnam

Du The Huynh and José Gomez-Ibañez

Capital city	Land area	Total population	Urban population	GDP per capita	Passenger cars
Hanoi	329,560 sq. km	90 million	32% (29 million)	$1,911	14 / 1,000 people

Data source: World Bank
Maps source: d-maps.com

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1 Introduction

Since the so-called Doi Moi reforms opened Vietnam's economy to market forces in 1986, Vietnam has experienced economic growth averaging more than 6 % per year. With a GDP of $185 billion, or $2000 per capita, it has joined the ranks of middle-income countries (Vietnam General Statistics Office 2015). Economic growth has been accompanied by rapid urbanization and motorization. According to official statistics, the urbanization rate is 33 %, but measured by an agglomeration index applied using global data for 2010 by World Bank it is 53 %. By the end of 2014, Vietnam had 45 million registered motor vehicles, of which 95 % were motorcycles (Nguyen-Duc 2015).

Ho Chi Minh City and Hanoi are by far the largest cities in the country, with official populations of eight and seven million, respectively. If the temporary and unregistered immigrants are included, the population of both cities is around the ten million mark. The next three largest cities in Vietnam have official populations of between one and two million (Vietnam's General Statistics Office 2015). Hanoi is Vietnam's political capital while Ho Chi Minh City is generally considered to be the commercial and economic capital. Together, the two cities account for 17 % of the national population and 25 % of the national urban built-up area but generate about a third of the national GDP and nearly half of the government budget revenue (Table 13.1).

Over the past two decades, the population of Ho Chi Minh City has grown by 73 % while that of Hanoi by 53 % (adjusting for the boundary expansion that tripled Hanoi's land area in 2007). The economy in each city has increased around eight times while the number of registered vehicles has increased more than 10 % annually. Both Hanoi and Ho Chi Minh City have been struggling with growing levels of traffic congestion. Most residents have adopted motorcycles as the solution to their mobility problems. Virtually, every person aged 16 years or older owns a motorcycle. While motorcycles are often blamed for causing traffic problems in Vietnamese cities (Tung-Nguyen 2010), transportation experts point out that the situation would be much worse if travelers were using cars instead (Dapice et al. 2010; Huynh and Bowen 2011; World Bank 2011; Huynh 2012).

Efforts to reduce motorcycle use by improving public bus services have not been very successful, partly because buses have not been given priority on the road and partly because of the dispersed pattern of urban development and trips. The street networks of Hanoi and Ho Chi Minh City are dominated by narrow alleys which are hard to serve with public transport. Unsurprisingly, buses serve less than 10 % of the trips in both cities (Ministry of Transport 2014). The development of rail-based mass transit systems has been started in these cities, but their high costs make it

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Table 13.1 Selected indicators for Hanoi and Ho Chi Minh City

	Hanoi		Ho Chi Minh City	
Items	1995	2014	1995	2014
Total area (km^2)	921	3324	2095	2095
Urban area in 2010 (km^2)		315		423
Total population (millions)	2.35	7.26	4.70	8.05
Urban population (millions)	1.08	3.55	3.43	6.72
Total registered vehicles (millions)		5.60	0.86[a]	6.85
of which motorcycles		5.04	0.84[a]	6.27
Vehicles per household		2.84		3.34
of which motorcycles		2.56		3.06
Vehicles per 1000 persons		771		851
of which motorcycles		695		779
GDP (billion dollars)	1.32	24.5	3.54	40.6
GDP per capita (dollars)	563	3375	753	5043
Budget revenue (billion dollars)	0.65	6.2	1.50	11.7

Source: Authors' calculations and based on Hanoi's Statistics Office (1995–2015), HCMC's Statistics Office (1995–2015), and World Bank (2015)
[a]Data for 1994

unlikely that the systems will be completed on schedule. Current expectations are that each city will see just one rail line open by 2020. Even if the proposed lines are completed as planned, it is forecast that they will account for less than 10 % of urban trips. The two cities will have to improve their bus systems significantly if they are to achieve their goals of increasing the public transport modal share to 35 % in Hanoi and 20–25 % in Ho Chi Minh City by 2020.

Roads currently cover less than 10 % of the built-up area of Hanoi and Ho Chi Minh City. Given that a car needs at least four times as much road space as a motorcycle, a huge amount of extra road network would be needed if a significant proportion of the population switched from motorcycles to private cars (Dapice et al. 2010; Huynh and Bowen 2011; World Bank 2011). In this context, motorcycles may be more attractive than conventional wisdom suggests. It may be wise to give both buses and motorcycles priority over cars in the allocation of street space.

2 Urban Land Use Patterns and Spatial Structure

Both Hanoi and Ho Chi Minh City are still rather monocentric cities in urban structure, with employment concentrated in the center and the residential population accommodated in a surrounding ring extending out for at least 20 km. The main force shaping their urban expansion has been the market—notwithstanding the introduction of modern planning by French colonists and the adoption of the central planning model after independence. The legacy of French urban planning can be observed in the centers of the two cities. This was a modest fraction of the total developed area, even in colonial times (Huynh 2015). More recently, the municipal governments have invested money and effort in planned developments, but these areas are much smaller than the spontaneous, informal developments. Generally, the formal sector accounts for a modest proportion of the total housing supply while urban housing demand has grown significantly due to the large influx of rural migration.

Many rural migrants have purchased or appropriated agricultural land to build houses (Trinh and Nguyen 1998; Waibel et al. 2007). Between 1993 and 2002, more than 152,000 houses were built illegally in Ho Chi Minh City (ALMEC Corporation 2004). Typically, these developments have insufficient infrastructure and little or no land for open or common spaces. Migrants economize on land for roads by laying out lots that are thin and deep with the narrow end fronting on a narrow road. Due to their shape, the resulting buildings are commonly called "tube houses." Except for CBDs and a few newly planned areas, informal urban development can be found across many parts of the two cities (World Bank 2011). Owing to informality and spontaneous construction, an extraordinary 83 % of households (estimated) in Ho Chi Minh City own their homes (HIDS 2013). While informal settlements have afforded low-cost shelter for the poor, their development has also brought about many problems, including traffic congestion, pollution, overcrowding, insecurity, and a shortage of public facilities (Huynh 2012).

Municipal governments have attempted to upgrade many informal areas by providing new infrastructure including roads, sewage, drainage, and water supply systems. However, the high population density and the complications of expropriating land have prevented the creation of well-organized road networks and other facilities. For example, the road system in Ho Chi Minh City in 2007 consisted of 2800 km of conventional roads and 5000 km of alleys. Of the conventional roads in the inner districts, a mere 14 % were wider than 12 m (i.e., suitable for full-size buses) while 51 % were 7–12 m wide and suitable only for cars or minibuses. The remaining 35 % were only wide enough for bicycles or motorcycles (HCMC 2007). Overall, only 8–9 % of the built-up land is dedicated to transportation in Hanoi and Ho Chi Minh City. The road coverage share is similar in Jakarta, Bangkok, and other cities in neighboring developing countries, but roughly twice as high in Tokyo and four times as high in New York (Fig. 13.1).

