Urban infrastructure in Sub-Saharan Africa – harnessing land values, housing and transport

Literature review on public transport

Report 4

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Executive summary

This document reports the results of a literature review undertaken as part of a larger project focused on harnessing land values as a way of funding urban infrastructure in Sub-Saharan Africa. The field of the literature review was public transport infrastructure in Sub-Saharan African cities.

The questions that guided the literature review included:

- What role do public transport systems play in facilitating the productivity of city economies, and the provision of equitable access to city labour markets?
- What is the state of public transport systems in Sub-Saharan African cities, and through what historical processes did the status quo emerge?
- What alternative approaches to improving/reforming existing public transport systems have been implemented or considered, and where implemented, what is the evidence of their impact?
- What are the implications of the different approaches to public transport system improvement/reform for financing arrangements, and equity?

The principal responses to these questions, drawn from an interpretation of the reviewed literature, are as follows:

- In large cities where dependence on non-motorised modes for all travel needs is no longer feasible, public transport systems are essential to provide equitable access to city labour markets and other opportunities, and to enable the city economy to be efficient and productive.
- The state of paratransit-based public transport systems in Sub-Saharan African cities are inadequate, and there is an evident case for system improvement and reform. An essential component of any such reform will need to be the introduction of road space priority to free public transport vehicles from the congestion externalities arising from private transport on high volume corridors, and to rationalise vehicle size to match available road space and passenger demand profiles when such priority has been provided.
- Four approaches to improvement and reform have been proposed, in the form of: the installation of new mass transit to replace existing services; a slower stepped transition from paratransit to mass transit; existing service upgrade; and the introduction of sophisticated contractual forms of service regulation in the form of concessions or franchises. Elements of these approaches can be observed in various contemporary Sub-Saharan African public transport improvement programmes, but none has yet achieved success at scale.
- There are no panaceas in the form of directly transferrable public transport technologies or models, and to achieve any measure of success cities will need to develop innovative and contextually appropriate strategies. Indeed, the alternative approaches identified in the literature are not mutually exclusive, and might be considered in different parts of city's network and form part of a broader improvement strategy. The urbanisation pressures facing most Sub-Saharan African cities indicate that current resource constraints are unlikely to be eased in the medium term. In considering alternative courses of action, public authorities will therefore need to carefully assess the commercial risks they assume. They will also have important trade-offs to consider. Foremost amongst these is how to concentrate available resources: in the face of limited resources, should

expensive new high quality services be installed for a narrow segment of the passenger market, or should lower service quality improvement be pursued but to the benefit of a larger number?

It is concluded that the available literature, while showing encouraging growth in recent years, has many gaps. Much attention is still required to explore the details of contextually appropriate mechanisms for public transport improvement and reform, and to record the many challenges and lessons that existing programmes have encountered. The distributional equity and city productivity impacts of different approaches to improvement and reform are also poorly demonstrated, as are the institutional preconditions for success.

1 Introduction

The African Centre for Cities (ACC) has been appointed by the United Kingdom's Department for International Development (DfID) to undertake a study on harnessing land values as a way of funding urban infrastructure in Sub-Saharan Africa (SSA), with supplementary studies on housing and public transport. The study is divided into two phases: inception and implementation.

This literature review report, focussing on public transport infrastructure in Sub-Saharan African cities, forms part of the Implementation Phase.

The report is divided into seven chapters.

Chapter 2 describes the focus of the literature review. It starts by discussing the urbanisation pressures within which future attempts to improve city public transport infrastructures will be embedded. It then identifies the research questions that guided the literature review, describes the method that was adopted in the search for relevant publications, and discusses the quantity and quality of the body of literature that was found.

Chapter 3 presents a general, acontextual discussion, not focussed specifically on studies of the particular context of Sub-Saharan Africa, on the role that public transport infrastructure systems play in city development. It begins with a definition of the various modes, and their characteristics, that make up public transport systems. It then discusses the importance of public transport systems in supporting the productivity of city economies, and in providing more equitable access to city opportunities for diverse city populations.

Chapter 4 presents a contextually focussed discussion on the state of public transport systems in Sub-Saharan African cities. It starts by describing the historical forces that shaped contemporary public transport systems in this context. Next it discusses the nature of contemporary public transport systems with respect to the modes that are in operation, and their shares of the public transport passenger market. It then discusses the adequacy if these public transport systems, the grounds upon which their improvement or reform is warranted, and some institutional challenges in implementing these improvements and reforms.

Chapter 5 explores alternatives through which inadequate public transport systems could be improved and reformed. It begins by identifying the alternative approaches that have been presented in the literature, and discusses these in relation to the potential for their application in the Sub-Saharan African context. It then presents case examples of implementation, or attempts thereat, of the different approaches identified.

Chapter 6 tentatively explores, in matrix form, the implications the alternative approaches identified in chapter 5 have for required financing arrangements, public sector institutional capacity and city-wide passengers benefits in the short to medium term. Whereas chapters 3, 4 and 5 seek to extract a coherent argument from the body of literature reviewed, this chapter seeks these implications from first principles.

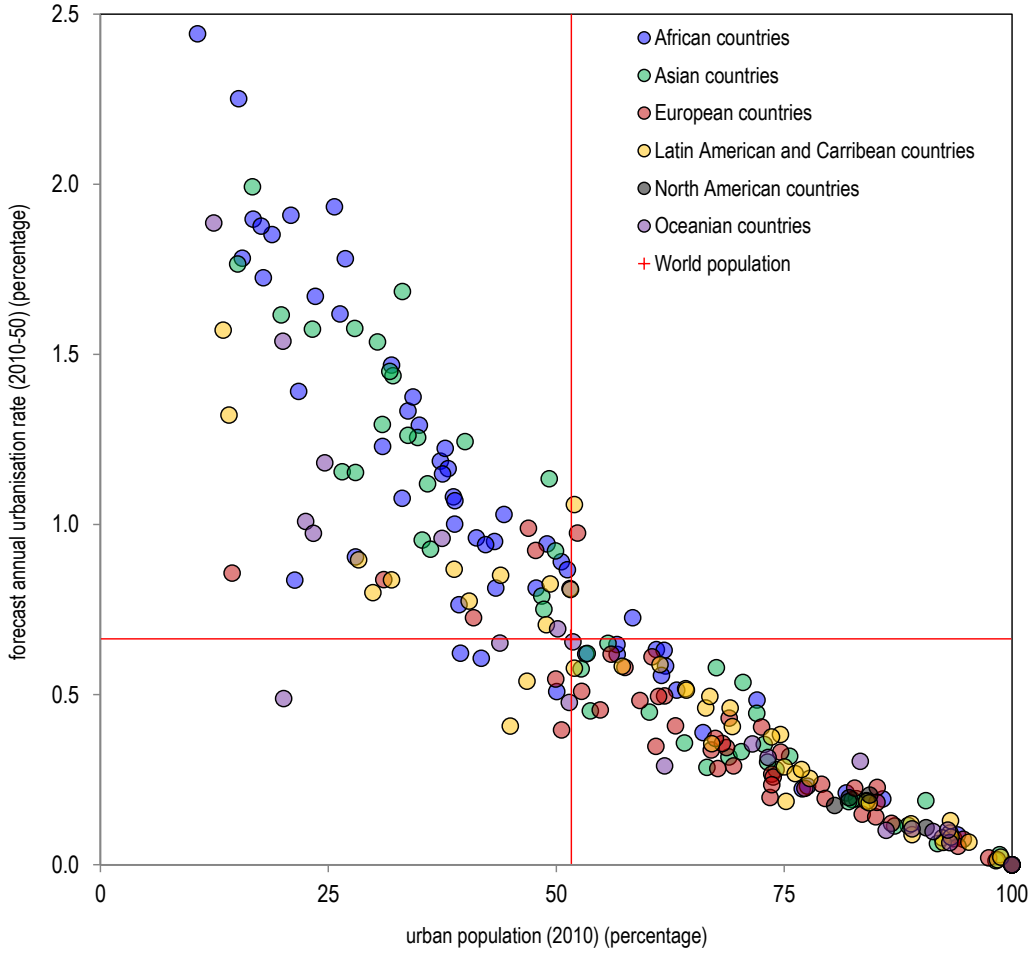
Chapter 7 concludes by synthesising the main points of argument presented in the report, and by making tentative observations on where new research and new knowledge is required.

2 Focus of the literature review

This chapter describes the focus of the literature review. It starts, in section 2.1, by discussing the urbanisation pressures within which future attempts to improve city public transport infrastructures will be embedded. Section 2.2 then identifies the research questions that guided the literature review, section 2.3 describes the method that was adopted in the search for relevant publications, and section 2.4 discusses the quantity and quality of the body of literature that was found.

2.1 Contextual background

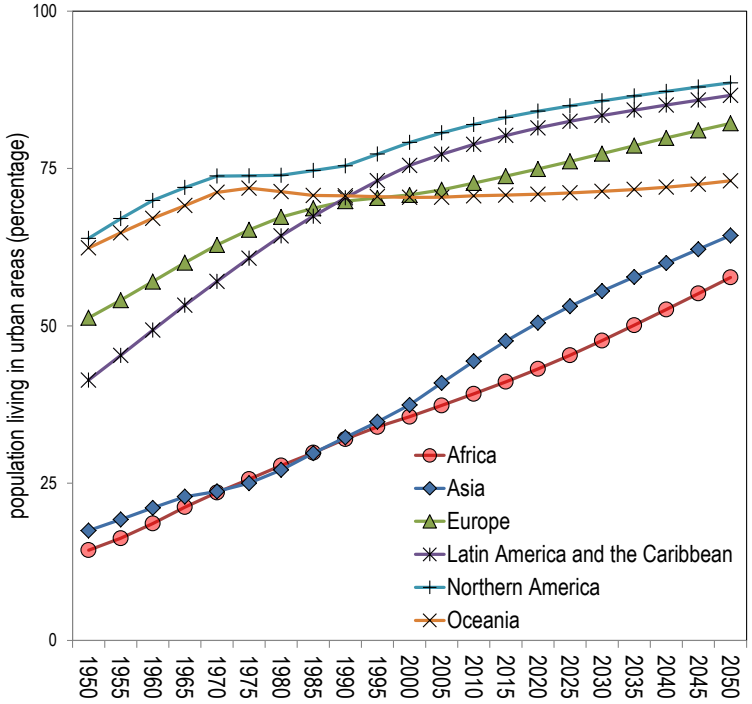
The contextual background to the public transport literature reviewed in this report is the broader urbanisation dynamic that is unfolding on the continent, compounding an already high fertility rate. Forecast rates of global urbanisation are highest in African countries, with only Asia exhibiting similar growth pressures (see figure 2.1) (UNDESA 2012). This high rate of urbanisation is off a relatively low base – figure 2.2 illustrates that a low proportion of Africa's population lives in urban settlements relative to other global regions. Thus even with comparatively high urbanisation rates, Africa will continue to have a lower urban population than other global regions. Figure 2.3 illustrates actual and forecast trends in African urban population growth, suggesting that the one billion mark will be reached soon after 2040 (UN-Habitat 2010).



Source: UNDESA (2012)

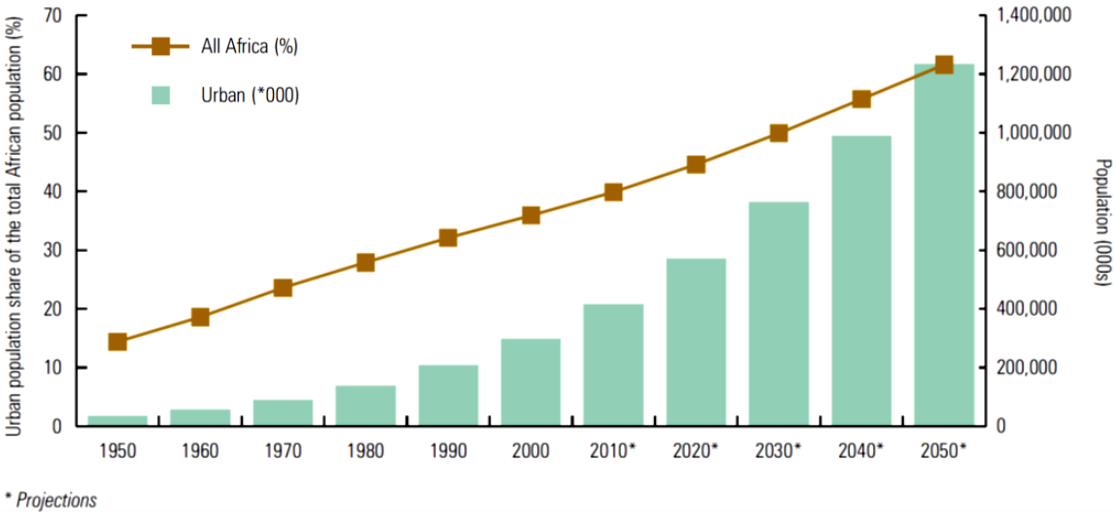
Figure 2.1 Forecast urbanisation rates by global region: 2010-2050

The pressures associated with urbanisation, in the form of growing demands on urban infrastructure capacity, are therefore likely to be felt by African cities to various degrees for many decades to come. In particular, the expansion of urban public transport infrastructure systems will assume great importance, and the planning and financing of these expansions will present a considerable challenge. This literature review explores contemporary perspectives on how this public transport system improvement might be pursued.



Source: SSATP (2015:11), citing UNDESA (2012)

Figure 2.2 Urban population trends by global region: 1950-2050



Source: UN-Habitat 2010:1, citing UNDESA (2010)

Figure 2.3 African urban population trends: 1950-2050

2.2 Research questions

The research questions that guided the literature review were derived from the study's terms of reference that was refined in the inception phase. These research questions included the following:

- What role do public transport systems play in facilitating the productivity of city economies, and the provision of equitable access to city labour markets? (addressed in chapter 3)
- What is the state of public transport systems in Sub-Saharan African cities, and through what historical processes did the status quo emerge? (addressed in chapter 4)
- What alternative approaches to improving/reforming existing public transport systems have been implemented or considered, and where implemented, what is the evidence of their impact? (addressed in chapter 5)
- What are the implications of the different approaches to public transport system improvement/reform for (capital and operating) financing arrangements (i.e. who pays for what, and where do commercial risks lie)? (addressed in chapter 6)
- What are the implications of the different approaches to public transport system improvement/reform for equity (i.e. who benefits, and what are the income and gender dimensions)? (addressed in chapter 6)

2.3 Research methodology

A search for scholarly publications in the field of public transport was conducted between February and March 2015. The search focussed on English language publications in the field of public transport in (both Anglophone and Francophone) Sub-Saharan African countries. Emphasis was placed on finding peer-reviewed publications (mainly journal papers, book chapters and conference papers), but important non-academic publications (e.g. government policy documents, or development agency reports) were also included in the search.

The following databases were searched:

- Science Direct (http://www.sciencedirect.com/)
- Google Scholar (http://scholar.google.co.za)
- CODATU (http://www.codatu.org)
- Southern African Transport Conference (http://repository.up.ac.za)
- Scopus (http://www.scopus.com)

A standard set of keywords was used to search each of the above databases for relevant publications (see table 2.1). The keywords were grouped into three main themes: public transport services; paratransit services; and cross-cutting themes.

Table 2.1 Keywords used in literature search

Theme	Keywords
Public transport services:	• public transport • transit • intermodal transit (and intermodal public transport) • bus • rail • train • light rail (and LRT) • bus rapid transit (and BRT)
Paratransit services:	• paratransit • intermediate public transport (and intermediate transit) • informal transit (and informal transport) • shared taxi • minibus taxi (South African colloquialism) • kombi (and combi) taxi (South African colloquialism) • matatu (Kenyan colloquialism) • dala dala (Tanzanian colloquialism) • tro tro (Ghanaian colloquialism) • danfo (Nigerian colloquialism) • molue (Nigerian colloquialism) • gbaka (Ivorian colloquialism)
Cross-cutting themes:	• sustainable transport • transport security • integrated transport and land use planning • transport governance • transport finance

The keywords were accompanied by a number of filters to narrow the search results. Firstly, the database searches were restricted to publications published between 2004 and 2015. Secondly, the words 'Africa' and 'city/cities' were added as filters to refine the search results further.

The resulting collection of publications were recorded in a bibliometric database, which included data fields relating to public transport theme, year of publication, publication type and author information. During the process of reviewing the literature, further important publications that were missed in the various database searches were added to the bibliometric database and to the inventory, on an *ad hoc* basis.

2.4 Quantity and quality of literature

A total of 257 publications were captured in the bibliometric database. Figure 2.4 presents the proportion of different public transport-related themes deal with in the publications found in the literature search. The figure suggests that greatest substantive attention over the past decade has been given to paratransit services at 34%, followed by all public transport modes (i.e. publications that deal with public transport systems on a non-mode specific basis) at 20% and bus rapid transit (BRT) at 19%. Least substantive attention was found on the topics of accessibility analysis, transport finance, transport governance and land use-public transport integration (all at 0.4%).

Figure 2.5 explores where these publications were produced at a country level. Publications are allocated to countries on the basis of the institutional affiliation of the lead (or sole) author. The figure suggests that the greatest number of publications have been produced in South Africa at 40%, followed by France (10%), Kenya (9%), Nigeria (8%), the United States (5%), United Kingdom (5%) and Ghana (5%). This distribution reflects both the relative research capacity and

resources of Sub-Saharan research institutions, and the countries in which greatest activity has occurred in public transport policy and implementation over this period (see section 5.2).

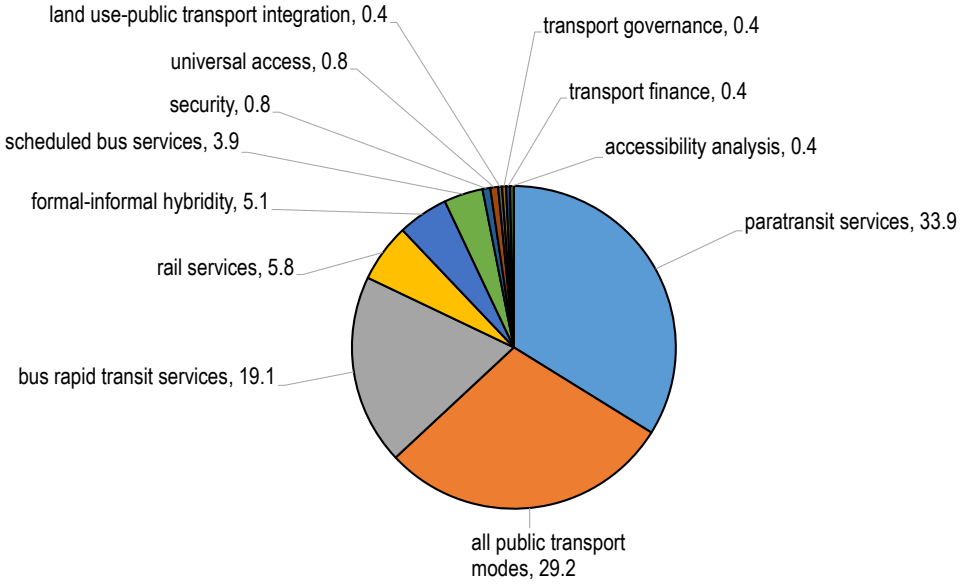
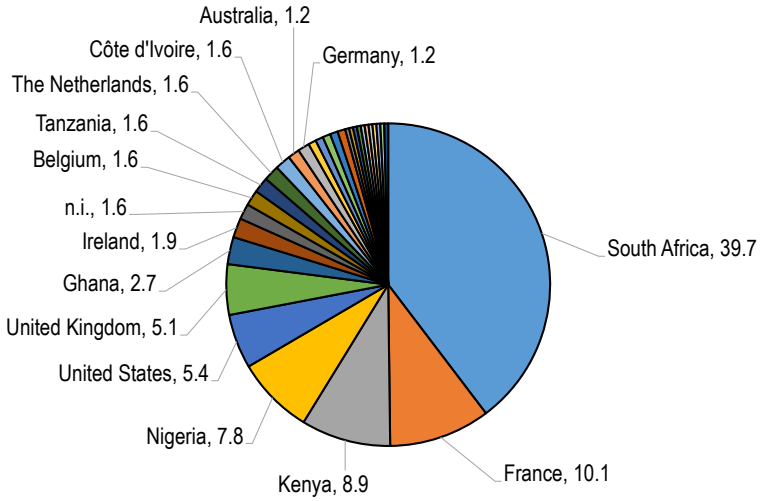


Figure 2.4 Public transport publications, by theme (n=257, percentage)



Note: Data labels are limited to countries with ≥1.0% of publications

Figure 2.5 Public transport publications, by lead author institution country (n=257, percentage)

A crude sense of the quality of the body of literature can obtained from the types of publications, and whether they are typically subjected to peer review. Figure 2.6 presents the proportion of different publication media. Journal papers account for the largest share, at 38%, followed by conference papers (37%): together accounting for three-quarters of the scholarly publications found in the literature search. The remainder of the publications were postgraduate theses or

dissertations (11%), non-government policy reports or manuals (5%), book chapters (4%), research reports (4%) and government policy documents (<1%). Given that journal papers are peer-reviewed (with, of course, varying levels of rigour), and at least some conferences undertake peer-review processes (e.g. the annual Southern African Transport Conference), figure 2.7 suggests that the quality of publications may be improving, as much of the recent increase in publication was due to increases in journal and conference papers.

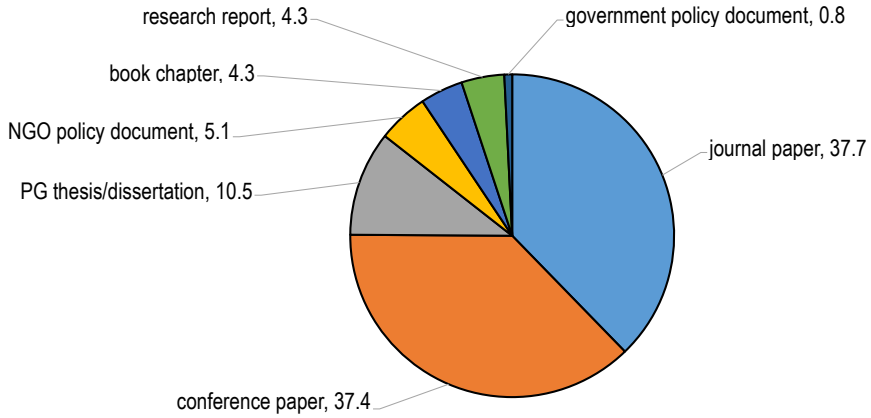


Figure 2.6 Public transport publications, by publication media (n=257, percentage)

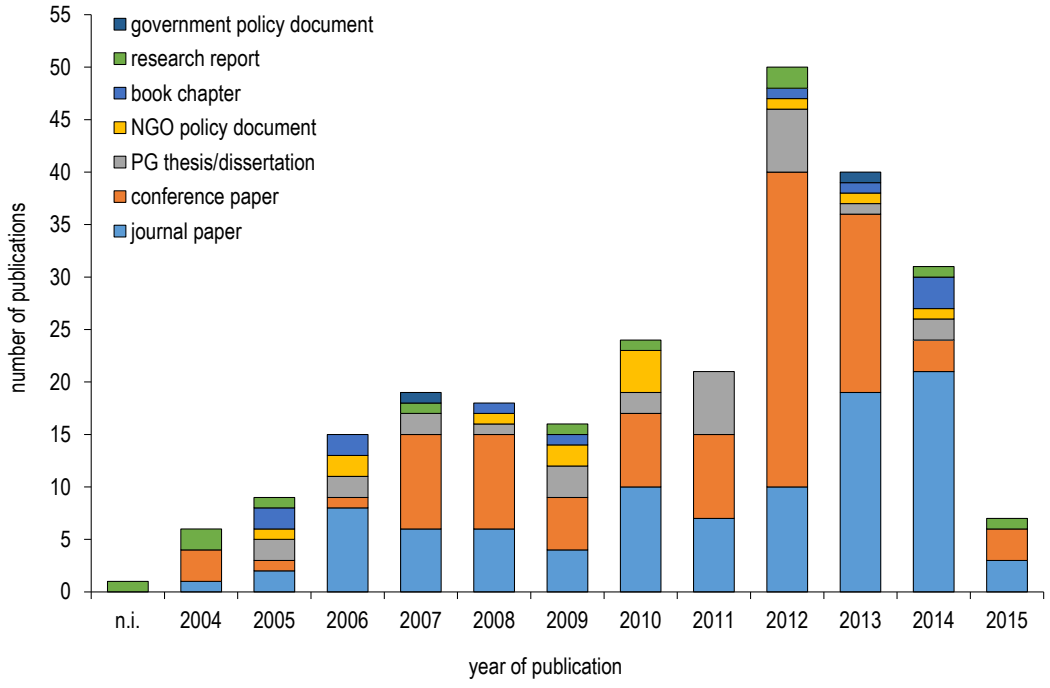


Figure 2.7 Public transport publications, by theme and publication media: 2004-present (n=257, count)

3 The role of public transport in city development

This chapter discusses the role that public transport systems and infrastructure play in city development. It draws from a wider literature than that found in the targeted literature search described in the previous chapter. Section 3.1 defines

various modes of public transport and describes their characteristics. Section 3.2 discusses the importance of public transport systems in supporting the productivity of city economies, and in providing more equitable access to city opportunities for diverse city populations.

3.1 Modes of public transport

Private transport is primarily characterised by the fact that the trip maker owns the vehicle and has full control over when and where trips are made. By contrast, public transport services have a variety of ownership arrangements that exclude the individual trip maker, and limit the user's ability to control when trips are made, as well as where these start and end. Users of both private and public transport services can be sensitive to the cost of travel and to the presence of other passengers, which could limit their freedom to travel.

Private transport and scheduled public transport are at the extremes of the transport modal spectrum; in between there are a variety modes demonstrating different elements of the private/public extremes. Vuchic (2007) provides an overview of these different modes by usage (see table 3.1). The discussion hereafter will focus on public transport and paratransit.

Scheduled (formal) public transport

Public transport typically operates according to fixed headway intervals or a fixed timetable, have set fares and often run on a dedicated or semi-dedicated right-of-way. A subdivision of such types of services by infrastructure is whether they are fixed-track (rail) or road-based (broadly, the bus sector). Vehicle capacity ranges widely across road- and rail-based modes, often with provision for both seated and standing passengers in larger vehicles. These types of services, when provided by private companies, often receive some form of financial support from public authorities.

There are a variety of fixed-track services. These operate exclusively on dedicated rights-of-way and run on a guided track on steel wheels or rubber tyres. Such modes include light rail transit (LRT), metro-type services, which are typically grade separated from other traffic and pedestrians, and suburban rail, which runs at ground level. These services have high capacity coaches, and operate at relatively high commercial speeds. This type of mass carrier is arguably essential to meet the mobility and access requirements of large, dense modern cities. Rail services offer the greatest capacity, but commonly come at a higher cost than road-based modes (Hensher and Golob 2008).

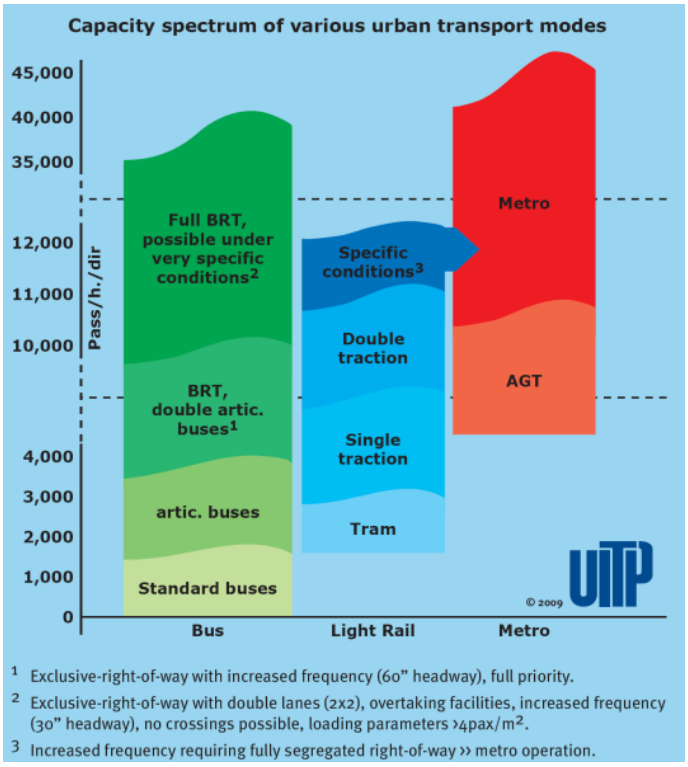
In the road-based domain there are also a variety of modes. The highest capacity mode is bus-rapid transit (BRT), and has some of the attributes of fixed-track services such as dedicated (though not fixed-track) rights-of-way, stations, and high-capacity vehicles. BRT services still contend with general traffic at intersections, which is commonly dealt with through specialised signalling systems and turning lanes. Conventional bus services – Vuchic's (2007) 'street transit' – do without many of the technological advances and dedicated infrastructure of rail services and BRT, but nonetheless operate according to fixed routes and schedules. One route schedule may apply in the peak period, and another may offer a reduced service in off-peak hours (Meakin 2004).

Dauby (2009) provides a schematic of the ranges of carrying capacities that the abovementioned modes provide (see figure 3.1). Vuchic (2007) provides a similar estimation of peak passenger carrying capacities (termed 'line capacity'), and plots this against operating speed.