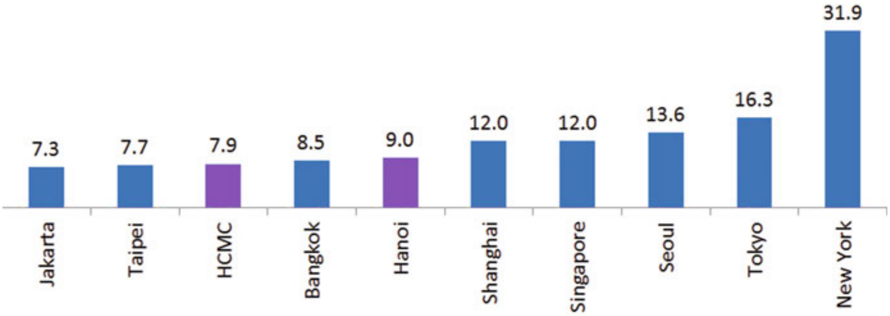

Fig. 13.1 Land portion dedicated to transport in selected cities (%). *Source*: Adapted from ALMEC Corporation (2007), Huynh and Bowen (2011), and World Bank (2011)

3 Trends in Transport Use and Mobility

Since the 1990s, a number of surveys and studies on transport and mobility have been conducted in Hanoi and Ho Chi Minh City. The two most comprehensive and reliable surveys are those by ALMEC Corporation (2004, 2007). In addition, a number of smaller scale studies have been carried out, including those by JBIC (1999) and Ho Chi Minh City University of Transport (2014). The main results of the foregoing surveys and studies are summarized in Table 13.2.

Data indicate that modal shares have changed dramatically over time. In the 1980s, bicycles were the main urban transport mode in Vietnam. By the mid-1990s, one-third of travelers in Hanoi and two-thirds of travelers in Ho Chi Minh City had shifted to motorcycles. Within the next decade motorcycle's share had climbed to roughly 80 % in both cities. In Ho Chi Minh City, the number of registered motorcycles increased from 0.5 million in 1991 to more than six million in 2014. In both cities, the second largest competing mode—public transport in Hanoi and bicycles in Ho Chi Minh City—served only 10 % of trips.

In the face of the motorcycle dominance, the other modes serve niche markets and purposes. Public transport and bicycles are used by low-income residents and students while private cars are used by high-income residents and for business purposes. The share of business trips made by car is around 11 % in Hanoi and 9 % in Ho Chi Minh City.

Mobility rates (i.e., the number of daily trips per capita) varies based on household income and vehicle ownership. On average, residents in both cities make around 2.5 daily trips (excluding walking). But those in car- and/or motorcycle-owning households make approximately four daily trips. Those who own a bicycle

Table 13.2 Main transport indicators in Hanoi and Ho Chi Minh City

	Hanoi				Ho Chi Minh City		
Items	1995	2005	2008	2013	1996	2002	2014[a]
Trip rate/day (with walking)	2.6	3.5				3.0	3.0
Trip rate/day (without walking)	2.0	2.5				2.5	
Modal shares (%)	100	100	100		100	100	100
Motorcycles	31.6	63.2	81		64	77.9	85
Bicycle	61.3	25.3	2.5		32	13.6	8.2
Public transport	5.6	6.7	10.7	10	2	1.7	2.1
Car	0.7	3.6	4		1	1.2	1.1
Other	0.8	1.1	1.8		1	3.8	3.6
Average travel time (min)		19	19			18	18
Average trip length (km)		5.5				<6.0	4.7
Trip length by motorcycle (km)		5.8				<6.0	5.5

Source: Adapted from JBIC (1999), ALMEC Corporation (2004, 2007), Hanoi's People's Committee (2010), and HCMC University of Transport (2014)

[a]The 2014 survey in Ho Chi Minh City included only the route along the first metro line (currently under construction). The other surveys were citywide.

make three daily trips, while those who do not own any vehicle make fewer than two daily trips. Clearly, higher incomes and vehicle ownership translate into increased mobility.

Reported travel times in Hanoi and Ho Chi Minh City are short despite the fact that distances are similar to cities of comparable size. The average trip length is 5–6 km. The average travel time is less than 20 min (Bertaud 2011). Nearly two-thirds of trips take less than 15 min while fewer than 10 % take more than a half hour. Most trips by motorcycle are less than 6 km while trips by bus average 9–10 km, a distance similar to those in other developing cities (Mitric and Chatterton 2005; Richar Meakin Consultant 2005; Ardila-Gómez 2005).

Travel times and distances do not appear to have changed significantly over the last decade despite sustained population and economic growth. The most recent survey—by Ho Chi Minh City University of Transport (2014) of residents living along the route where the first metro line is being built—has revealed that the average travel time is still around 18 min while the average trip distance is 1.2 km for pedestrians, 2.5 km for cyclists, 5.5 km for motorcyclists, and 9.5 km for bus passengers. However, the situation may be changing since major traffic jams are increasingly common. The two cities may be reaching a tipping point beyond which congestion becomes extremely severe.

4 Urban Transport Problems

4.1 Dominance of Motorcycles

Households in Hanoi and Ho Chi Minh City typically own two or three motorcycles because of their affordability and convenience for the prevailing urban development patterns in Vietnam's cities. A typical motorcycle costs $1000–2000 (Honda Vietnam 2015), a manageable sum given a GDP of more than $3300 per capita in Hanoi and $5000 in Ho Chi Minh City. Moreover, the operating cost of a motorcycle (including fuel, vehicle depreciation, and parking) for a typical trip of 6 km is similar to the cost of a bus ticket and much cheaper than a trip by private car (Huynh and Bowen 2011) (Fig. 13.2).

Not only are motorcycles cheaper they are often also faster than alternative modes. For a 5–7 km trip—the most common travel distance in the two cities—a motorcycle typically takes 15–20 min, whereas a private car takes 25–30 min, and a bus 30–40 min (Huynh and Bowen 2011). Travelers regard walking to, and waiting at, a bus stop as less attractive than riding a motorcycle, which in turn is considered as less attractive than time traveling in an air-conditioned bus or private car (SYSTRA MVA 2008).

Vietnamese urban residents, in addition to having multiple daily tasks such as shopping or childcare, often hold second part-time jobs and therefore often need to trip-chain. Moreover, many workers need to commute at night while many public bus

Fig. 13.2 Motorcycles in Ho Chi Minh City. Photo by authors

services end at 9 pm. Private transport modes (i.e., cars but especially motorcycles) are flexible in terms of routing and scheduling than public transport and thus better suited to these lifestyles.

Motorcycles are also better suited to the long and narrow alleys that characterize the prolific informal settlements in the two cities. They can offer door-to-door service for alley dwellers while buses often require them to walk long distances to the nearest stop. The situation is made more unpleasant because sidewalks for pedestrians are often obstructed by vendors and parked motorcycles (Nguyen 2011). Indeed, street vending is so popular in Vietnamese cities that leasing public sidewalk space to small businesses is currently under consideration (Ngoc Hau 2010).

Vietnam's climate further encourages the use of motorcycles and discourages the use of buses. There are two main seasons in Vietnam: a hot and sunny season and a monsoon season characterized by sudden heavy rain. In rainy or hot weather, riding an air-conditioned bus would appear to be more comfortable than riding a motorcycle but the problem lies with walking to bus stops and waiting for the bus, especially where shelters are dirty and the sidewalks that lead to them are inexistent, poorly maintained, or flooded.