Table 3.1 Classification of urban passenger transport by type of usage

Characteristic \ *Usage type*	*Private*		*For-hire*		*Public or Common Carrier*
Common designation	Private transportation		Paratransit		Transit
Service availability	Owner		Individuals, groups		Public
Service supplier	User		Carrier		Carrier
Route determination	User (flexible)		User (carrier)		Carrier (fixed)
Time-schedule determination	User (flexible)		User (carrier)		Carrier (fixed)
Cost-price	User absorbs		Fixed rate		Fixed fare
Carrier type	*Individual*				*Group*
Modes	Walking Bicycle Motorcycle Automobile	Carpools Vanpools	(Rental car) Car sharing Taxi	Dial-a-ride Jitney (Charter bus)	Street transit (bus, trolleybus, streetcar) Semirapid transit (bus rapid transit, light rail transit) Rapid transit (rail and rubber-tired metros, regional rail) Specialized modes
Optimum (but not exclusive) domain of operation					
Area density	Low–medium	Origin: low; Destination: high	Any		High–medium
Routing	Dispersed	Radial	Dispersed		Concentrated (radial), ubiquitous
Time	Off-peak	Peak only	All times		Peak, daily hours
Trip purposes	Recreation, shopping, business, other	Work only	Business Special services		Work, school, business, social, other emergency

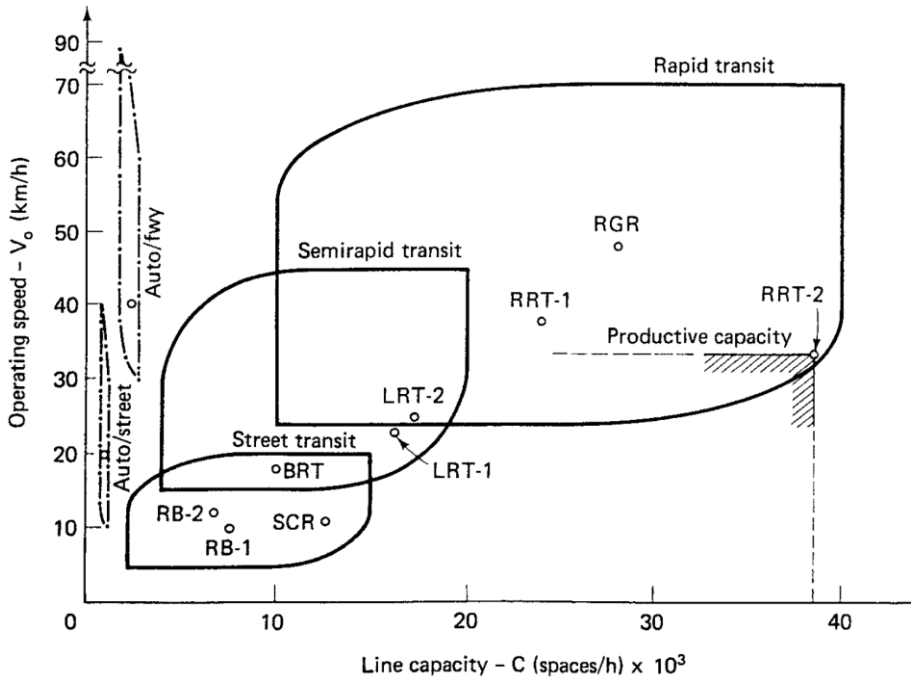
Source: Vuchic (2007:46)



Source: Dauby (2009)

Notes: BRT=bus rapid transit; AGT=automated guideway transit

Figure 3.1 Public transport modes and passenger capacities



Source: Vuchic (2007:78)

Notes: RB=regular bus; SCR=streetcar; BRT=bus rapid transit; LRT=light rail transit; RRT=rapid rail transit; RGR=regional rail

Figure 3.2 Public transport modes, passenger capacities and operating speeds

Paratransit

The term paratransit refers to unscheduled public transport services that typically utilise small buses, minibuses (vans) and smaller sedan vehicles. Paratransit in one or more of these formats is common in developing world countries – see, for instance, Cervero's (2000) international review of these and for-hire services. The ubiquity of paratransit in Sub-Saharan Africa (as discussed in detail in chapter 4) has led to it filling many, if not most, of the market niches that the modes in figure 3.1 occupy with large fleets of small vehicles.

In its most basic form one vehicle would provide transport services to a small group of users, for a fixed rate, and virtually exclusively. The origin and destination is typically controlled by the user, or by a subset of users making a trip, but the time of making a trip is determined by the availability of the vehicle. The scale of use makes it possible to have a degree of freedom of movement, but at a lower cost than owning a vehicle, whether shared or outright. This resembles private modes due to the (partially) exclusive-use nature of vehicles.

The most common type of paratransit service is delivered by minibuses under a variety of names in different cities. Such minibus services have been given a variety of colloquial names, for example: *dala dalas* in Dar es Salaam; *danfos* in Lagos; *cars rapides* in Dakar; *gbakas* in Abidjan; *matatus* in Nairobi and *tro tros* in Accra (Behrens *et al* 2015). The services are characterised by being owned by individuals who are either the driver themselves, or who employ drivers, especially when owning and operating multiple vehicles. Vehicles are typically 9- to 18-seater minibuses, but sedan cars and larger midi-bus vehicles are also found. In many parts of particularly East and West Africa two-wheeled for-hire services (in the form of motorcycle taxis known, for instance, as *bodaboda* in Kenya and Uganda, and *okadas* in Nigeria) supplement or compete with four-wheeled paratransit.

Paratransit is subject to limited regulation, and dedicated rights-of-way for this mode are uncommon. There is, however, some form of self-regulation within many cities by way of operator or route associations (Sohail *et al* 2006). Individual owners typically form associations to jointly control the number of vehicles operating on particular routes, and to mediate loading arrangements at ranks. Owners pay membership fee and levies for the operational management function.

Services are unscheduled, with vehicles departing from formal pick-up points (ranks) when reaching a pre-determined occupancy, which is full during peak periods (Meakin 2002, Cervero 2000). Alternative operations have vehicles roaming the streets in an area to pick up passengers *en route* to more formal pick-up points. When full these vehicles can either move directly to a destination, or take passengers to a rank where they can transfer onto a different vehicle that makes the trip to the desired destination. In this sense paratransit services demonstrate internal organisation according to feeder and trunk demand. In smaller cities, or rural towns, and during off-peak trips, passengers can sometimes arrange to be picked up or dropped off at home, hence exercising some control of the start and end point of a trip.

The flexibility of paratransit service has made it a very attractive mode for passengers who very often do not have access to private transport, and have travel distances that are too far to walk. While the service offering is ideal for shorter, localised trips, it is often employed over much longer distances, with resultant long travel times and inefficiencies of scale.

Paratransit services have proven notoriously difficult to regulate, and such attempts are often driven by the need to resolve or minimise conflict. Instances of the paratransit industry self-organising scheduled services are rare, and while economies of scale can be achieved by larger vehicles on longer routes, this is also not common.

3.2 Role in city economies and equitable access

As noted in section 2.1, Sub-Saharan African countries are characterised by high rates of urbanisation: from 1990 to 2010 the urban population in this region increased from 28% to 37%, with mean annual rates of change in the same period being in the region of 4% (UN-Habitat 2010, 2013a). The potential for urbanisation is great, given that the majority of the region's population lives in rural areas. Urban conditions hold more promise than remaining within rural areas, especially as agricultural conditions deteriorate due to, amongst other factors, climate change and mechanisation.

Urbanisation often results in a high degree of informality with population growth exceeding provision of formal infrastructure for basic services like water, sanitation and electricity. In the absence of adequate and enforceable urban plans, such informal settlements tend to be located on the periphery of cities, given the lower value of land, which has consequences for the modes of transport available to their inhabitants. It is therefore not surprising that urban services, and especially formal public transport systems, also lag behind settlement formation by some margin.

Public transport's role in equitable access

The variety of trips made by people on a daily basis are served to differing degrees by the different service offerings that Vuchic (2007) identifies (see table 3.1). While shorter trips are ideal for walking or cycling, longer distances (i.e. greater than ~8 kilometres) are better served by motorised forms of transport. Public transport is typically more energy efficient than private cars if running at reasonable occupancy rates, but offers less flexibility and typically longer travel times. However, the choice of mode for a particular trip is very often made on financial considerations alone - especially so in the Sub-Saharan African context (Olvera *et al* 2013, Sietchiping *et al* 2012). At one end of the spectrum people often walk significant distances simply because they cannot afford motorised forms of transport, while at the other end, people who are not sensitive to cost use cars to travel even very short distances. The congestion that the latter causes impacts on the reliability of public transport.

The distinctions between scheduled public transport and paratransit as discussed in section 3.1 are pertinent in view of such peripheral and informal urban growth, and due to the cost sensitivity of large portions of potential users. Due to their innate flexibility paratransit services are well-suited to respond to peripheral and informal urbanisation patterns, whereas scheduled public transport services, particularly at the higher end of the capacity spectrum, take time to plan and implement. This does not mean to say that there is no purpose in expanding formal public transport services, or in considering measures that would address problems with paratransit operations.

Continued reliance on paratransit services in their present form means that the shortcomings of these services are perpetuated. These shortcomings include fierce on-the-road competition, asset sweating (i.e. extracting greater service from aging or unroadworthy vehicle fleets in order to avoid vehicle replacement costs), and the inefficiency of accommodating large passenger movements from peripheral urban locations to more centrally-located economic opportunities. In relation to the latter, the economies of scale offered by high-capacity scheduled modes could be used to the benefit especially of economically vulnerable passengers. Measures to improve paratransit services could also be of benefit to passengers, particularly from a safety point of view. (Chapter 5 reflects on both formal public transport and paratransit improvements, while chapter 6 discusses the implications for passengers of pursing strategies that concentrate improvement efforts on either new or existing services.)

Irrespective of whether provided by mass transit or paratransit modes, public transport services are essential in providing equitable access in cities that have become too large for non-motorised travel. Without these services, offered at affordable fares that maintain conditions of non-excludability and non-rivalry, those without access to private transport (i.e. the poor, young, old and disabled) are stranded and excluded from the range of employment, commercial, social and education opportunities that a city offers.

A small literature has emerged in Sub-Saharan Africa on the particular vulnerability and needs of these groups within transport systems generally. Some publications focus on the needs of women (e.g. Salon and Gulyani 2010 in Nairobi, Seedat *et al* 2006 in Johannesburg, and Porter *et al* 2013 in a variety of Sub-Saharan African contexts). Other publications focus on the elderly (e.g. Odufuwa 2005 in four Nigerian cities, and Ipingbemi 2010 in Ibadan). Further publications focus on children (e.g. Chacha and Bwire 2013 in Dar es Salaam, and Ipingbemi and Aiworo 2013 in Benin City. Lucas (2011) explores the link between transport disadvantage and social exclusion more generally, in the context of Tshwane.

Passenger satisfaction surveys that disaggregate results by user group (e.g. Behrens and Schalekamp 2010 in Cape Town, Chinomona *et al* 2013 in Harrismith, Olawole and Aloba 2014 in Osogbo, and Vilakazi and Govender 2014 and Govender 2014 in Johannesburg) provide some insight into the problems these groups experience with public transport services more specifically. These studies illustrate a fairly consistent pattern of greater female passenger dissatisfaction with, and concern for, service attributes relating to security features at stops and in vehicles. The elderly are another group that report high levels of dissatisfaction with the availability of services that meet their needs and accommodate their limitations in physical mobility.

Economic roles of public transport

In the context of Sub-Saharan cities, public transport plays important economic roles. Foremost, it is as enabler of access to economic opportunity. Public transport (both scheduled services and paratransit) plays a crucial role in the urban economy as it increases the size of labour catchment areas, when offered at adequate service levels. While this is true for persons who would otherwise walk excessive distances, it would similarly apply to those who incorrectly perceive the car to be superior in all instances.

It should, however, be noted that economic productivity, while essential to increasing employment opportunities, should not be the sole objective in providing public transport. Access to education, health and institutional facilities, as well as recreation and retail activities are essential for personal development and the development of higher order skills. These in turn, would enable diversification of the urban economy and the development of entrepreneurs and the possible creation of new industries.

Public transport operations in themselves also provide economic opportunity, often in communities where other forms of employment are scarce. The operators of formal scheduled services provide operational and administrative jobs, typically within the formal sector. In relation to paratransit, each vehicle provides work for at least one driver, and in some instances also a conductor. This is only the direct employment aspect. Vehicle maintenance and the various administrative and operational functions of operator collectives add indirect employment. With urban paratransit fleets often numbering in the thousands within a given city, paratransit's contribution to economic product is significant.

Literature presenting evidence of the impact of public transport investments on the performance of economies was found to be surprisingly sparse. Most studies consider the relationship between general transport infrastructure investment and

economic performance (e.g. Sequeira 2013). One study in 2009, that explored the impact of public transport infrastructure more specifically (Weisbrod and Reno 2009), identified two categories of public transport infrastructure investment effects. The first relates to the direct effects on creating immediate jobs and income by supporting manufacturing, construction and service operation activities: estimating that in the United States (US) an average of 36,000 jobs per annum are supported per USD 1 billion of annual spending on public transport; and, corresponding to the 36,000 jobs, approximately USD 3.6 billion of business output (i.e. sales volume) is added. The second category is longer-term effects on economic efficiency and productivity resulting from changes in travel times, costs and levels of access. Investment in public transportation is argued to potentially affect the economy by, amongst other things, providing: business operating cost savings associated with worker wage and reliability effects of reduced congestion; and business productivity gained from access to broader labour markets with more diverse skills, enabled by reduced traffic congestion and expanded public transport service areas.

4 Public transport infrastructure in Sub-Saharan African cities

This chapter presents a contextually focussed discussion on the state of public transport systems in Sub-Saharan African cities. Section 4.1 starts by describing the historical forces that shaped contemporary public transport systems in this context. Next section 4.2 discusses the nature of contemporary public transport systems with respect to the modes that are in operation, and their shares of the public transport passenger market. Section 4.3 then discusses the adequacy of these public transport systems, the grounds upon which their improvement and reform is warranted, and some institutional challenges in implementing these improvements and reforms.

4.1 Historical development

This section reviews the limited literature describing the historical processes through which contemporary Sub-Saharan African public transport systems emerged. Only one study providing a sub-continental perspective on this history was found in the literature search (Kumar and Barrett 2008), so consequently the section draws from this and various other publications that trace the history of individual case cities, and attempts to develop a sub-continental perspective from these.

Across many Sub-Saharan African cities, during the first half of the twentieth century colonial governments established monopolistic public transport operations. While some of these services were rail-based, most were road-based. An example of an early rail-based undertaking is The Cape Town and Green Point Tramway Company established in Cape Town in 1861 (GABS 2013). Examples of road-based undertakings are the Overseas Transport Company of London introduced to Nairobi in 1934 (Klopp 2012), the Dar es Salaam Motor Transport Company established in Dar es Salaam in 1949 (Kanyama *et al* 2004), and the *Compagnie sénégalaise de transports collectifs* in Dakar in the late-1940s (Kumar and Diou 2010). The road-based operations typically comprised fleets of conventional large buses operating scheduled services on networks of fixed routes focussed on an urban centre, with standardised fares, passenger information and vehicle branding.