4.2 Difficulties in Promoting Public Transport

Public transport was first introduced in Vietnam in the late nineteenth century by French colonizers (Tran 1973). However, it never became the backbone of urban transport in Hanoi or Ho Chi Minh City. In the early 1980s, buses served only 10 % of the trips in each city, and with the Doi Moi reforms, public transport became less relevant. In 2002, municipal governments started to reinvigorate public transport services and dedicated substantial resources to this task, including heavy subsidies for existing bus systems and capital funds for new metro systems (ALMEC Corporation 2004, 2007). However, the results in terms of modal share have been disappointing to date.

Hanoi is now served by ten bus companies operating around 1300 buses on 89 routes, 70 of which were subsidized by government. The largest company is Transerco (or Hanoibus), a state-owned enterprise which accounts for 82 % of the vehicles and 90 % of the bus ridership in the city (C.N.Q 2014). The other companies are small: most are private or quasi-private. In 2013, Hanoi's buses carried 460 million passengers—an increase of only 14 % since 2008 (Nguyen 2013). Meanwhile, the fare collection deficit was 60 %, which was paid by the municipal government (Nguyen 2015). In 2004, this deficit was only 30 % (Neilson 2004). Subsidies to the bus enterprise currently account for 1.5 % of the municipal budget (Hanoi Statistics Office 2015).

Ho Chi Minh City is served by 12 bus companies operating about 2800 buses (700 of which publicly owned) on 120 routes (105 of which subsidized). Private enterprises play a more important role in Ho Chi Minh City than in Hanoi. However, buses still serve less than 10 % of trips in the city (DOT-HCMC 2011). Overall, 45 % of bus operating costs are subsidized (Huynh and Bowen 2011), and these subsidies account for 2.3 % of the municipal budget (HCMC Statistics Office 2015).

Although the bus services offered are limited in number, they are reasonably well patronized. The bus load factor in Ho Chi Minh City averaged 39 % in 2009 (Huynh and Bowen 2011), which is similar to many cities around the world (PPIAF 2006). The bus load factor in Hanoi in unknown but is probably higher since the city has fewer buses but a higher ridership rate than Ho Chi Minh City. Increasing the frequency of bus services on existing routes or extending routes to under-served areas is likely to generate an increase in ridership, but the necessary subsidies make this a prohibitive option.

Both cities have attempted to give buses priority in traffic but these efforts have been half-hearted and ultimately unsuccessful for the most part. Ho Chi Minh City experimented with exclusive bus lanes on five routes and achieved increases in bus ridership but the trials were abandoned after objections from other street users. Both cities have also developed plans to build Bus Rapid Transit (BRT) in selected corridors but the progress is very slow. The only priority measure that is widely applied (in city centers only) is a ban on the use of curbside lanes by private cars. This measure protects bus operators from automobiles but not from motorcycles, which are permitted to use these lanes.

Furthermore, buses are stigmatized as the travel mode of the poor, particularly since the vehicles are uncomfortable and poorly maintained, and the staff are not customer oriented and have little incentive to improve the service (Huynh and Bowen 2011). Pickpockets are also a problem but conductors are reluctant to warn riders or intervene for fear that the perpetrators will retaliate. Since many circumstances favor motorcycles over buses, and the bus system has many deficiencies, it is unsurprising that public transport is unpopular. Consequently, efforts to promote bus use have been largely unsuccessful. In the face of this failure, both major cities in Vietnam are implementing plans to build massive rail transit systems.

Hanoi's comprehensive transport masterplan for 2030 (adopted in 2011) foresees the construction of a 325 km rail transit network. Rail and bus, in combination, are expected to serve 35 % of urban trips by 2020 and 55 % by 2030. Similarly, the proposed 316 km rail transit system for Ho Chi Minh City (the plans were approved in 2013) is expected to serve 20–25 % of trips by 2020 and 35–45 % by 2030. When complete, these systems will be among the largest mass transit systems in the region, after Shanghai and Beijing (Musil and Simon 2015). However, the feasibility of these rail plans is uncertain as the capital costs far exceed the financial resources of the two cities (Dapice et al. 2010; Huynh 2015; Musil and Simon 2015). The actual construction is far behind the proposed schedules, and the lines under construction are experiencing cost overruns of 50 % or more (Tuan-Phung 2014). After numerous delays, it is expected that Hanoi's first metro line will open by 2016 (Doan-Loan 2014) while Ho Chi Minh City's first line will open by 2020 (Huu-Cong 2015). If the other lines experience the same cost escalation, then the total capital cost of these rail systems would be equivalent to half of the annual GDP for Ho Chi Minh City and more than the annual GDP of Hanoi (based on 2014 figures). If the systems are built, the projections are that buses would remain a critical mode carrying more than 65 % of public transport trips while rail would serve less than 10 % of the total urban trips (MVA-ASIA 2008).

4.3 Rapid Increase of Private Car Ownership and Use

Currently, private cars carry a very small share of trips in the two cities but consume a disproportional amount of road space: up to eight times more road space than motorcycles (Husu et al. 2003). The prospect of a rapid increase in private cars is thus a serious transportation challenge facing the two cities. The threat is approaching rapidly in both cities and likely to become critical in Hanoi before Ho Chi Minh City. Between 2008 and 2014, Hanoi's population grew at an average annual rate of 2 % while car ownership increased at an average annual rate of 15 %. During the same period in Ho Chi Minh City, the population increased at about the same annual rate but car ownership increased at an average annual rate of 7 % (Hanoi's Statistics Office 2008–2015; HCMC's Statistics Office 2008–2015). By the end of 2014, cars in the two cities numbered almost 600,000.

Both Hanoi and Ho Chi Minh City have urban structures that are incompatible with the mass adoption of private cars as an urban transport mode. Only a modest proportion of their built-up area is dedicated to roads, and their population densities are relatively high (400 persons/ha in inner city districts). Even a car ownership level of 250 vehicles per 1000 persons (relatively low by Western standards) would require that vehicular streets occupy 19 % of the total built-up area (World Bank 2011). Under these circumstances, there would be immediate gridlock if significant numbers of people switched from motorcycles to cars.

5 Urban Transport Governance, Decision-Making, and Financing

Vietnam has a four-tiered system of government consisting of national, provincial, district, and communal levels. Power is mainly concentrated in hands of the national and provincial governments. The Ministry of Transport is responsible for transport matters of national importance, such as national strategic transport development plans. The provincial transport departments are in charge of all transport matters in their provinces or cities (Hanoi and Ho Chi Minh City are classified as provinces). However, the provincial transport masterplans must be approved by the Prime Minister in consultation with sectorial and related ministries. *De jure*, the Ministry of Transport advises provincial transport departments on technical issues. In reality, its main control over the provinces is through the allocation of their transport budgets and the approval of their transport plans. Permission to invest in transport projects is given by the Prime Minister to the heads of provinces, directors of sectorial departments, heads of districts, or even communal levels. In terms of staffing, the provincial departments of transport are rather independent from national influence. As a result, provincial staff members are most responsive to the interests and directives of the provincial government.