In the second half of the twentieth century the continuation of these operations became increasingly difficult. Faced with rapid growth in city populations and concomitant traffic increases, and stagnant road capacity, commercial speeds reduced and operating costs increased. In the context of limited fiscal resources,

government authorities were unable to provide sufficient capital and operating funding support. In many cases private monopoly bus companies were nationalised as part of the decolonisation processes in the 1960s (Finn 2008). In this immediate post-colonial era, fares were regulated and many governments were reluctant to increase them for political reasons. Initially, many state-owned bus companies were able to operate without subsidy, but as operating deficits grew and subsidy budgets stagnated, they had difficulty in maintaining and replacing vehicle fleets. The result was steady decline in both the quantity and quality of service. Most of the public bus companies eventually failed, with many of the bankruptcies occurring in the 1990s when structural adjustment policies severely limited the availability of public funds for subsidy (Kumar and Barrett 2008).

In most cities, the deterioration and collapse of scheduled bus services allowed the establishment of large-scale paratransit operations, offering flexible services typically in the form of small- to medium-sized buses with capacities ranging between nine and 25 seats. Some Sub-Saharan African cities ultimately had no formal large-bus or rail services, and their public transport systems came to rely exclusively on paratransit services operated as informal businesses. With a few exceptions, this change in service offering did not result from a deliberate policy decision to deregulate public transport in the same way privatisation policies were implemented in other parts of the world at that time, but rather represented a localized response to growing unserved passenger demand and relatively unrestricted market entry in a regulatory vacuum (McCaul 1990, Behrens *et al* 2015).

Service provision was typically weakly regulated, although in some cities, area or route operating licences were introduced in attempts to limit market entry, and vehicle roadworthiness varied according to the enforcement capability of responsible public authorities. Services were, and continue to be, provided by fragmented owners, with small vehicle fleets that were typically rented out to drivers. Drivers normally keep cash fare revenue less a daily 'target' payment to the vehicle owner and fuel expenses, or are paid a commission in the form of an agreed portion of weekly fare revenue (Joubert 2013). These driver remuneration practices resulted in a strong incentive to compete aggressively for, and carry, full passenger loads, and to despatch vehicles on a 'fill-and-go' basis.

Public transport systems in contemporary Sub-Saharan African cities are therefore heavily reliant upon paratransit services, and in most cities they hold the largest modal share (see table 4.1).

Table 4.1 Paratransit share of road-based public transport passenger markets in selected African cities

City (country)	Paratransit market share	Data collection year	Data source
Kampala (Uganda)	100%	c2008	Kumar and Barrett 2008
Kigali (Rwanda)	99%	c2008	Kumar and Barrett 2008
Dar es Salaam (Tanzania)	98%	c2013	Roux 2013
Dakar (Senegal)	97%	c2008	Kumar and Barrett 2008
Douala (Cameroon)	95%	c2010	UATP 2010
Conakry (Guinea)	93%	c2008	Kumar and Barrett 2008
Bamako (Mali)	91%	c2008	Kumar and Barrett 2008
Lagos (Nigeria)	89%	c2008	Kumar and Barrett 2008
Nairobi (Kenya)	87%	c2008	Kumar and Barrett 2008
Ouagadougou (Burkina Faso)	86%	2000	Godard 2008
Accra (Ghana)	86%	c2008	Kumar and Barrett 2008
Algiers (Algeria)	82%	2004	Godard 2008
Niamey (Niger)	81%	1997	Godard 2008
Windhoek (Namibia)	81%	c2010	UATP 2010
Johannesburg (South Africa)	72%	2002	CoJ 2013a
Yaoundé (Cameroon)	65%	2010	Godard 2013
Abidjan (Ivory Coast)	61%	1998	Godard 2008
Cape Town (South Africa)	58%	2013	CoCT 2013a
Cairo (Egypt)	52%	1998	Godard 2008
Casablanca (Morocco)	38%	1998	Godard 2008
Addis Ababa (Ethiopia)	36%	c2008	Kumar and Barrett 2008

Source: Behrens et al (2015)
Note: Most individual data sources do not specify whether the market share is measured during the peak period or over the entire day, and whether trips for all purposes are included, so comparisons may be inaccurate in some cases.

4.2 Supply and demand characteristics of contemporary public transport systems

This section collates the available secondary quantitative data on the public transport modes operating in contemporary Sub-Saharan African cities, and their share of passenger markets. Recent data are difficult to obtain, and the sources that are available often provide limited detail on the exact nature of mode use measurements applied, which makes comparisons across sources less reliable.

Studies that have collected comparative sub-continental supply and demand information at a country or city level include: Kumar and Barrett (2008), Trans-Africa Consortium (2008, 2010), UATP (2010) and SSATP (2015). These, and a few other individual sources, are drawn from in table 4.2(a and b), which presents the public transport modes that are in operation in the subcontinent, and in table 4.3, which presents the share these modes hold of city public transport passenger markets.

Table 4.2 demonstrates that the most common modes of public transport that provide intra-city services are minibus paratransit and conventional large bus services. The number of cities and countries reported to have conventional bus services in operation is a little surprising: it is, however, possible that in some instances unscheduled bus paratransit (i.e. the large bus *matatus* in Nairobi and *molues* in Lagos) have not been distinguished from conventional scheduled large bus operations. Certainly intra-city train and BRT services are uncommon. The

cities in which these mass transit modes do operate, tend to be in wealthier countries and usually primate in nature.

Table 4.3 indicates, as in the case of table 4.1 which focusses on just road-based services, that paratransit holds the dominant share of the public transport passenger market. In instances where this is not the case (e.g. Ouagadougou and Abidjan), this is probably due to public transport services holding a relatively smaller share of the total modal split, with for-hire modes (particularly motorcycle taxis in West African cities, as noted by UN-Habitat 2013b) holding a larger share than in the other cities.

Table 4.2 Intra-city public transport modes in operation, by (a) city and (b) country

(a) Sub-Saharan African city	**Paratransit**		**Transit**				
	minibus	**bus**	**heavy rail**	**light rail**	**bus rapid transit**	**BRT-lite**	**bus**
Abidjan (SSATP (2015))	X						X
Accra (Trans-Africa (2010))	X						X
Addis Ababa (SSATP (2015))	X						X
Bamako (Kumar and Barrett (2008))	X						X
Cape Town (CoCT 2013)	X		X		X		X
Conakry (Kumar and Barrett (2008))	X						X
Dakar (Trans-Africa (2010))	X						X
Dar es Salaam (Trans-Africa (2010))	X						X
Douala (Trans-Africa (2010))	X						X
Gauteng city region (SSATP (2015))	X		X		X		X
Harare (Kenworthy and Laube (2001))	X						X
Kampala (Kumar and Barrett (2008))	X						
Kigali (Kumar and Barrett (2008))	X						X
Kinshasa (Kumar and Barrett (2008))	X		X				X
Lagos (Kumar and Barrett (2008))	X	X				X	X
Nairobi (SSATP (2015))	X	X	X				X
Ouagadougou (SSATP (2015))	X						X
Windhoek (Trans-Africa (2010))	X						X

(b) Sub-Saharan African country	Paratransit		Transit				
	minibus	bus	heavy rail	light rail	bus rapid transit	BRT-lite	bus
Angola (TransAfrica (2008))	X						X
Benin (TransAfrica (2008))	X						
Botswana (TransAfrica (2008))	X	X					
Burkina Faso (TransAfrica (2008))	X						X
Burundi (TransAfrica (2008))	X						X
Cameroon (TransAfrica (2008))	X						X
Cape Verde (TransAfrica (2008))	X						X
Cen. African R. (TransAfrica (2008))	X						
Chad (TransAfrica (2008))							
Comoros (TransAfrica (2008))	X						
Congo (TransAfrica (2008))	X						
Cote D'Ivoire (TransAfrica (2008))	X						X
D. R. of Congo (TransAfrica (2008))	X						X
Djibouti (TransAfrica (2008))	X						X
Equ. Guinea (TransAfrica (2008))	X						
Eritrea (TransAfrica (2008))	X						X
Ethiopia (TransAfrica (2008))	X						X
Gabon (TransAfrica (2008))	X						X
Gambia (TransAfrica (2008))	X						X
Ghana (TransAfrica (2008))	X						X
Guinea Bissau (TransAfrica (2008))	X						X
Guinea (TransAfrica (2008))	X						X
Kenya (TransAfrica (2008))	X	X	X				X
Lesotho (TransAfrica (2008))	X						X
Liberia (TransAfrica (2008))							X
Madagascar (TransAfrica (2008))	X	X					
Malawi (TransAfrica (2008))	X						X
Mali (TransAfrica (2008))	X						X
Mauritius (TransAfrica (2008))							X
Mozambique (TransAfrica (2008))	X						X
Namibia (TransAfrica (2008))	X						X
Niger (TransAfrica (2008))	X						X
Nigeria (TransAfrica (2008))	X	X				X	X
Rwanda (TransAfrica (2008))	X						X
Senegal (TransAfrica (2008))	X						X
Seychelles (TransAfrica (2008))							X
Sierra Leone (TransAfrica (2008))	X						X
Somalia (TransAfrica (2008))	X						
South Africa (TransAfrica (2008))	X		X		X		X
Swaziland (TransAfrica (2008))	X	X					
Tanzania (TransAfrica (2008))	X						X
Togo (TransAfrica (2008))	X						
Uganda (TransAfrica (2008))	X						X
Zambia (TransAfrica (2008))	X						X
Zimbabwe (TransAfrica (2008))	X						X

Table 4.3 Intra-city public transport mode passenger market share, by city

Sub-Saharan African city	Paratransit		Transit				
	minibus	bus	heavy rail	light rail	bus rapid transit	BRT-lite	bus
Abidjan (SSATP (2015))	47.1%						52.9%
Accra (Trans-Africa (2010))	99.0%						1.0%
Addis Ababa (SSATP (2015))	60.0%						40.0%
Bamako (Kumar and Barrett (2008))	90.9%						9.1%
Cape Town (CoCT 2013)	52.8%		23.2%		0.7%		19.9%
Conakry (Kumar and Barrett (2008))	93.3%						6.7%
Dakar (Trans-Africa (2010))	82.6%						17.4%
Dar es Salaam (Trans-Africa (2010))	98.3%						1.7%
Douala (Trans-Africa (2010))	97.7%						2.3%
Gauteng city region (SSATP (2015))	86.0%		8.9%		0.3%		4.7%
Harare (Kenworthy and Laube (2001))	71.8%						28.2%
Kampala (Kumar and Barrett (2008))	100.0%						
Kigali (Kumar and Barrett (2008))	98.7%						1.3%
Kinshasa (Kumar and Barrett (2008))							
Lagos (Kumar and Barrett (2008))	94.9%						5.1%
Nairobi (SSATP (2015))	79.9%		1.1%				19.0%
Ouagadougou (SSATP (2015))	20.0%						80.0%
Windhoek (Trans-Africa (2010))	74.3%						25.7%

Notes:

1. The category of minibus paratransit includes both large bus and sedan paratransit vehicles. The data sources do not distinguish between these paratransit vehicle sizes consistently.
2. For the data sources that do not specify the trip purposes to which the mode shares apply, it is assumed that the mode share relates to trips undertaken for all purposes across the entire weekday.
3. In some cities the share of public transport modes of the entire modal split (i.e. including private/for-hire motorised and non-motorised transport modes) is low, as there is a large share of for-hire (e.g. motorcycle taxi) and non-motorised (e.g. walking and cycling) modes. This applies particularly to the West African cities of Ouagadougou, Bamako, Conakry and Douala.

4.3 Contemporary challenges

This section discusses literature dealing with the adequacy of contemporary Sub-Saharan African public transport services, and the grounds upon which reform, or at least significant improvement, of these services has been argued to be necessary. Publications that deal with contemporary challenges, and the case for reform, at a sub-continental scale include: Gauthier and Weinstock (2010), SSATP (2015), Behrens and Salazar Ferro (2015) and McCormick *et al* (2015). Of these, the policy paper recently prepared by Transitec for the African Transport Policy Program (SSATP 2015) and the Swiss State Secretariat for Economic Affairs (SECO) has the widest geographical scope, and is therefore drawn upon most heavily.

The mounting urbanisation discussed in section 2.1 will place immense strain on city infrastructure networks, of which public transport systems are a core component. Unlike in the developed world, where rapid urban growth was typically fuelled by the momentum of industrialisation, in Sub-Saharan Africa, urbanisation may not necessarily be supported by matched increases in economic productivity and wealth (SSATP 2015). The resources required to support urban and human development, and to implement and manage affordable urban infrastructure services, may therefore be heavily constrained in many cities.

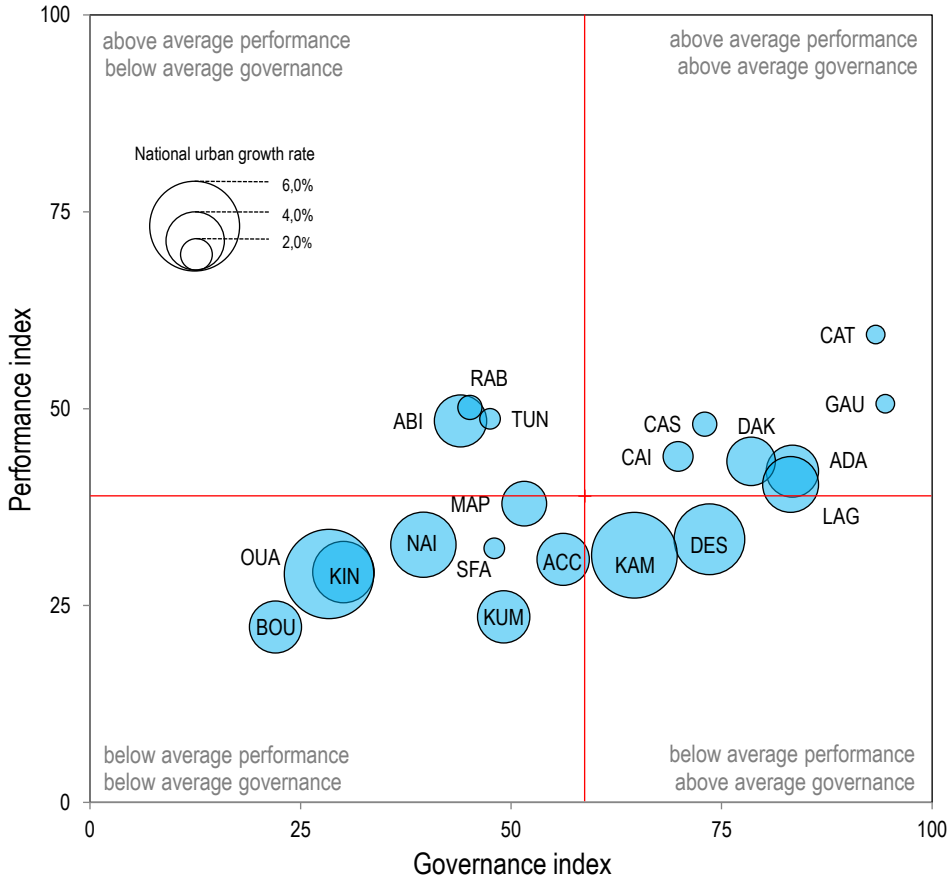
As discussed in chapter 3, as cities grow in extent and population, the ability of non-motorised modes to satisfy the travel demands of households decreases and the need for motorised forms of transport increases. The lower the mean levels of household income, the more affordable these motorised transport services need to be. Collapsed formal public transport undertakings (as discussed in section 4.1) have resulted in informal for-hire (e.g. motorcycle taxis) and public transport (e.g. minibus paratransit) service providers stepping in to satisfy this demand. The adequacy of these services, however, has been widely criticised in the literature. With respect to public transport services more specifically, a common result of weak public sector regulation and driver revenue targets (i.e. the above-mentioned business models in which vehicle owners either claim a fixed daily revenue target and drivers keep the variable balance as income, or drivers keep an agreed portion of fare revenue as commission), is destructive competition and poor quality of service (Adeniji 1987, Gauthier and Weinstock 2010, McCormick *et al* 2015).