A serious problem with the decision-making structure in Vietnam is the ambiguity of rights and responsibilities created by the collective decision-making style favored by the communist party. It is often unclear whether a decision rests with senior party leaders or with professional staff in the subnational agencies which are responsible for the implementation of that decision. This has created an internal culture of risk aversion where professionals fear they will be punished if their initiatives fail, or else will not be rewarded if they succeed. Thus, there are no incentives for creativity and “out-of-the-box” solutions in urban transport matters. Most staff members await instruction from superiors (Huynh 2012).

Urban transport funds in Hanoi and Ho Chi Minh City are accrued from a combination local revenues, national government transfers, and Official Development Assistance loans from more developed countries and from international development agencies such as the World Bank and the Asia Development Bank. Municipal governments are unlikely to be able to finance ambitious transportation plans on their own. The most expensive projects, such as arterial and ring roads and rail systems, rely heavily on Official Development Assistance loans. A few urban transport projects, such Phu My Bridge and the Hanoi Highway in Ho Chi Minh City, have been financed through public–private partnerships (PPPs) which were first introduced in Vietnam in the 1990s and have become more popular recently. However, disputes between governments and the private concessionaires over investments, schedules, and other issues have somewhat dampened the enthusiasm.

Overall, Vietnam's two major cities have invested significant resources in building transport infrastructure. In the last decade, Ho Chi Minh City has invested more than 5 % of its annual GDP in transport infrastructure. This rate of investment in transport is only slightly higher than that for Vietnam as a whole between 2005 and 2010 (Huynh 2015), but it is much higher than the public investment in transport in most other countries, in which investments typically amount to 2–2.5 % of the GDP (UNESCAP 2006).

Notwithstanding high urban transport investments, the planning profession has not been very effective in shaping the development of Vietnamese cities (Huynh 2015). First, the rate of urban population growth is usually underestimated, making the plans quickly obsolete. Second, plans often call for unrealistic levels of investment and do not specify priorities should full funding not be available. Third, plans are not persuasive in that they do not assess alternative land use or transportation policies. Fourth, many different and often conflicting plans are prepared by various agencies and it is unclear which ones have precedence. Fifth, private developers are influential and often push for changes in the plans. Finally, due to low public participation in planning processes, there is insufficient popular understanding of, or support for, sustainable transport plans.

Unrealistic planning encourages ad hoc and potentially short-sighted solutions to urban transportation problems. For example, as congestion became more severe, both Hanoi and Ho Chi Minh City built flyovers (which were not foreseen in the plans) in order to provide some immediate traffic relief. Not only were these projects not foreseen in the plans, they have merely transferred the problem to the next major intersection, and made it more difficult to design bus priority lanes or locate convenient bus stops.

The function of urban planning in Vietnam appears to be less about the control of land uses and more about the facilitation of negotiations on infrastructure funding among levels of government and foreign assistance agencies. Aid agencies are reluctant to fund costly infrastructure projects without assurance that these fit into some larger plan, even if the plan is considered to be unrealistic.

6 Proposed Urban Transport Solutions and Implementation Issues

6.1 Discouraging Automobile Use

In order to avoid transport gridlock, it is crucial for Hanoi and Ho Chi Minh City to avoid substantial shifts from motorcycles to private automobiles; this has priority over promoting bus patronage. Containing automobile use can be achieved in a number of ways. One strategy is pricing. Vietnam currently levies a high import tariff and a special purchase tax on automobiles. These tariffs and taxes have made car ownership unaffordable for most families but, as the economy grows, the income threshold needed to purchase a car will be reached. At that point, new car taxes and registration fees will need to be employed and other measures introduced in order to discourage those who already own a car from driving in the peak periods on congested roads.

Cordon pricing in city centers offers some potential. The scheme need not be very complicated to administer, as Singapore demonstrated in 1975. Motorists can be required to display a simple paper license on their windscreen as proof that they have paid a special fee to enter the central area during rush hour. However, cordon pricing requires careful planning and may be controversial, especially if implemented after travelers have already switched to cars.

Both Hanoi and Ho Chi Minh City already have a few schemes in place to restrict car use in their central zones: automobiles cannot travel or park on curbside lanes. Extending those schemes to all urban roads would be a simple and effective strategy to increase bus and motorcycle flow. However, at the moment drivers outside city centers are allowed to use these lanes. Curbside parking is often allowed too, with fees as low as $.25 (5000 dong) for an unlimited stay. It is difficult to prohibit drivers from using curbside lanes once they have come to rely on them.

6.2 Improving Motorcycle Travel

If Hanoi and Ho Chi Minh City are to continue to rely heavily on motorcycles, they must try to reduce the associated safety and pollution risks. Currently, Vietnam counts 25 traffic deaths per 100,000 people, which puts it among the 30 most dangerous countries in the world (World Health Organization 2013). Motorcycles are an important cause of the high number of fatalities in Vietnam, particularly on suburban and rural roads where speeds are higher. In 2007, the government took an important step toward road safety by adopting a law requiring motorcyclists to wear helmets. Virtually, all Vietnamese motorcycles have small engines (150 cc or less) since larger motorcycles require a special permit and license. The small size helps reduce emissions and may cut injuries as well. However, much more work is needed to promote safety and reduce emissions.

6.3 Coordinating Land Use and Public Transport

To become more sustainable, Hanoi and Ho Chi Minh City need to adopt land use policies that encourage the use of public transit (rail and bus). As explained, the population densities are now too high and the road and alley widths are too narrow to accommodate bus (and car) access. Traditional urban neighborhoods offer a high quality of life in many respects (i.e., different income groups live side-by-side and motorcycle commutes are generally short and quick). However, as incomes rise, these neighborhoods, especially in central location, are likely to be redeveloped with high rise apartment buildings offering larger and more modern units (Huynh 2012). The city government need to ensure that redevelopment improves public transportation access, by allowing and/or requiring bus lanes on arterial roads and higher residential densities along those arterials.

New rail lines provide more obvious and immediate opportunities to coordinate transport and land use by promoting Transit-Oriented Development (TOD) around stations so that more people can live, work, and shop within walking distance of a station. In view of the rapid growth of population and incomes in Hanoi and Ho Chi Minh City, TOD policies are particularly timely. A substantial amount of construction is likely to take place in the next few decades on both greenfield and brownfield land, which is then likely to stay in place for a long time. The opportunity to promote new development near public transportation corridors and stations should not be missed.

One concern is that the income and social diversity of traditional alley neighborhoods may not survive redevelopment. Higher income households might move to areas with better amenities, which are accessible by private cars, thus eroding urban resources even further. In the absence of income or property taxes, the wealthy are unlikely to fully cover the cost of the public resources that they will consume. If they relocate to corridors along the new rail lines (for which the public sector is paying), they are likely to capture much of the added value. Therefore, real estate taxes, development fees, and congestion tolls should apply so that this group can take bigger social responsibility.

7 Conclusion

Hanoi and Ho Chi Minh City face intense and somewhat unique transportation challenges. The first and most striking is the dominance of motorcycles. While this mode is popular in other cities of the region, such as Jakarta, it has been present in Hanoi and Ho Chi Minh City for a longer time and is more widespread. Motorcycles are affordable and convenient for commuters, especially those who live in crowded traditional neighborhoods with tube houses and narrow alleys. While motorcycles use street space more efficiently than cars, they are less efficient than buses. However, as incomes increase, Vietnamese households are likely to seek a better quality of life and travel than traditional neighborhoods and motorcycles can offer.

The second challenge concerns the operation of public transit systems so that they can provide an effective alternative to the motorcycle and the automobile. This has been exceedingly difficult in both cities because their bus systems all but disappeared in the decade after the end of the American War. As a result, when incomes reached a level sufficient to allow individuals to give up their bicycles for a motorized travel mode, the bus option was unavailable for most. Since the early 2000s, both Hanoi and Ho Chi Minh City have devoted substantial resources to improve their public transport systems but the results have been disappointing. Public transport only carries around 10 % of trips, and most riders are low-income residents or temporary immigrants. Ambitious plans to build rail transit systems with more than 300 km of lines have been developed in both cities and the construction of the first lines is underway. However, the planned systems are so costly that they are not likely to be completed any time soon. Even if completion occurs on schedule, rail systems are projected to carry fewer passengers than the bus systems. A combination of rail, BRT, and bus systems is required. Reserving exclusive lanes for the existing buses and building new BRT corridors is paramount. Furthermore, TOD in conjunction with rail and BRT investment should be pursued as population and economic growth is likely to stimulate a considerable amount of construction activity.

The final challenge is to prevent an explosive shift from motorcycles to automobiles as incomes grow. This would bring about traffic gridlock in Vietnam's cities since roads currently occupy less than 10 % of the urban land and parking space for cars in cities is minimal. For this reason, motorcycles may therefore be more attractive than conventional wisdom suggests. It may also be wise to prioritize both buses and motorcycles over cars in the allocation of road space and to replace the current mixed traffic of the present.

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Chapter 14
The Urban Transport Crisis in Emerging Economies: A Comparative Overview

Dominic Stead and Dorina Pojani

This chapter reflects on the 12 case studies contained in this book, and identifies some of the key issues, trends, and policy measures which emerge from the previous chapters. Consideration is also given to the lessons that can be learned from these countries and the extent to which they may be generalizable and applicable in other contexts across the world. The chapter is structured according to the main headings used in each of the country-specific chapters.

1 Urban Land Use Patterns and Spatial Structure

Many of the cities considered in this book have experienced rapid population growth. Some countries, which have historically been predominantly rural (e.g., India, Turkey, and Vietnam), have experienced large waves of rural–urban migration and a rapid pace of urbanization in the last quarter century. Better amenities and opportunities offered in cities have acted as a magnet for impoverished rural residents; the "bright city lights" effect has also been at play. Other countries, such as Russia, Brazil, and Mexico, underwent this stage of development more than three or four decades ago, and, therefore, their urban populations have been more stable in recent times.

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All 12 countries find themselves burdened with sprawling and motorizing megacities. Motorization means an exponential increase in the number of cars on the roads but also large numbers of motorcycles, especially in Asia and Latin America (e.g., Brazil, China, Colombia, India, Indonesia, and Vietnam). Current motorization rates surpass both the population growth rate and the urbanization rate in some countries.

Growing motorization has not resulted in increased accessibility for all. In fact, the reverse is true for many urban residents. Gridlock is commonplace in many cities for large parts of the day. The infrastructure is increasingly unable to cope with the huge growth in the volume of traffic. Consequently, use of nonmotorized modes is excluded or marginalized on much of the urban transport infrastructure. Not only are cities struggling to cope with the amount of vehicles in use on the existing infrastructure, but the demand for space to accommodate immobile vehicles (i.e., parked) is also exceeding capacity.

All countries have seen an increase in disposable incomes but also more economic polarization. The income gap between social classes has been widening. The trend among middle-income families is toward suburban living, housing being more affordable and spacious outside central cities. Therefore, land consumption has occurred faster than population growth in many cities. New developments funded by private investors, and catering to the wealthier residents, have accelerated this trend. It has resulted in some entire peripheral neighborhoods serving as dormitory communities for inner city employees, which has contributed to increasing physical segregation among population groups as well as lengthy commutes. In Latin American cities, gated suburban communities are ubiquitous. In Chinese cities, they are increasingly common.

The densities of some suburban developments are too low to provide viable, affordable public transport. Others consist of patches of high-rise developments which could potentially be served by public transport (e.g., Iran and Mexico). However, a lack of coordination between private housing developers and public transport providers produces a situation in which bus or rail services are provided only years after the apartments are built, if at all. By then, the population has settled into car-oriented habits which are especially prevalent among the middle and upper classes.

While suburbs have been sprawling in all directions, urban cores have often been densifying. Employment is frequently concentrated in the CBD or a limited number of inner city areas, generating large unidirectional travel flows. Monocentric urban development (a single dense core surrounded by sprawling suburbs) adds to congestion across the transport network. However, monocentric development and unidirectional travel flows can, at least in theory, provide better opportunities for mass transit planning than criss-cross travel patterns among low-density suburbs. In a few cities (e.g., Bogotá), efforts have been made to deconcentrate employment and housing into secondary centers but the success in reducing the dominance of the main center has been limited.

Commercial and office developments at the urban edges have also taken place (e.g., India's "technology parks"), and new residential districts have grown around these new employment centers. However, the housing provided is not always affordable for workers and access to these centers by public transport is limited. As such, these development patterns have exacerbated traffic congestion problems.

Many countries contain vast peri-urban settlements, frequently self-built by low-income residents. Informal developments (e.g., Brazil's "favelas" and India's shantytowns) are often located on marginal land, which has low access to public services, including public transport. As a consequence, the urban poor travel long distances, often on foot or bicycle (e.g., in India). This portion of the population carries a disproportionate burden of the externalities created by unsustainable spatial development patterns, despite the fact that their contribution to these externalities is lower than that of wealthier groups. In other words, while the wealthy choose to suburbanize and drive, the poor are forced to live in the fringe, and, having no access to cars, rely on travel modes with lower environmental impact.

2 Trends in Transport Use and Mobility

Notwithstanding the rapid increases in the use of motorized modes, as noted above, the majority of the population in all the countries included in this volume does not currently own a car (see Introduction). Private motorization levels in these countries are still low in comparison to the European and North American averages. They are however poised to grow rapidly.

Nonmotorized modes (walking and cycling), which accounted for a large proportions of urban trips in the past, have decreased in importance. China, for example, widely acknowledged as the "bicycle kingdom" in the mid-1980s, experienced a huge decline in cycling since, while car ownership rates doubled in the space of just a few years during the early 2000s, and continue to grow very quickly.

On the other hand, public transport remains the most important mode of travel in large cities in many of the countries included in this volume. Buses are more dominant than rail-based urban public transport options in most countries (although the number of journeys made by metro is approaching the number of journeys made by bus in some Chinese cities such as Shanghai). Consequently, individuals without access to a car tend to use bus services much more than rail services. However, because many bus services are not segregated from other modes of transport, their reliability and attractiveness is low, and buses are commonly considered as a mode of last resort.