Behrens *et al* (2015) argue that the problems commonly associated with paratransit operations in the Sub-Saharan African context can be linked to both ease of market entry, which in some instances may be entirely self-regulated through route associations or cooperatives (Sohail *et al* 2006, Orero and McCormick 2013), and the capacity of public authorities to formulate and enforce coherent regulatory regimes. Un- or under-restricted market entry has led to overtrading on more lucrative routes. In the absence of effective law enforcement, this has led to attempts to violently remove competitors (Dugard 2001, Khosa 1992), aggressive driver behaviour (Mutongi 2006, Wa Mungai and Samper 2006), unsafe operations in the form of excessive speeding, signal jumping, illegal stopping and unroadworthy vehicles (Khayesi 1999, Kanyama *et al* 2004, McCormick *et al* 2015) and unfair labour relations (Khayesi 1999, Rizzo 2002, McCormick *et al* 2015). When vehicle assets have not been maintained and their replacement not planned for, the result has been tenuous business viability. Poor viability has in turn resulted in overloading on more lucrative routes, and the withdrawal of services from less lucrative routes or during less lucrative times of the day. The resulting services often fail to meet the needs of the residents of Sub-Saharan African cities. Paratransit operations have also caused significant externalities: old and poorly maintained vehicles tend to be heavy emitters of air pollutants (Kanyama *et al* 2004); and boarding and aligning practices that spill into traffic lanes reduce already limited road capacities considerably.

There is a broad consensus in the literature that there is an evident case for improving the quality, reliability and coverage of public transport systems in Sub-Saharan African cities. Part of this improvement effort should seek the introduction of larger vehicles with prioritised use of road space on higher volume corridors (Gauthier and Weinstock 2010, Bruun and Behrens 2014), thus enabling superior operating efficiencies and commercial speeds, and lower congestion and environmental externalities.

Recent studies indicate, however, that the capacity of public authorities in the subcontinent to implement large scale improvements to city public transport systems is constrained in terms of both human and financial resources (Christie *et al* 2013, SSATP 2015). In some contexts the absence of this institutional capacity to undertake contextually appropriate mode alternatives analysis and plan public transport improvement projects that match prevailing urban and political contexts and fiscal resources has led to significant errors in the estimation of capital costs, operating subsidy requirements and implementation timeframes (Behrens and Salazar Ferro 2015). It is unsurprising, as noted by Barrett *et al* (2015), that in West Africa those cities that have managed to implement public transport system improvements in recent years all included some form of institutional reform in the improvement process (i.e. the establishment of AGETU [*Agence de Gestion du Transport Urbain*] in Abidjan, UPTUs [*Urban Passenger Transport Units*] and the proposed GAPTE [Greater Accra Passenger Transport Executive] in Accra, CETUD [*Conseil Exécutif des Transports Urbains de Dakar*] in Dakar, and LAMATA [Lagos Metropolitan Area Transport Authority] in Lagos).

The African Transport Policy Program study by Transitec (SSATP 2015) attempted to measure this capacity in 20 selected case cities through the development a 'governance index' (see figure 4.1). Fifteen of the 20 case cities were located in Sub-Saharan Africa. The 'governance index' was developed to measure a city's institutional ability to improve the performance of its transport system. An associated 'performance index' was developed to measure this performance. The indices were calculated using secondary data collected from resident experts in each case city, through a questionnaire developed for this purpose. This questionnaire included a mixture of qualitative and quantitative questions. Figure 4.1 reveals unsurprising correlations between better performance and stronger institutional capacity, and better performance and lower urbanisation pressures. A further finding reported in the study was a lack of reliable and comparable quantitative data on city transport performance. Unsurprisingly the study found a correlation between stronger institutional capacity, and greater data availability and reliability.



Source: SSATP (2015:22)

Notes: ABI=Abidjan (Ivory Coast); ACC=Accra (Ghana); ADA=Addis Ababa (Ethiopia); BOU=Bouaké (Ivory Coast); CAI=Cairo (Egypt); CAT=Cape Town (South Africa); CAS=Casablanca (Morocco); DAK=Dakar (Senegal); DES=Dar es Salaam (Tanzania); GAU=Gauteng city region (South Africa); KAM=Kampala (Uganda); KIN=Kinshasa (Democratic Republic of the Congo); KUM=Kumasi (Ghana); LAG=Lagos (Nigeria); MAP=Maputo (Mozambique); NAI=Nairobi (Kenya); OUA=Ouagadougou (Burkina Faso); RAB=Rabat-Salé (Morocco); SFA=Sfax (Tunisia); TUN=Tunis (Tunisia)

Figure 4.1 Urban transport governance and performance indices, including forecast national urban growth rates 2010-15

An important component of institutional capacity to implement change is clearly the ability to raise sufficient capital and operating cost funding through taxes and levies, or though loans from financial institutions. The appropriation of 'best practice' public transport technologies that have not been fitted adequately to specific local institutional frameworks and passenger demand profiles, and as a result have not accurately anticipated and secured the capital and operating cost funding required by these systems, will likely prove unaffordable without a major diversion of public resources from other sectors of fiscal spending (Wilkinson et al 2011, Behrens and Salazar Ferro 2015).

Some South African cities offer examples of where 'best practice' technology transfers are encountering fiscal barriers. In these cities, the initial anticipation of subsidy-free or less subsidy dependent BRT systems (DoT 2007, Viva 2007) has proven incorrect (CoJ 2013b, Seftel and Petersen 2014, TCT 2015), and indeed the operating subsidies needed might even end up being higher than current levels. Preliminary high-level estimates and early phase experiences suggest that

significant subsidies will be needed for BRT operations, in addition to the costly compensation of exiting paratransit business owners (Von der Heyden *et al* 2014). Even if the improved schedule stability and efficiencies associated with dedicated bus lanes, pre-boarding fare control and reduced bus stop dwell times reduced the per passenger subsidies associated with the relatively inefficient conventional bus services being replaced, any large scale switching of passengers from unsubsidised paratransit services to subsidised BRT services will, by definition, increase total operating subsidy requirements considerably (Bruun and Behrens 2014). It has been estimated that, for the six largest metropolitan cities, total transit operating subsidies will almost double in real terms over 10 years if policy objectives are fully realized (PDG 2011).

A case can of course be made for the treatment of public transport systems as public goods, and for their subsidisation by the state in order to maintain non-excludability and non-rivalry. If a higher performance system is being aimed at private car users (i.e. 'choice' passengers) then a subsidy might also be justified by benefits (in the form of decreased congestion and air quality externalities) to the city from a reduction in car use (Ubbels *et al* 2001). However the national and municipal treasuries are under increasing fiscal pressure, and are unlikely to support dramatic increases in public transport subsidy levels (Bruun and Behrens 2014). Municipal government treasuries are likely to be particularly concerned with the financial risks that accompany gross cost contracting[1] arrangements associated with BRT systems (Behrens and Salazar Ferro 2015).

Limitations in institutional capacity and fiscal resources require that public investments into public transport infrastructure improvements are both innovative, and subjected to thorough analysis and evaluation to ensure that they are appropriate to context. Before reviewing, in some detail, the alternative approaches to reforming or improving public transport systems that have been offered in the literature in the following chapter, it is perhaps useful to discuss first how mode technologies are currently being promoted and diffused in the Sub-Saharan context.

Over the past decade, BRT systems have received greatest policy attention (Behrens 2014). Following the widely acclaimed successes in public transport improvement in Latin American cities, BRT systems have been viewed by many city governments throughout the world as a viable alternative to light rail and metro systems (Hensher and Golob 2008).[2] The basis for this view is a supposition that the capital and operating costs of BRT systems are substantially lower than rail systems, and that the passenger capacities they can achieve are broadly similar. While pre-dated by some Northern American and European urban busways (Chicago [1939] and Runcorn [1971]), the complete package of BRT innovations are widely attributed to Curitiba (Deng and Nelson 2011, Mejía-Dugand *et al* 2013). The features of full specification BRT were introduced in this city gradually: following the initial investment in dedicated busways in 1974, innovations in pre-

[1] Gross cost contracting involves the procurement of specified services at a price determined through tendering or negotiation, by a public authority, from an operator. The operator passes all on-vehicle revenues to the procuring authority (sometimes a third party collects fare revenue), and does not take on any revenue risk. The operator is responsible for meeting agreed targets regarding the cost of providing the contracted service, but has little incentive to attract additional passengers because (service kilometre) income is not determined by farebox revenue.

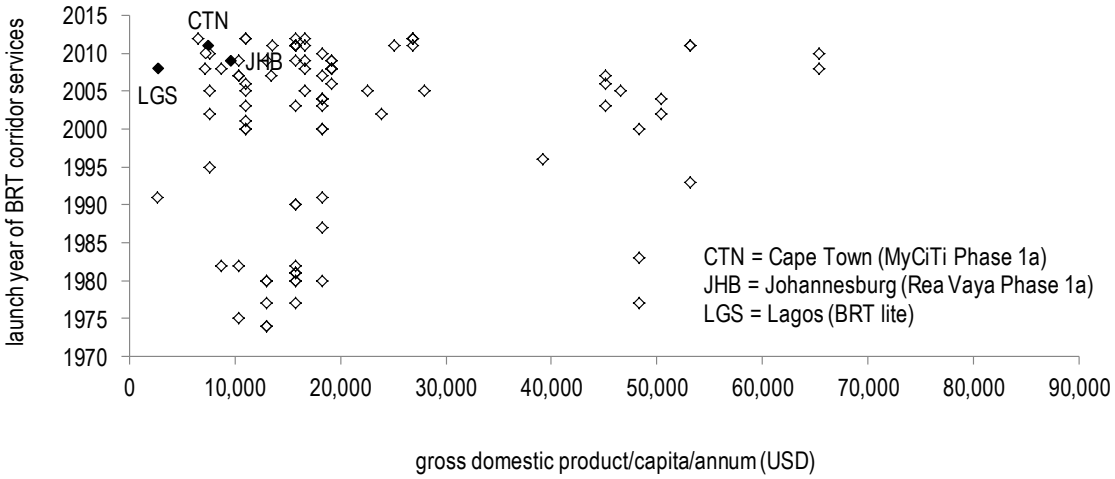
[2] Notwithstanding the emphasis placed on BRT systems in contemporary policy discourse, a number of rail systems have also been constructed (or are being contructed): most notably the standard gauge Gautrain serving parts of the Gauteng city region; and a light rail system in Addis Ababa. Rail investments are also planned in Lagos and Dar es Salaam, and the South African government has initiated a comprehensive modernisation of its rolling stock.

boarding fare control and a single fare for passengers transferring between trunk and feeder services were introduced in the 1980s. For many years Curitiba's *Rede Integrada de Transporte* was regarded as the international BRT exemplar (Rabinovitch 1996; Smith and Raemaekers 1998). In the past decade, however, attention has shifted to Bogotá's *TransMilenio* system implemented in 2000, largely on the basis of the extraordinary peak passenger loads achieved (Wright 2001).

The international diffusion of BRT technology has been fuelled by the dissemination of planning and design manuals. International development agencies – particularly the Institute for Transportation and Development Policy (ITDP) and the *Gesellschaft für Internationale Zusammenarbeit* (GIZ, formerly GTZ) – have disseminated technical guidance, most notably the ITDP's *Bus rapid transit planning guide* (Wright and Hook 2007) and the GTZ's *Sourcebook Module 3b: Bus rapid transit* (Wright 2003). To promote high quality BRT systems, ITDP and GIZ have more recently published annual iterations of *The BRT Standard* which defines what constitutes 'best practice' in BRT system design, and proposes a scoring method that celebrates high-quality systems (ITDP 2014). City BRT systems are awarded 'gold', 'silver' or 'bronze' status on the basis of the scores they achieve. A further means of dissemination has been what Wood (2014a) refers to as 'policy tourism' in which politicians, officials and industry stakeholders undertook study tours to exemplar Latin American cities. Wood (2014a) reports that between 2002 and 2014, seven study tours were undertaken by six South African municipalities to Latin American cities (Bogota, Curitiba, Guayaquil, Pereira, Quito and São Paulo).

In Sub-Saharan Africa, the first 'BRT-lite' services were launched in Lagos in 2008 (Dairo and Brader 2009), followed by BRT starter services in Johannesburg in 2009 (McCaul and Ntuli 2011, Allen 2013, Seftel and Rikhotso 2013) and in Cape Town in 2011 (McLachlan 2010, Schalekamp and Behrens 2013, Grey and Behrens 2013) (see figure 4.3). Construction of the first BRT corridor in Dar es Salaam began in 2012, and was scheduled for completion in 2014 (Ahferom 2009, Ka'Bange *et al* 2014, Rizzo 2014). Other cities, particularly in South Africa, are well advanced in their planning phases (e.g. Pienaar *et al* 2007, Moodley *et al* 2011, Voukas and Palmer 2012, Agyemang 2015, Weinstock and Hook 2015). With notable exceptions in West Africa, some of these proposals, at least initially, were explicitly or implicitly directed at the large-scale replacement of paratransit services through the phased incorporation of incumbent operators into formal bus operating companies, or through compensation deals (Behrens and Salazar Ferro 2015).

Figure 4.3 presents a timeline of BRT (or proto-BRT) corridor service launches by city gross domestic product per capita. While it cannot be claimed that these data are comprehensive, the figure does demonstrate that over the past decade BRT technology has diffused fairly rapidly. Behrens 2014 reports that of the 168 BRT corridors for which launch year data are available, 115 (68%) were launched in the last decade. The data highlight the late adoption of BRT in above mentioned cities, as well as the pioneering contribution of Latin American cities (particularly Lima [1972], Curitiba [1974], Belo Horizonte [1975], Goiania [1976], Porto Alegre [1980], Recife [1982] and São Paulo [1980]). Bus transportation arguably represents one of the few policy sectors in which innovation and technological development has flowed stronger from the 'global south' to the 'global north', than other way round.



Source: Behrens and Salazar Ferro 2015, citing www.brtdata.org (accessed 15-Nov-2012).