Travel times and distances have increased substantially in all countries, often as a direct consequence of suburban sprawl and high traffic congestion levels. Mobility has also increased: people are now making more journeys (and more motorized journeys) than they did in the past. While the poor travel less than the wealthy, their trips are often longer in terms of distance and time, due to their peripheral residential location and their use of slower transport modes.

Motorized modes commonly receive a series of direct and indirect subsidies, including road construction, tax reductions, low licensing costs, free street parking, low gasoline prices, and purchase credits. In a number of countries, the automobile industry has been the recipient of direct financial support and incentives from the state in order to foster industrial development (e.g., in China and Nigeria). More recently, incentives for low-cost vehicles have been provided in various countries (e.g., "low-cost green cars" in Indonesia), which have further contributed to rapid motorization.

Some of the cities discussed in this volume (e.g., South African cities and Nigeria's capital Abuja) have been built based on the modernist paradigm of segregated land uses, lower densities, and wide vehicular roads. Meanwhile, the existing urban structure of many other cities (e.g., in India and Vietnam) is incompatible with the mass adoption of private cars as an urban transport mode. Only a modest proportion of their built-up area is dedicated to roads, and their population densities are relatively high. Therefore, even relatively low increases in car ownership levels are creating major gridlock.

Very different mobility patterns among different urban population groups are apparent. The poor make relatively few trips per day, mostly on foot or by bicycle and sometimes by public transport (not uncommonly, bus and tram tickets are unaffordable for this group). Meanwhile, the rich travel further and more frequently. Clearly, this observation is not just limited to emerging economies—developed countries display a similar pattern. A large gender difference in mobility patterns can also be observed in some countries, especially those in which the culture is more patriarchic (e.g., Brazil, Indonesia, India, Iran, and Mexico). Increasing car use among women is partly related to higher levels of participation in employment but also due to public safety concerns for pedestrians.

3 Urban Transport Problems

The urban problems which are directly produced by unsustainable transportation practices are immense. These include environmental pollution, traffic congestion (and gridlock), safety (traffic injuries and fatalities), security (crime or fear of crime), oil dependence, and inequality in mobility and transportation access.

Anthropogenic atmospheric pollution due to growing automobile use has become life threatening. In the São Paulo region, for example, it is estimated that about 8000 people die prematurely each year due to transport-related pollution. Meanwhile, atmospheric emissions in Beijing—the most polluted of the three largest cities in China with the highest level of private car ownership in the country—were almost three times above the local limit, while Shanghai and Guangzhou were close to double the limit. Air pollution has produced major discontent among Chinese citizens. Similar levels of pollution are reported for Indian cities, where high emissions are fast becoming a concern for smaller cities as well as larger ones. A key driver of poor air quality in many cities is the continuing prevalence of two-stroke engines in two-wheeled and three-wheeled vehicles, which are more affordable than private cars and have been growing very rapidly in number. In Nigeria, virtually all vehicles are imported, many of which are second hand. Once imported, they can stay in use for years. Clearly, high levels of pollution do not originate from private transport alone: the bus is also a major contributor, especially where the fleet is old. In Colombian cities, for example, the average age of the bus fleet (excluding the BRT fleet) is more than 10 years. In some cities, especially in Asia, industrial plants located near urban areas, and intense construction activities to accommodate new urbanites and investors, contribute to air pollution in a major way.

In terms of traffic flow, vehicle speeds and efficiency have decreased in almost all cities. Istanbul, Mexico City, Rio de Janeiro, and Moscow are now among the most congested cities in the world. Moreover, parking continues to be free of charge in many urban areas, leading a severe shortage of spaces, both on- and off-street, and producing antisocial behavior such as parking on sidewalks or in green spaces.

Conditions for walking and cycling are often unpleasant or unsafe. Current approaches to urban transportation planning and management are far from pedestrian oriented or cyclist friendly. In city centers, where pedestrian and cyclist circulation is the highest, priority is still often given to motorized vehicles. Sidewalks are narrowed in order to provide more capacity for car traffic. To facilitate vehicular flow, at-grade pedestrian crossings have been removed, forcing pedestrians to use subway tunnels or bridges, or cross moving traffic. In many cases, authorities are reluctant to introduce physical measures or pricing mechanisms to restrict car use.

Traffic incidents have become a leading cause of death in urban areas. Reckless driving, low enforcement standards, growing use of motorcycles, and mixed traffic on urban roads (e.g., in India) are among the main culprits for this situation. The number of fatalities in Brazil is among the highest in the world: around 30 per 100,000 inhabitants. In addition to safety, security while travelling is a major cause for concern in some of the countries discussed in this book, especially in Latin America and Africa. The risk of being assaulted, robbed, or sexually harassed is high for pedestrians and public transport users, especially women, and affects transport choice. A range of measures have been introduced in various countries to tackle the issue, including the employment of female taxi drivers and female conductors, the installation of CCTV in public transport vehicles and stations, the reservation of certain areas of the metro and BRT systems for women, children, and senior citizens at peak hours (e.g., Mexico City), and the design of smart phone apps which assign safety scores to public spaces (e.g., India's Safetipin). Nevertheless, the problem is still acute.

Oil dependence and security is another growing concern. Even oil-rich countries experience problems in this respect. Despite extensive oil resources in Iran and Nigeria, a substantial amount of gasoline is imported from abroad. After the imposition of international sanctions on Iran, the direct purchase of foreign gasoline was severely limited and could only take place through mediator countries. In several countries (e.g., Brazil and Nigeria), the availability of domestic oil increases the reluctance of policy-makers to tackle increasing car and motorcycle dependence.

Urban disruption, noise, visual pollution, and stress are other equally pressing problems of transport in many countries. While users' transportation choices are largely responsible for many of the ills afflicting emerging economies, weak institutional arrangements and poor decisions on part of urban transport suppliers (both public and private) account for a considerable share of the problems as well.

In many cities, bus ridership has declined as public transport services have become less reliable and more overcrowded in peak hours due to high levels of traffic congestion (where buses do not run on dedicated lanes or corridors). A vicious circle of decline in bus ridership has affected the financial performance of operators and limited their ability to improve and expand services. For example, many public bus services in Vietnam only operate until 9 pm which forces citizens to turn to cars and especially motorcycles for more flexibility in terms of routing and scheduling of daily activities. In an effort to recuperate costs, some public transport operators have increased fares to a level higher than the unit operating cost of private motorized vehicles. This strategy has only served to push away more passengers.

Rather than making concerted efforts to create or restore mass transport, some countries have allowed or even encouraged informal small-scale operators (e.g., mototaxis in Colombia; rickshaws in India; mini and midi buses in Nigeria; *dolmuş* in Turkey) to step into the market and fill the void left by formal services. While paratransit modes provide a valuable service, especially for the poor, without burdening the public largesse, they also account for significant levels of pollution, noise, and congestion. Passenger comfort and safety in informal vehicles is minimal. Moreover, citywide tickets or travel cards are not generally accepted by paratransit operators, which creates a barrier to the integration of fares.