Figure 4.3 Diffusion of bus rapid transit corridor systems, by city gross domestic product per capita (n=99)

The policy tendency in Sub-Saharan Africa described earlier in this section to seek easily transferable existing solutions to public transport problems developed elsewhere, which replace existing paratransit operations, is argued here to be problematic. Notwithstanding the problems with existing services discussed earlier, the paratransit sector often presents benefits seldom associated with formal, fixed systems (McCormick *et al* 2015). Paratransit business owners are quick to respond to new demands for service, and as a result penetrate many and diverse passenger markets within the city (Cervero and Golub 2007). In the context of the aforementioned unprecedented forecast urbanisation on the subcontinent over the coming decades (UNDESA 2012), and the pressures this will place on already stretched government capacities and fiscal resources, an ability to respond rapidly to new patterns of demand is likely to be an important asset (Behrens *et al* 2015). This demand-responsiveness, service innovation and coverage is of course achieved free of direct operator subsidisation. Paratransit can also offer an important source of income and poverty alleviation to a segment of the population that often finds itself superfluous to the formal economy (McCormick *et al* 2015). The following chapter elaborates these themes, and describes in some detail the approaches that have been posited in the literature as a means of reforming public transport systems in Sub-Saharan African cities.

5 Public transport improvement and reform in Sub-Saharan African cities

This chapter explores alternatives through which public transport services could be, and have been, improved. Approaches that could be taken to reforming existing services are discussed in relation to the potential for their application in the context of contemporary Sub-Saharan cities and the characteristics of their existing public transport systems. Notable amongst these characteristics are the reliance on fragmented road-based public transport, and within the road-based sphere the proliferation of paratransit-type services. Against this background four alternative reform approaches are presented in section 5.1. These approaches draw on the international theoretical literature as well as on the limited literature on the implementation in practice of these approaches in Sub-Saharan Africa (the

categorisation of approaches draws from Schalekamp *et al* 2010, 2015). Each of the approaches requires a different degree of infrastructural change and investment, and the discussion is ordered from the approach requiring the most change to that necessitating little or no change. In section 5.2 case examples are provided of implementation, or attempts thereat, of different approaches to reform public transport systems in the region.

5.1 Alternative approaches to public transport improvement and reform

The first approach to public transport that is presented in this section is the introduction of a new mode of mass transit into which existing operations are assimilated. This is followed by a discussion of a stepped transition of existing public transport operations to a consolidated system. The third potential approach to public transport reform is modal improvement of existing operations with supporting minor regulatory changes. The last approach discussed in this section is that of the introduction of alternative competition regulation regimes to mediate existing operations.

Introduction of a new mass transit mode incorporating existing services

The introduction of a large-scale new mode of public transport presents opportunities to incorporate and/or displace existing public transport operators in order to improve services. A new mode of mass transit can be either rail-based or road-based. However, in the Sub-Saharan African context it is particularly the road-based aspect of this approach that is of interest. This is reflected in the very small body of literature on rail-based improvements in the region, primarily limited to South Africa and to the upgrading of existing surface commuter rail services (see Heyns *et al* 2013, Onderwater 2012) and service aspects of the Gautrain rapid rail system in the Gauteng Province (see Van der Merwe *et al* 2012, Van der Westhuizen 2007) of this country.[3] Neither of these processes incorporated the reform of road-based services. In contrast to rail-based reform, interest in BRT as a new mode of mass transit to reform existing public transport has seen far wider attention in the region, as discussed above in section 4.3.

BRT introduction allied to the large-scale assimilation of existing public transport services was popularised as a reform approach in Latin America. Curitiba's Rede Integrada de Transporte (RIT) as it stood in the 1970s is commonly seen as the first BRT system (ITDP and GIZ 2012). Bogota's TransMilenio system built on the Curitiba RIT concept, but with operational and technical refinements and an overt aim of paratransit assimilation. Bogota's 'second wave' BRT implementation approach has since found its way across the globe, including to a number of Sub-Saharan cities (individual cases are discussed below in section 5.2). The BRT-based reform approach aims to install a citywide network of high-quality bus services. These services would replace and incorporate existing public transport services. On high passenger demand lines dedicated road space and preferential treatment at intersections are commonly introduced to increase bus travel speed. In low demand areas feeder services are less distinguishable from standard bus services, except for potentially unified vehicle and infrastructure branding matching that of trunk services. Other features of BRT installation commonly include central operational monitoring and management, and integrated cashless fare collection systems.

The BRT-led approach has in practice tended to conform to a particular pattern. The complete network plan is typically split into various project phases and corridors; this allows the complexity and cost of implementing new services, and negotiations around existing operator assimilation, to be spread geographically and

[3] The current rail service planning in Addis Ababa, Dar es Salaam and Lagos mentioned in an earlier footnote, appear to have received little attention in the literature.

over time. The first phase is a critical component of this approach as its demonstrates to operators situated in other parts of the city that those operators who were incorporated into the first project phase draw financial and employment benefits from participating in the BRT system. It also demonstrates to funding authorities that investment in further phases would be warranted. A key argument advanced in favour of the BRT large-scale infrastructure-led reform approach is that demonstrable service quality improvement is needed in the first phase to persuade political decision-makers to support funding for subsequent project phases (Wright 2004).

Stepped transition to a reformed system

An approach to public transport reform that is less reliant on the 'big bang' approach of BRT is that of a stepped transition to an improved or high-quality road-based system that uses existing public transport operations as basis. Browning (2001, 2006) articulated this approach, which was attempted in the Nelson Mandela Bay Metropole in South Africa in the late 2000s. In contrast to the phased construction of BRT infrastructure, it follows an engagement process with a more flexible outcome that does not rely on the implementation of BRT concurrent to the restructuring of existing services. A potential outcome of this approach can nonetheless be a complete BRT system. However, instead of following an engagement trajectory with a fixed outcome (i.e. assimilation into BRT operations led by infrastructure construction), a stepped transition provides existing operators with a way out of the engagement process at multiple points. Browning argues that if existing operators – particularly paratransit operators – do not have such an escape option that they would find it difficult to commit to large-scale change and would be likely to return to their previous operating practices.

This approach to public transport reform comprises sequential steps that would span over many years. It is most suited to reforming paratransit or similarly fragmented road-based operations. The first step of this approach is that public authorities support paratransit operator groupings to form commercial entities (e.g. cooperatives or companies) and to institute professional management to operate existing vehicles. Such operational costs would be covered through an interim vehicle management contract. Paratransit owners would thus relinquish only the management of their vehicles and drivers to the management company. In so doing this step would achieve a more orderly form of operations. This would involve negotiations to allocate routes, vehicles and drivers fairly to reflect differences between more and less lucrative routes and times of day. At this stage vehicles still remain the property of the original owners. Since the vehicle ownership structure is untouched, if the collective management scheme should collapse then owners could revert to their prior paratransit operations. However, should collective management be successful, the next step would be to introduce cashless fare collection to separates fare box cash from vehicle operations. Browning suggests that fare-box revenue be handled by a separate company, which would then be disbursed by this company to each operator. It is also an option for the vehicle management company to collect fares. Irrespective of the fare collection mechanism that is employed, the transition must be handled transparently as it requires operators to remain convinced that the revenue that they generate is not being taken away from them.

This approach allows for more flexibility than comprehensive BRT installation. It could nevertheless result in the same outcome, in the form of a full specification BRT system (Hitge and Van Dijk 2012). Such an outcome would only be realised over a much longer timeframe, as the initial aim is to address problems with existing operational and ownership structures. However, similar to the BRT-based approach, a stepped transition cannot guarantee that reform outcomes will be achieved. The assumptions that existing operators would necessarily be willing participants in the reform process, and that there is sufficient public institutional

capacity to complete all the steps of the upgrade process, may not reflect the actual context in Sub-Saharan African cities. Nevertheless, dividing the transition into a sequence of more contained outcomes, and thus increasing the potential for existing operators' participation, could reduce the risk of extensive investments in infrastructural or institutional reforms going to waste. It still remains critical that a positive relationship between public authorities and existing operators is established. Public authorities must also be able to commit in the long term to driving reform. In a stepped approach to reform there is also the possibility that there could be a smaller scale of participation in collective management than would be required to achieve the necessary economies of scale to justify the cost of change. This would in turn reduce the extent of improved services that are offered to passengers.

Upgrading of existing public transport services and allied regulation

A third approach to reform focuses on upgrading existing operators and strengthening regulators systems. The rise and dominance of small-scale, atomised operations rendered by paratransit and small bus businesses suggests that they are more efficient and attractive to passengers than is generally accepted, and that their flaws are over-emphasised. These types of services are also minimally reliant on direct public funding. Lomme (2008) in his analysis of the paratransit sector in South Africa suggests that these types of services should be supported and upgraded, rather than replaced by new public transport modes. In view of the advantages that these existing services offer, market entry should preferably be deregulated to allow free competition between multiple operators. Such deregulated competition should be mediated by market forces, which when viewed historically have led, amongst others, to lower fares, reduced overall public expenditure, improved services, greater innovation, and a greater demand-responsiveness.

Their failings are, however, clearly acknowledged. Cervero (2000) discusses many of them: aggressive competition for passengers on the road, dangerous driving behaviour, inefficient road space utilisation particularly on longer distance routes, a predominant focus on lucrative routes, and poor vehicle maintenance. Cervero argues that such traits do not mean that authorities should regulate paratransit out of existence. Authorities should rather promote safety and fair competition, and leave matters of supply, service, and price to the market. Operator associations often fill the market entry regulation void, and thus serve a *de facto* regulatory function. Despite the pressure that this takes off regulatory authorities, there is still a role for the public sector to play. Such roles include setting and enforcing requirements relating to operations, safety, vehicles and labour. Compliance with these requirements should be the only legal limitation to market entry, the enforcement of which falls within the public sector ambit. Public authorities can also play an infrastructure provision role, though it would be at a smaller scale than with the BRT or stepped transition approaches. The upgrading and maintenance of existing vehicle ranking facilities and high-demand passenger boarding points form part of these considerations, as do dedicated road-space and preferential intersection treatments. Table 5.1 provides a summary of the range of possible initiatives that might be considered.

Table 5.1 Categorization of measures for improving paratransit services

Business development	Operating environment	Vehicle fleet	Operations
• business consolidation (including cooperatives and route associations) • business skills training • business diversification (including fuel, tyres, insurance, financial services, maintenance, advertising) • bulk purchasing discounts	• rank/terminus provision including wayfinding signage • road space prioritisation, (including MBT lanes, queue jumpers, signal priority) • embayments (including signage)	• vehicle renewal incentives • cooperative loans including vehicle purchase and repairs	• driver training • salaried drivers • consolidated driver recruitment and management (including pax. compliance, driver demeanour, uniforms • consolidated vehicle management and tracking using ICT • speed governors • pax info (via phones, stationary signs, vehicle signage) • cashless ticketing

Source: Bruun and Behrens (2014)

In line with arguments in favour of market entry deregulation and limiting public intervention to improving service quality and safety, the aim with upgrading existing operations is to encourage service diversity. This would almost inevitably also boost competition with the limited fixed-route scheduled public transport systems in the Sub-Saharan African cities. Cervero (2000) argues that urban passenger transport markets benefit most from an array of service and price options, rather than from economies of scale. The inherent flexibility and profit motivations of competing and diverse atomised services make them more market-responsive than large-scale rail- and road-based businesses, and also more likely than public authorities to develop new services in response to changes in demand patterns. Such services responses include increased suburb-to-suburb movements, off-peak travel, or peripheral informal settlement growth. Where atomised services compete directly with scheduled bus or train services, Cervero suggests that the policy objective should be simply to ensure that they do so fairly.

Instituting greater competition regulation through contractual agreement

The last approach to public transport reform entails public authorities instituting competition regulation on an area-based level. Where there are existing or planned mass transit services, this approach may also lend itself to the provision of feeder services to such trunk services; it is not uncommon for paratransit to play this feeder role. Mechanisms to achieve such competition regulation include the introduction of franchises and concessions. Barter (2008), Gwilliam (2002), Halcrow Fox (2000) and Meakin (2004) discuss the characteristics of such contractual mechanisms in relation to regulating public transport operations, though introducing such mechanisms could be accompanied by the smaller infrastructural investments as discussed in the existing service upgrading approach above.

The literature agrees that there are two types of franchises. The first is the provision of services on specific routes, and the second is franchises covering an area-based package of routes (Meakin 2004). The type would depend on the size of the geographical area; however, Barter (2008) warns that franchising is a cumbersome mechanism to regulate individual routes and might stifle network development. In the case of route packages individual route development would largely be left to operators to maximise both operational needs and the efficiency of passenger service. The role of the public authority would be to institute and monitor over-arching service requirements. There need not necessarily be a transfer of funds between the public authorities and operators. Operators could feasibly take the risk of both service development and fare collection (Halcrow Fox 2000). The role of the authority is largely detached. Public authority involvement would be limited to specifying the desired fare levels and service requirements, and subsequently to monitor the degree to which franchisee's performance matches these requirements. A key issue in a route package system that is built gradually over time, is how to avoid larger operators hugging the most profitable routes and unwanted overlaps between routes.

Gwilliam (2002) and Halcrow Fox (2000) draw specific distinctions between franchises and concessions. Under a concession the operator is given the exclusive right to provide a service or package of services within a particular area, while different franchises may cover the same area. In a concession arrangement there is thus no competition between different operators on the road. Rather, the opportunity for competition arises only when operators bid for available concessions. Under a concession agreement the operator takes complete financial responsibility for providing the concessioned services. The public authority would define the limitations of such services, which generally relate only to the basic standard of service. Such standards may include vehicle safety and livery standards, as well as emission controls. In a franchise situation the authority would specify the service that is to be provided to a greater level of detail than in a concession, but with the consequence that the authority must then be prepared to cover the cost of such services. A concession arrangement removes the need for public authority intervention in technical, organisational and financial matters. At the same time this would limit the potential for the authority to intervene in the service that is provided. In the context of reform, the aim with introducing either of these contractual mechanisms would be to establish greater control over services. The type of mechanism would depend on the scale control and involvement that the authority would want: the more influence an authority wants in terms of fares and the level of service that is to be provided, the less appropriate a concession becomes and the more effective a franchising arrangement becomes.

A key reason why franchises and concessions should be considerations in public transport reform is because they can match the existing territorial nature and internal structures of existing paratransit operations. Paratransit operations in practice resemble concession arrangements. Public authorities take little or no direct responsibility for financial risk or specifying operations, and paratransit operators are left to serve passenger demand and extend services as urban areas expand. Associations to which individual operators belong serve a mediating and coordinating role amongst their individual businesses and routes. In some cases associations also provide a degree of service quality monitoring. Collective organisations thus already perform roles at the operational, planning and regulatory levels, for example dispatching vehicles, maintaining ranking facilities, resolving conflicts, and developing routes (Cervero 2000, Golub 2005, Sohail *et al* 2006). Associations and operators furthermore have a detailed understanding of the operational requirements and passenger demand in the areas in which they are active. These roles might not be officially recognised, but could nonetheless fit within what might be required of a franchise- or concession-holder. With some degree of recognition and support from the public sector, and where there are little

overlapping interests between operator organisations, introducing a contractual agreement could formalise this role. This could also work with typically limited public authority capacities to develop the public transport market.

5.2 An overview of contemporary public transport improvement and reform initiatives in Sub-Saharan Africa

A number of cities in the Sub-Saharan African region have set out to improve and reform their public transport systems using one or multiple approaches discussed in section 5.1. Broadly speaking, two main goals are pursued in public transport reform, both of which affect existing service operations. The first goal typically is to introduce a new public transport service that incorporates, competes with or displaces paratransit, while the second is to improve existing services either comprehensively or through addressing selective aspects of their operations.