Many examples can be found where different, potentially complementary modes of public transportation run in an unintegrated and even competitive way. In Cape Town, for example, the BRT system operates along routes parallel to the railway rather than being used to feed trunk rail corridors and fill gaps in the rail service. In Turkey, dolmuş services often operate along routes served by rapid transit systems taking away passengers from these systems; part of Istanbul's BRT system operates along the same route as one of the metro lines and has diverted metro passengers, leading to exceedance of capacity within just a few years of opening. In Russia, privately run bus services are poorly integrated with municipal services and often compete for passengers along similar routes, leading to the inefficient use of vehicle capacity, fuel, and road space. Reorganizing public bus transport systems and paratransit modes to feed the rapid transit systems (BRT or rail) is desirable from an efficiency perspective but highly problematic to achieve as all operators are keen to stay on high-demand corridors in order to maximize profits.

In some cases, the poor are priced out of formal public transport services. In India, for example, the poor often cannot afford private motorized transport and are reliant on nonmotorized, informal, or public transport. In Lagos, Nigeria, bus fares are generally unaffordable for the lowest quartile of the population. In Vietnamese cities, the operating cost of a motorcycle for a typical short trip of 6 km is similar to the cost of a bus ticket. In Russia, the present system of public transport is two-tiered whereby one tier (of private operators) provides higher frequency services to users who can afford to pay full fares and another tier (of public operators) provides more limited services to people entitled to concessionary fares (e.g., students and pensioners). This is an ironic situation as private operators were originally allowed into the market in order to support the mobility of the poor.

4 Urban Transport Governance, Decision-Making, and Financing

Very few examples can be found among the countries discussed in this volume, where the responsibilities for urban transport governance are coordinated effectively. Many case studies illustrate a combination of weak administrative arrangements, limited planning capacity, and a lack of coordination between land use and transport policy-making, which together inhibit the development of more innovative, integrated, sustainable policies. Most often transport tasks are spread across a myriad of agencies, especially in large metropolitan areas which contain several local governments. Where they are granted real decision-making power, these institutions often have differing ideologies and areas of focus. Comprehensive and integrated long-term visions for sustainable transport are rare. In many cases, although transportation planning and management may, in theory, be devolved at the local level, municipalities lack the budget to fulfill their transport-related responsibilities. As a result, they rely on financial help from higher levels of governments, especially for large capital investments, which then leads to political and "turf" struggles.

In larger cities, transport governance is particularly problematic, not only due to the scale of issues, but also because larger cities often include intra urban but also interurban transport infrastructure and services, which is typically overseen by national and state agencies, leading to conflicts and inefficiencies. Often, developments along major road corridors which fall outside municipal jurisdictions are not subject to strong planning controls. In some countries emerging from a Soviet tradition (e.g., Russia and India), traditional land use and development controls remain the responsibility of the architecture and planning departments, while road construction and public transport operations are carried out separately by infrastructure and transport departments. The activities of these departments are often poorly coordinated, particularly in large municipalities. Disciplinary "silos" are common in other countries too (e.g., South Africa) where different departments (frequently staffed by different disciplines or professions) make decisions without interdepartmental dialogue. Regional metropolitan bodies exist in some cases (e.g., Cape Town, Lagos, and a few Indian cities) with legal authority over environmental and transportation issues, but these often lack human and financial capacity.

There is often no shortage of transport plans for cities in countries with emerging economies. However, the lack of funding as well as political will often severely limits their implementation. Another key challenge to the effective implementation of urban transport policies and plans is the political influence of transport operators involved in providing public and private services (e.g., the Union of Road Transport Workers in Nigeria and paratransit drivers in Turkey). However, the involvement of the private sector in local transport financing is increasing in many countries, and sometimes actively encouraged to fill funding gaps. In India, PPPs have recently been introduced for the construction, operation, and maintenance of urban infrastructure projects. Rather than easing the financial burden of cities, PPPs have often led to legal and financial disputes to the detriment of transport operations and management.

In all the countries included in this volume, governments still have a long way to go in terms of building technical capacity, coordinating the transport sector with other government sectors, and employing travel demand management strategies. Addressing issues of traffic management, enforcement, public transport regulation, and related questions requires significant professional capacity. It also demands institutional cooperation and the willingness and the ability of institutions to coordinate the work of professionals within and across public and private organizations, in order to work efficiently toward the common goal of transport sustainability that is convincingly articulated and based on the local context.

5 Proposed Urban Transport Solutions and Implementation Issues

Notwithstanding the range of transport problems delineated above, all emerging economies are taking some steps to deal with the urban transport crisis. While the measures are disparate, there are some common trends which are summarized below. The discussion is structured around nine commonly adopted or proposed "interventions" or "solutions" rather than by country, based on a framework constructed by the editors (see Pojani and Stead 2015).

5.1 Road Infrastructure

The typical policy response to the growth in motorization and congestion has been the construction of additional road infrastructure despite the fact that it is mainly used by an elite minority. More roads have in turn created more urban sprawl and reduced the attractiveness of, and opportunity to use, nonmotorized modes of transport. They have also severely undermined pedestrian accessibility, especially for the mobility-impaired. Experience in a number of countries, including Iran, Turkey, and South Africa illustrates that road construction may only reduce traffic congestion in the short term. In the long run, extra capacity has fueled additional travel demand everywhere. In view of this evidence, professionals involved in urban transport policy and planning need to embrace the notion that they cannot build their way out of congestion. In many cases, the mentality is changing but not quickly. Sometimes the rhetoric indicates a change in thinking but the reality does not. A turn of attitudes in parking policy is needed too, recognizing that free parking comes at a high cost.

5.2 *Rail-Based Public Transport*

Mass transit is being developed in some cities (e.g., India, China, and South Africa). Aided by a strong economy, Chinese cities have been at the forefront in this respect. However, in most other countries, urban rail is expensive to build and it is not always affordable. (Cable car systems, such as Medellín's Metrocable constitute an exception which works well in hilly terrains.) In addition to high costs, a problem that rail systems suffer is their poor integration with other modes and operators. To achieve integration and shift current mode-based planning approaches, strategic and comprehensive public transport master plans are needed. These master plans need to define rail as the backbone of the public transport network and buses and paratransit as the feeder systems. In many cases, this will require reconfigurations of existing public transport routes. To function effectively, the master plans need to be complemented by supportive traffic management, travel demand management, and parking policies.

5.3 *Road-Based Public Transport*

There is evidence from nearly all the countries included in this volume that BRT systems (i.e., road infrastructure networks exclusively for buses) are an appealing and effective public transport option. BRT has been created in its full version that mimics rail-based systems or as simple network of segregated bus lanes. In Rio de Janeiro, the development of the Transoeste and Transcarioca BRT lines has led to considerable improvements in travel time in comparison to regular bus services which run in mixed traffic. Meanwhile, Curitiba's BRT is a landmark system not only in Brazil but worldwide. One of the first major transport innovations to emerge from a developing country, it sparked a transport revolution in that many other cities (in both developed and developing countries) were inspired to build their own BRT systems. Other examples of high-quality public transport can be found in Bogotá (TransMilenio) and Guangzhou.