These two goals are not necessarily mutually exclusive. Some reform programmes have set out to coordinate efforts to achieve both, while in other instances concurrent but separate projects aim to achieve both goals in the same city or country. The success of these efforts depends on a number of elements. These elements include: the capacity of the implementing authority or authorities to coordinate and manage reform; operators' preparedness to absorb or accept change; the level of complexity of the reform programme or programmes; and the available level of funding. Sub-Saharan Africa provides a number of examples illustrating a diversity of reform approaches and outcomes.

The initial phases of the reform projects in Cape Town, Johannesburg and Dar es Salaam conform with the approach focussed on the introduction of a new mass transit mode and the incorporation of existing services into this system. Lagos follows this approach as well, although there are elements of a stepped approach to reform insofar as full specification BRT services were not implemented and existing paratransit operators were not excluded from operating within the corridor and its feeder catchments. Port Elizabeth adopted a more incremental approach consistent with the stepped transition to a reformed system. Accra follows this stepped approach as well, but includes elements of the approach focussed on the upgrading of existing services. The project described in Dakar conforms largely with the approach focussed on the upgrading of existing services (as does the South African fleet renewal scheme discussed), but includes an element of the approach focused on instituting more sophisticated competition regulation through franchises as well.

Cape Town

The Cape Town municipality set out to develop a high-specification BRT system in 2007. This system aimed to eventually cover the entire city and fill gaps in the urban rail network, and drew heavily on the Bogota BRT approach (Wood 2014a, 2014b). The project formed part of a national government programme that aimed to improve public transport services in a number of urban areas around the country. The Cape Town BRT system, known as MyCiTi, was planned in a phased manner. The first trunk and feeder services commenced operations in 2011, while the full first phase of the project is projected for completion in 2015. Grey and Behrens (2013) offer a strategic analysis of the extent of the first project phase's impacts on surrounding land use. Existing bus and paratransit operators were given the opportunity to become the operators of MyCiTi. The transition process has, however, proved to be fraught with difficulties, including disgruntlement, violent opposition, and legal challenges from operators (McLachlan 2010, Schalekamp and Behrens 2013). Construction progress outpaced operator incorporation, and the first phase's capital and operating costs have overshot estimations by some margin. In the upcoming phase it appears that the system's specification level will be toned

down, though the paratransit sector's political structure is far more complex in this phase, which penetrates the predominantly low-income sector of the city.

Johannesburg

Johannesburg, part of the Gauteng province conurbation, embarked on a high-specification BRT scheme, named Rea Vaya. It shares the approach of the Cape Town's MyCiTi system, and sits within the same national framework. The project was also conceived in a phased manner to incorporate the municipal bus company and paratransit operations. A distinction is that the initial round of paratransit negotiations was concluded more rapidly than in Cape Town. Negotiations took place only with two entities, in the form of regional paratransit associations, and the affected bus company was a municipal entity, which further simplified engagement (see McCaul and Ntuli 2011, Venter 2013). A Colombian BRT operator assisted in establishing and running the new operating company, name Piotrans. It is of note that there was significance resistance from residents in the first phase, where a key trunk route ran through a wealthy suburb. This forced a change in routing to a less convenient corridor. Rahim (2014) describes broader socioeconomic impacts of the project. There was, nonetheless, strong leadership from the city councillor for transport during the first years of the project. She consistently stood firm during negotiations with paratransit operators; this stance was an important factor in maintaining the momentum of the project. With her resignation in 2013 some of the project's momentum has been lost.

Dar es Salaam

The city council of Dar es Salaam commenced in 2003 with developing a BRT system, known as Dar es Salaam Rapid Transit (DART), to improve the level of mobility of the city's residents. Funding for the first phase of the project was provided by the World Bank and the ITDP supported project planning. Besides the mobility aim, the project was also planned to gradually replace paratransit operations (Ahferom 2009). Paratransit operators were encouraged to form consortiums to bid for service provision, though these consortiums had to include an international partner. DART implementation has been slow – construction on the first phase only commenced in 2010 after a World Bank loan was approved in 2008 to fund construction. Limited government funding and institutional capacity have been prominent factors in the slow progress of the project. In 2014 international consultants were appointed with the mandate to advise the DART agency on the procurement of bus operation, fare collection and fund management services (DART 2014). This has spurred progress with the project. Separately to DART, measures were put in place to develop paratransit codes of conduct and operational standards, to enforce labour rules and contracts, and to bar 18-seater minibuses from operating in the city centre to ease congestion. These measures have not led to a marked improvement in the services provided by paratransit operators.

Lagos

Lagos, the largest city in Sub-Saharan Africa, launched an enhanced bus system in 2008 under the auspices of the then newly established Lagos Metropolitan Area Transport Authority (LAMATA) (see Dairo and Brader 2009). Unlike the previous examples, the BRT-lite service omitted level boarding, continuous exclusive rights-of-way, and enclosed stations, amongst other features commonly found in full-scale BRT systems. This led to a rapid implementation period of the pilot service. Institutional reorganization formed a large part of the programme, though in terms of modal reorganisation there was no overt replacement of existing public transport services. Instead, BRT-lite added to the modal choice on the corridor in which it was introduced – such competition with existing services was seen to be beneficial and added to passenger choice (Adebayo 2009 and Kolawole 2010 investigated passenger attitudes in relation to the BRT-lite). Nonetheless, the ownership model allowed for the incorporation of the main paratransit union as well as the state-

owned bus entity. Due to the design of the system there have been operational problems, notably right-of-way conflicts and slow operating speeds, though it still offers travel time savings. The basic level of specifications significantly reduced implementation costs, although there is a concomitant lower standard of service to passengers.

Port Elizabeth

South Africa's Nelson Mandela Bay Metropolitan Municipality, which incorporates the city of Port Elizabeth, initially followed a different approach to Cape Town and Johannesburg in reforming its public transport system. Instead of commencing with a phased BRT programme, the municipality agreed with paratransit operators in the city on a stepped paratransit formalisation programme that covered the entire city. Though not formally documented, Browning was involved in this process and thus it drew directly on his previous publications (see Browning 2001, 2006). The outcome was envisaged to be an improved bus or BRT system, though only after preparing paratransit operators to take up such operations. The first step in the programme was to create five cooperatives that consolidated multiple existing paratransit associations and covered the main geographic regions of the city, and one overarching cooperative to coordinate their activities. Dedicated lanes were to be created only where necessary and to be shared by paratransit and bus operations, with the first being installed for the 2010 FIFA World Cup. The collectives were established within a short timeframe (that ran from mid- to end-2009), but since the project diverged significantly from the national Public Transport Strategy approach and funding mechanisms (which favoured BRT) it proved a challenge for the municipality and national government entities to come to an agreement. Delayed progress, and politics – both public and internal to paratransit interests – ultimately led to the stalling of engagement around the membership and responsibilities of the collectives and, in turn, the collapse of the overall reform process. Efforts to introduce a BRT-led reform programme surfaced in 2012, though this approach has floundered due, amongst other factors, to poor public sector management.

Accra

Paratransit operators in Accra were historically self-regulating by way of the route-based unions to which they belonged. Between 2007 and 2012 the national government, supported by the World Bank, planned a large-scale public transport reform programme to promote both existing modes and BRT (Finn 2008). This multi-faceted approach aimed to incorporate existing bus and paratransit operations in a licensing framework, but also to introduce a new mode of mass transit. Services were to be aligned with demand, and the use of larger buses encouraged on main arterials. A BRT demonstration corridor was also planned, which included support services by scheduled buses and paratransit vehicles. The options given to paratransit operators were to improve their vehicles and continue existing services, to develop feeder and local bus services, or to compete for core bus services by formalising operations. The expectation was that paratransit will eventually be displaced by the formal services, although the city is growing rapidly enough to offer continued service opportunities. The project has achieved mixed success (see Finn 2012, World Bank 2012, 2013). In 2011 registration and licencing of existing bus and paratransit operations commenced. Construction of the pilot corridor of the BRT service was initiated, but only two bridges were constructed by December 2012. Cost overruns meant that funds were not sufficient for the terminals, depots and feeder routes of the pilot BRT system to be constructed. An interim planning and regulating entity was created, but the fully-fledged transport authority was still not established by the end of 2012. To allow additional time for the institutional changes to take place the project completion date was extended December 2014, though Agyemang (2015) suggests that the future of the overall reform project is still uncertain.

Dakar

In Dakar ubiquitous paratransit services regulated themselves at route-level before the municipality launched a public transport reform process in 2005 (as documented by Kumar and Diou 2010). As in the case of Accra and Dar es Salaam the World Bank also assisted in this project. This reform programme was preceded by some years by the formation of a transport regulatory body, CETUD (Dakar Urban Transport Executive Council), in 1997. The aim of the reform programme was to help paratransit operators to access new vehicles, and to consolidate their ownership structures. Operators were assisted to form 13 collectives ('economic groupings'), and each collective was offered a formal route franchise. The programme also established a vehicle-financing scheme to these groupings, under which they would collectively be responsible for loan repayments and maintenance on the leased vehicles. Efficiency gains through ownership restructuring, better route allocation, and improvements in fare collection have had a greater impact on service improvements rather than just fleet renewal on its own, though the fleet renewal was an important catalyst to change. This case demonstrates a combination of the existing operations upgrading and the new competition regime introduction approaches. In addition to the reform programme, CETUD has in recent years been investigating the financial viability of a BRT pilot scheme. Should the economic groupings become the operators of such a BRT system, the various individual improvements would collectively amount to a stepped transition approach.

National paratransit vehicle renewal programme in South Africa

In addition to the BRT-led reform drive in South Africa there has also been a national paratransit-specific renewal scheme, the Taxi Recapitalization Programme. This programme has been in effect since 2006. Van Schalkwyk (2009) documented the programme's formulation and early years of implementation. The programme introduced a system under which old minibuses could be surrendered for scrapping on condition that the owner holds a valid operating license. In return for vehicle surrender, a fixed capital amount (presently ±USD6 000) is paid to the owner. The owner then has the option either to take the contribution in cash and leave the sector, or to use the contribution towards purchasing a new minibus. The national Department of Transport releases updates to its list of vehicles conforming to the prescribed safety specifications from time to time, and the capital contribution is adjusted annually to take account of inflation. The significant shortfall that paratransit operators have to cover out of their own pockets is often problematic given that the scrapping allowance equates only to a quarter to one-fifth of the cost of a new vehicle. Nonetheless, as an example of upgrading of existing operations this reform approach has been moderately successful: national figures indicate that between 2006 and 2013 around 54 000 of the estimated national fleet of paratransit minibuses of 135 000 have been replaced.

6 Implications of alternative public transport improvement and reform approaches

The material presented in this chapter differs from that presented in chapters 3, 4 and 5 in that it does not draw from the available body of literature. Rather, it tentatively explores the implications that different ways of pursuing public transport improvement and reform may have. More specifically it explores, in matrix form, the potential implications the alternative approaches identified in chapter 5 have for required financing arrangements (section 6.1), public sector institutional capacity (section 6.2), and city-wide passenger market benefits (section 6.3).

Of the four approaches to public transport system improvements discussed in chapter 5 – given the urban infrastructure focus of the broader project that this

literature review serves – only the implications of those with an explicit and distinct infrastructure development component are considered in this chapter. Thus the approach focussed on reforming the competition regulation framework through concessioning or franchising is not included. This approach may or may not involve new infrastructure provision, and it is therefore difficult to conceptualise or generalise the implications it has particularly for financing and passenger experiences.

6.1 Financial implications

The financial implications for public authorities are discussed in terms of capital and operating costs. Capital costs include infrastructure installation, fleet acquisition and (where applicable) incumbent operator compensation. Operating costs include running the public authority itself, subsiding operating expenditure (when costs exceed fare box revenue), infrastructure maintenance, fleet maintenance (where applicable), and passenger-side subsidies (if provided). Financial implications are also discussed in terms of potential revenue generation through land development in the vicinity of public transport stops, and through actual service operations.

Table 6.1 (a and b) posits whether the impact of the typical implementation of each approach is likely to place high, medium or low (or zero) burden on the public authority in the case of expenditure, or offer medium or low (or zero) potential in case of revenue streams. The ratings in the matrix are discussed briefly for each approach in turn.

Table 6.1 Implications of alternative approaches for public sector financing arrangements

(a) expenditure		**New mass transit mode**	**Stepped transition**	**Existing service upgrade**
Capital	• fixed infrastructure	high	high / med	med / low
	• fleet	high	high (later on)	high / med
	• incumbent op. compensation	high	low/zero	low/zero
Operating	• public authority	high	high	med / low
	• operating deficit subsidy	high (context specific)	high (context specific)(l.o.)	low/zero
	• infrastructure maintenance	high	high (later on)	medium
	• fleet maintenance (where applicable)	high	high (later on)	low/zero
	• passenger-side subsidy (if prov.)	context specific	context specific	context specific

Notes: high=high public sector cost burden; medium=medium public sector cost burden; low/zero=minimal or no public sector cost burden

(b) revenue generation		New mass transit mode	Stepped transition	Existing service upgrade
Land development	• land value capture – levy or contrib.	high	med / low	low/zero
	• land value capture – lease rental	high	med / low	low/zero
Operations	• station retail	high	medium	med / low
	• advertising	high	high (later on)	low/zero

Notes: high=high public sector revenue potential; medium=medium public sector revenue potential; low/zero=minimal or no public sector revenue potential

'Levy or contribution' land value capture refers to mechanisms in which additional land value derived from public transport system improvements is extracted from adjacent property owners, in the form of betterment levies, developer exactions and impact fees, or negotiated developer contributions.

'Lease rental' tax land value capture refers to instances in which land ownership of adjacent developed properties is retained (solely or jointly) by the public authority, and additional land value is extracted through rental income.

New mass transit mode

In addition to considerable capital investments in infrastructure and rolling stock, complex new mass transit systems, especially when first introduced into a city, also require capital expenditure on components like fare collection systems, control centres and depots or marshalling yards. In many instances incumbent operators need to be compensated for the withdrawal of their operating licenses and loss of business, especially if the validity of such licenses is protected by legislation. New mass transit systems are therefore capital intensive and consequently typically publicly provided, and require strong political decisions for priority above other sectors of service delivery. Implementation typically involves the purchase or expropriation of land, or disruption to other property owners, which can be politically sensitive. Large scale infrastructure investments are sometimes also viewed as susceptible to corruption, with estimates that corruption can increase the cost of such projects by between 5 and 20% (Chakwizira and Mashiri 2009).

The operating cost burden of mass transport projects is also generally high. A sizeable public authority needs to be capacitated and resourced to plan and regulate operations. Operating deficit and passenger-side subsidies are often also required.

Financing arrangements for such projects are complex and require careful risk assessment. The risk associated with the repayment of capital financing is dependent upon the sustained quality of service operations over the financing life of the assets, and associated fare revenue. For this reason the maintenance regimes of the system need to be locked into the financing agreement in order to ensure the operating income stream is sustained and protected, and capital investors can rely on protection and growth of the initial investment. When private operators are contracted to provide service on a gross cost contracting basis, this transfers considerable financial risk to the public authority. Capacity to manage such risk then also needs to be built into the public authority.

A benefit of new expensive mass transit projects, aside from the fact that they provide for high passenger volumes, is the opportunity they provide to generate

revenue from sources other than fares. Large investments, especially rail, in the right conditions can result in on-site revenue generation through retail and advertising, and an increase in the value of adjacent land and properties. Mohammad *et al* (2013) have shown that rail projects have a positive impact on both land and property values, and that the added value is higher on land than on property. Significant variations in value occur amongst different land use types such as office, residential or retail uses. Cervero and Kang (2011) demonstrate that BRT systems can result in land value increases similar to those of rail projects, although their study revealed evidence of lower value growth in some contexts. Various land value capture mechanisms have been developed, and in some cases successfully employed in cities around the world (Suzuki *et al* 2015, Medda and Modelewska 2010).

Stepped transition

A stepped transition programme would require a well-developed network plan that would probably show one or more desired end-states, at least in relation to key corridors. Initial stages may require moderate capital investment within a standard range for roadway and stop infrastructure projects, while excluding expenses on depots, control centres or vehicle fleets. Capital expenditure in this phase would typically be aimed at improvement in the quality of existing facilities. In the later phases, however, capital expenditure requirements would increase as the service transitions into a mass transit system.

The operating cost burden would likely mirror that of a new mass transit project in later phases, but be less in the initial phases. Initial operating improvements would probably be financed through modest grants to operators or marginal subsidisation. Given the complex planning and negotiation process, a capacitated and resourced public authority would nonetheless be required from the outset.

While less impactful, a sustained programme of investment could give sufficient confidence to land owners to develop their properties in conjunction with the public transport improvements, and land value capture may be possible. Such revenue is likely to only come on stream in later phases.

Existing service upgrade

This approach is unlikely to be capital intensive, but rather focuses on operational improvements, coupled with regulatory change. Capital expenditure is likely to be highest in the area of fleet renewal, but some expenditure on ranks or major stops, embayments and road space prioritisation would also be required. Infrastructure investment would be aimed at removing bottlenecks for public transport services. However, unlike similar interventions in the stepped transition approach, these may not be coordinated along specific corridors according to a network plan.

Upgrading of vehicle fleets could also be stimulated by operational expenditure, such as subsidising the replacement of tyres, or developing vehicle service facilities. Other items of recurrent expenditure could take the form of training and testing vehicle crews, and developing the business management skills of vehicle owners.

This approach would not be aimed at a substantial mode shift or geographic targeting, and therefore not geared for land value capture mechanisms to recoup capital or operating costs. As this approach largely aims to subsidise elements of passenger safety, it does not affect the cost structure of a typical paratransit service, and hence would have little impact on operational revenue.

6.2 Institutional implications

The institutional implications for public authorities of the alternative approaches are discussed in terms of responsibilities relating to infrastructure and operations. Infrastructure responsibilities can relate to network planning, construction and

maintenance. Responsibilities for operations can relate to the formulation of a regulatory framework, operations planning (and provision if the public authority also acts as the service operator), negotiating the transition from informal to formalised businesses, engaging private operator's services (through licensing, concessioning, franchising or contracting), supporting operator development, fare collection and revenue distribution, fleet maintenance (when vehicles are owned by the public authority), enforcement, and passenger information systems.

Table 6.2 posits whether the different approaches would place high, medium or low (or zero) responsibilities on the public authority, with associated institutional capacity requirements. The ratings in the matrix are discussed briefly for each approach in turn.

Table 6.2 Implications of alternative approaches for the capacity of public sector institutions

		New mass transit mode	Stepped transition	Existing service upgrade
Infrastructure	• network planning	high	high	low/zero
	• construction prog. and contracting	high	high	medium
	• maintenance	medium	medium	med / low
Operations	• regulatory framework	medium	high	high
	• operations planning	high	high (later on)	low/zero
	• service operations	high (if applicable)	low/zero	low/zero
	• transition negotiation	high	high	low/zero
	• pr. op. service engagement	high	high (later on)	low/zero
	• operator support	low/zero	medium	high
	• fare collection and distribution	high	high / med (later on)	low/zero
	• fleet maintenance	high (if applicable)	low/zero	low/zero
	• enforcement	medium	medium	high
	• pax information provision	medium	medium	med / low

Notes: high=high public sector institutional capacity required; medium=medium public sector institutional capacity required; low/zero=minimal or no public sector institutional capacity required

New mass transit mode

The institutional capacity required to develop a public transport network plan differs from those of road network planning, and requires skills that are not likely to be present in cities with mostly informal public transport systems. In addition, equally

strong spatial, economic and social planning skills and competencies should be acquired in order to achieve the full urban development benefits of transport infrastructure investment. While it is typical to use experienced international contractors during the construction phase, it is essential for the implementing authority to attain and then retain appropriate human resource capacity during construction and when maintaining the new infrastructure. It is also critical that the supply of equipment, parts and technical expertise to maintain the system become embedded within the operating entity, whether this be in the public or private sector.

With respect to operations, the regulatory framework to operate a mass transit system would probably be less complex than that of a system with a larger number of operators, and thus less institutional capacity would be required than approaches that maintain the status quo. High level operations planning capacity would, however, be essential to adapt the operating regime and schedule changes with changing demand. This is especially important when aiming to integrate the transit system with supporting modes that play a feeder role. The public entity would require a substantial new staff compliment should it operate the system itself. The transition phase would require staff capable of managing complex negotiations with incumbent operators. Staff would also be required to contract private operators, and monitor and evaluate performance to ensure compliance. Staff would similarly be required to oversee fare collection systems and fleet maintenance (particularly if owned by the authority), and implement passenger information systems.

Stepped transition

The transition from prevailing paratransit service to scheduled and even mass transit services along certain corridors of a city would require a well-developed and robust network plan, together with a clear understanding of implications for spatial, economic and social development. Prevailing institutional capacity to construct and maintain infrastructure projects may be adequate during initial stages, where these are mainly road upgrades to provide priority for existing paratransit operators, but specialised capacity would be required when introducing mass transit elements into the network during later phases.

Due to the more complex approach than introducing mass transit in one phase, it would be important to have strong institutional capacity to defend or adapt elements of the plan as changes occur. High level capacity to conceptualise the unfolding of the incremental approach must also be retained by the public sector in order to lead engagement with the paratransit industry, and to achieve the desired outcomes during the negotiation process. The public sector's operational planning capacity would become increasingly important as elements of mass transit services are introduced later on. Ideally it should develop operational management skills in advance of the industry when preparing to introduce new components such as integrated ticketing and advanced information and communications systems. Goodin and Waldner (1979) emphasise the risk that decision makers may prematurely halt a potentially successful incremental policy because they are not aware that success will become apparent only after a certain level and duration of effort.

Existing service upgrade

The objectives of existing service upgrade programmes should be clearly formulated and communicated to the body of operators, and this requires considerable institutional capacity. Greatest capacity is likely to be required in developing, administering and enforcing a regulatory framework across a large number of fragmented operators. This framework would require an accurate and well-maintained database of paratransit operators, which keeps details of vehicles and benefits previously received. Institutional capacity would also be required to develop contextually appropriate operator support and development initiatives

(e.g. vehicle scrapping, service, business and driver training centres). In relation to the South African Taxi Recapitalisation Programme, for instance, Van Schalkwyk (2009) explains that the institutional arrangements for administering these kinds of interventions must not be under-estimated, and require substantial institutional and operational investment.

6.3 Passenger market implications

The alternative approaches, while varying in financial and institutional implications for the implementing authority, also have a wide range of implications for existing and potential users. The implications for the city-wide passenger market (focussing on the short-to medium-term) are considered in relation to service coverage, service duration (i.e. the number of hours of daily operation), service frequency and reliability, journey speed, safety, comfort and fare affordability.

Table 6.3 posits whether the short- to medium-term benefits of each approach to the city-wide passenger market would likely be high, medium or low (or zero). The ratings in the matrix are discussed briefly for each approach in turn.

Table 6.3 Implications of alternative approaches for the city-wide passenger market (short to medium term)

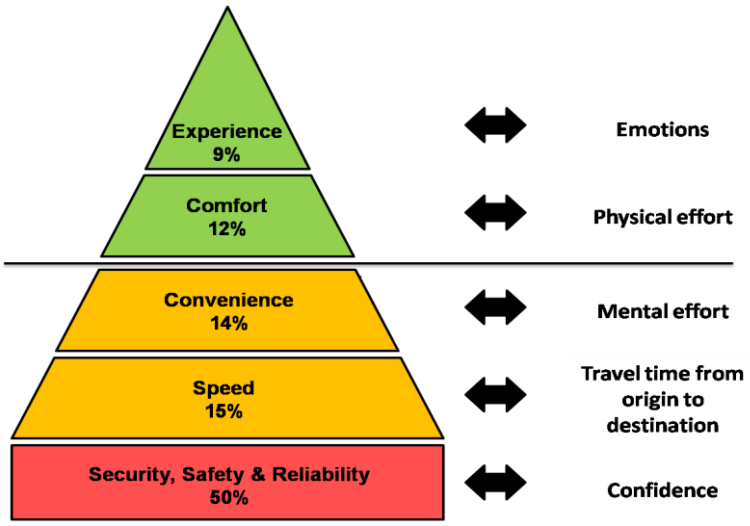
	New mass transit mode	Stepped transition	Existing service upgrade
Service coverage (city-wide)	med / low	high / med	high
Service duration (city-wide)	med / low	med / low	low/zero
Service frequency and reliability (city-wide)	med / low	med / low	low/zero
Journey speed (city-wide)	med / low	med / low	low/zero
Safety (city-wide)	med / low	high / med	high / med
Comfort (city-wide)	med / low	high / med	high / med
Fare affordability (city-wide)	med / low	med / low	low/zero

Notes: high=high short/medium-term service improvement benefits for city-wide passenger market; medium=medium short/medium-term service improvement benefits for city-wide passenger market; low/zero=minimal or no short/medium-term service improvement benefits for city-wide passenger market

New mass transit mode

A variety of studies have analysed how users perceive the quality of service of a public transport system. Indicators that commonly appear include personal safety, reliability, affordability, journey speed, waiting time and transfer efficiency (Hassan *et al* 2013, Cervero 2013, Meakin, 2004). Studies further indicate that the relative importance of the factors vary for different communities, and can even vary over time for the same community (StatsSA 2014). Figure 6.1 shows five quality aspects that define users' perceptions of a transport system, in this case for a Dutch community (Van Hagen 2003). The introduction of a new mass transit technology

provides the opportunity to influence all, or at least most, of these aspects in a single project or reform programme.



Source: after Van Hagen (2003)

Figure 6.1 Quality aspects associated with public transport use

New technologies have been shown to have a considerable positive impact on the public's perception of public transport, especially in developing country cities where the contrast to other services is pronounced. So, if implemented across an entire city, new mass transit modes have the potential to introduce significant benefits in terms of service coverage, duration, frequency, reliability, speed, safety and comfort. In resource constrained cities, however, the prospects of city-wide implementation in the short- to medium-term are often limited, and consequently in such contexts these benefits are concentrated amongst only a portion of the city population travelling along the corridors where the new services operate, with associated inequities in the allocation of benefit across the entire city population. It is for this reason that table 6.3, somewhat paradoxically, suggests that the quality of service benefits of expensive new mass transit modes are medium to low (i.e. only some of the passenger population benefit from the improved quality of service). The increased cost of mass transit systems may also push fares beyond the reach of poorer segments of the passenger market, unless there are the resources to provide subsidies.

New mass transit modes are often planned primarily for the preferences of choice passengers (for laudable travel demand management reasons), as, for instance, argued by Siematycki (2006) in the case of Delhi's metro railway service, and by Van der Westhuizen (2008) in the case of the Gauteng city region's Gautrain. But this can lead to services that do not match the needs of the poorest sectors of the passenger market (e.g. there may be restrictions imposed on passengers carrying bulky parcels, often required by those engaged in informal business sector, which prevent the service being of benefit to this group).

Stepped transition

As the stepped approach is not limited to a single corridor, but spread across a city, it can, if successfully implemented, potentially benefit a wide range of communities earlier, although the quality of service would not be as high as in the case of the 'big bang' approach. Chitauka and Vanderschuren (2014) have shown, for instance, that technology and infrastructure improvements in the form of queue jumpers for

public transport vehicles can contribute to significant time savings when cumulated throughout the network. While perhaps less politically appealing than new major projects, more communities from across a city would experience visible improvements in service delivery within a shorter timeframe, which could lead to positive pressure to accelerate the programme. However, when reaching the final phases of the transition, operating costs may also push fares beyond the reach of poorer passengers with the same need to provide subsidies as with the introduction of a new mode of mass transit.

Existing service upgrade

In the case of existing service upgrade, quality of service benefits would be less than that of the other approaches, particularly in relation to its impact on the hours of daily operation, service frequency and speed, but the benefits that do accrue would be spread across the entire network. Thus is could be argued that distributional equity is greater. This may have important gender dimensions, as women engaged in low-wage employment (e.g. cleaners and domestic workers) could have different origin-destination patterns to men. The coverage, safety and comfort benefit in the short- to medium term and at a city-wide scale would therefore be relatively high. Fare affordability would probably be largely unaffected.

7 Conclusion

It has been argued in this report that, in large cities where dependence on non-motorised modes for all travel needs is no longer feasible, public transport systems are essential to provide equitable access to city labour markets and other opportunities, and to enable the city economy to be efficient and productive. The state of paratransit-based public transport systems in Sub-Saharan African cities has been argued to be inadequate, and a case was made for system improvement and reform. An essential component of any such reform will be the introduction of road space priority to free public transport vehicles from the congestion externalities arising from private transport on high volume corridors, and to rationalise vehicle size to match available road space and passenger demand profiles when such priority has been provided.

Four proposed approaches to improvement and reform were identified in the literature: the installation of new mass transit to replace existing services; a slower stepped transition from paratransit to mass transit; existing service upgrade; and the introduction of more sophisticated contractual forms of service regulation. Elements of these approaches can be observed in various Sub-Saharan African public transport improvement programmes, but none has yet achieved success at scale.

There are no panaceas in the form of directly transferrable public transport technologies or models, and to achieve any measure of success cities will need to develop innovative and contextually appropriate strategies. Indeed, the alternative approaches identified in the literature are not mutually exclusive, and might be considered in different parts of city's network and form part of a broader improvement strategy. In considering alternative courses of action, public authorities have important trade-offs to consider. Foremost amongst these is how to concentrate available resources. Should new high quality services be installed for a narrow segment of the passenger market, or should lower service quality improvement be pursued but to the benefit of a larger number? The urbanisation pressures facing most Sub-Saharan African cities indicate that current resource constraints are unlikely to be eased in the medium term.

The available literature, while showing encouraging growth in recent years, has many gaps. Much attention is still required to explore the details of contextually appropriate mechanisms for public transport improvement and reform, and to

record the many challenges and lessons that existing programmes have encountered. The distributional equity and city productivity impacts of public transport are also poorly demonstrated, as are the institutional preconditions for success.

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