While BRT systems have significantly increased the attractiveness and capacity of the urban transport network in many cities, some schemes have been less successful than others. For example, Ahmedabad's BRT has not increased the public transport modal share. A similar situation is reported for the BRT scheme in Mashhad, Iran. Moreover, several BRT projects in India have been plagued by fragmented planning, operational inefficiencies, political struggles, land acquisition disputes, cost overruns, and informal settlement rehabilitation issues. In all cities which have attempted BRT implementation, these systems have not been perceived as a backbone of the urban transport system but rather as secondary. Moreover, BRTs in Pune, Indore, and Jaipur have been dismantled in order to be replaced by high-cost metro systems. In Bogotá, BRT fares, although reasonable, are too high for the poor. To reduce this burden, the city has introduced a subsidy for low-income residents, which is easing public transport access for this group.

Beyond innovations such as BRT, a common strategy to improve public transport services is the involvement of the private sector. While private provision of public transport services is not negative in itself, the integration of privately and publicly provided services is challenging from various perspectives, including operational efficiency, safety, and user convenience. Bus services are subject to various regulations but requirements such as service frequency, vehicle types, ownership, maintenance, and comfort are not always covered. Also, competition among providers (formal, informal, and semiformal, such as shared taxis) undermines service quality and quantity.

5.4 Support for Nonmotorized Modes

Very few cities are currently investing substantial amounts in cycling and walking infrastructure. Where it is happening, it is often taking place only in small pockets of the city or in disconnected corridors. Cycling is still frequently seen as a leisure activity rather than a form of everyday, multipurpose transport. Nevertheless, it seems that attitudes may be slowly changing among growing numbers of policymakers in some cities, and that cycling and walking are being recognized as important modes. Bogotá, which has benefited from Mayor Enrique Peñalosa's progressive vision in urban transport, is a rare exception in terms of investments in cycling infrastructure. With 392 km of segregated bicycle lanes, it is the city with the largest cycling infrastructure network in Latin America, leading to the capital being called an "urban bicycling pioneer" in the continent. In Brazil, the historical neglect of pedestrians in transport planning has started to change, at least in terms of rhetoric. Pedestrians are being formally identified as a key priority in new mobility plans. Support for cycling is also increasing, and large cycling networks have been developed in São Paulo and Rio de Janeiro. More are planned for other major cities in the country. In China, bicycle-sharing programs are being introduced to revive the cycling tradition. These programs are being introduced in many other cities with moderate success (e.g., Turkey).

5.5 Technological Solutions

Technological improvements are being harnessed in some of the countries included in this volume, especially in Asia. Inexpensive technologies such as new mobility services via cell phones (i.e., on-demand parking payments) already exist. Cell phone-based taxi and ride sharing services are becoming increasingly popular, especially with younger travelers. These services are quite attractive in terms of cost compared to private cars. Didi Taxi, a Chinese taxi service similar to Uber, entered operation in 2012 and offers a platform for planning taxi trips in real time through smartphones. In Indonesia, smartphone-based apps such as GrabTaxi and Go-Jek are becoming widespread. As a new phenomenon, their influence on current transport choices is small, but their use is set to grow. There is also growing interest in Intelligent Transport Systems, not only for the management of traffic, but also to assist in the provision of an effective transit service. India has launched the Smart Cities Mission, an urban renewal and retrofitting program which enlists technology in order to develop or retrofit 100 cities all over the country making them user-friendly and sustainable.

Notwithstanding technological optimism, there is also recognition that technological solutions are not only costly for emerging economies, but they cannot address all transport-related problems. Moreover, their benefits may be offset by rapid motorization. Besides future-oriented technologies, addressing the energy efficiency and environmental performance of the existing vehicle fleet is key to tackling the emissions of urban transport. But phasing out or converting the most polluting of motor vehicles has proven difficult in many cases.

5.6 Awareness-Raising Campaigns

Awareness raising among citizens on the harmful effects of car dependence and on the benefits of "complete streets" is crucial. Campaigns have been taking place in many countries, but their success in reversing travel habits has been minimal. To induce reform, perhaps the attention needs to shift to professional training and education. In some countries, dated higher education curricula and "brain drain" are partly responsible for the lack of reform. To address these issues, the Indian government has created financial assistance for professional training and sponsored Centers of Excellence in Urban Transport which offer postgraduate degrees in urban transport planning and management, conduct research, organize conferences and workshops, and provide technical assistance to the government. These are important steps but much more can still be done in terms of capacity building.

5.7 Pricing Mechanisms

Central to improving urban transport conditions is the internalization of the full social and environmental costs of different transport modes. In many countries, however, a climate prevails where there is great political reluctance to introduce any measures that curtail the use of motorized vehicles, especially the car. Some pricing and taxation schemes are counterproductive. For example, in India, buses are taxed more than personal vehicles. Road pricing schemes have been implemented in just a handful of countries. For example, cordon pricing has been introduced in Tehran, where drivers are required to pay an annual access fee. Although the scheme is considered to have reduced traffic levels within the cordon, its citywide impact has been limited. Moreover, reductions in pollution and congestion are being offset by the growing levels of motorization.

5.8 Vehicle Access Restrictions

There has been some experimentation with this strategy, with limited success so far. Cities in China, including Shanghai and Beijing, have introduced restrictions on private vehicle ownership by limiting the issue of license plates. Mexico City has prohibited all cars from circulating 1 day a week, and vehicles are required to stay off the road one Saturday a month. Attempts have also been made in a few cities (e.g., Jakarta) to limit the circulation of private vehicles by restricting vehicle use to alternate days (according to the plate numbers) with different levels of impact.

5.9 Control of Land Uses

Cities are slowly recognizing the need to adopt land use policies that encourage the use of public transit (bus and rail). This requires that development be concentrated along urban corridors and, especially, at nodes (stations) of the public transport network, according to the principles of Transit Oriented Development (TOD). New rail and BRT lines provide obvious and immediate opportunities to coordinate transport and land use by promoting development around stations. Some cities (e.g., Mexico City) have explicitly adopted TOD as a goal in their planning documents. But the appropriateness of different forms of development is context dependent. Uncontrolled low-density sprawl is, however, rarely appropriate.

6 Conclusion

To provide more equitable, accessible, and sustainable urban transport, a radical overhaul of urban transport policies and practices will be necessary. A paradigm shift is necessary in policy-making in order to achieve policy reform: from “mobility” to “accessibility”; from “vehicles” to “people”; from “modal” to “multimodal”; from “speeding up” to “slowing down”; from “segregation” to “integration” (Banister 2008). Limiting private car ownership and use is paramount.

Caution is required in terms of evaluating the appropriateness and effectiveness of policy solutions being transferred from country to country (Stead 2012). Equally, care is needed when considering the transferability of policies from larger cities to smaller and medium-sized cities (and vice versa). Although megacities have received a disproportionate amount of attention in this volume over other sizes of cities, the case of smaller and medium-sized cities is also important, particularly since they can be more vulnerable to fluctuations in the world economy. Moreover, they are also home to at least a quarter of the world’s population and offer great potential for sustainable transformations. In principle, their size allows for flexibility in terms of urban expansion, adoption of “green” travel modes, and environmental protection (Pojani and Stead 2015).

Finally, all the specific measures discussed above cannot yield satisfactory results if employed in isolation. Packages of measures are necessary in all cases (Stead and Banister 2003). Certain combinations of policies can work together, leading to impacts greater than the sum of their individual parts. The identification of policy packages, which are appropriate for the local context, is a crucial issue for promoting more sustainable urban transport.

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Index

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