HIGH VOLUME TRANSPORT
APPLIED RESEARCH

Photograph by: Khalfan Said, courtesy of the University of Cape Town

TRANSITIONS - Informal Transport Compendium Report

A literature review to establish the 'state of knowledge' and appraisal of gaps requiring further research

June 2021

TRANSITIONS / HVT044

iMC worldwide

UKaid
from the British people

This research was funded by UKAID through the UK Foreign, Commonwealth and Development Office under the High Volume Transport Applied Research Programme, managed by IMC Worldwide.

The views expressed in this report do not necessarily reflect the UK government's official policies.

Reference No.	HVT/044
Lead Organisation/ Consultant	Vectos
Partner Organisation(s)/ Consultant(s)	Goteomoz, J Turner Transport and Social Development Consultancy, Kwame Nkrumah University of Science and Technology (KNUST), Sierra Leone Urban Research Centre (SLURC), Tatenda Mbara (freelance consultant), Transitec, University of Cape Town (UCT)
Title	TRANSITIONS Informal Transport Compendium Report
Type of document	Project Report
Theme	Urban transport
Sub-themes	Climate Change (mitigation)
Author(s)	Roger Behrens (UCT), Simon Saddier (Transitec), Laurie Pickup and Tim Durant (Vectos) Contributors: Joaquín Romero de Tejada (Goteomoz), Charles Adams (KNUST), Braima Koroma and Joseph Macarthy (SLURC), Tatenda Mbara, Marion Hoyez and Herrie Schalekamp (Transitec), and Mark Zuidgeest (UCT)
Lead contact	Roger Behrens (UCT)
Geographical Location(s)	Accra, Cape Town, Freetown, Harare, Kumasi, Maputo

Abstract

Aim - The purpose of this report is to review the state of knowledge in the field of informal public transport in Sub-Saharan African cities, and to identify important gaps in knowledge from the perspective of formulating policy interventions with prospects for delivering low carbon, affordable and safe mass transport.

Method - The scope of the review was limited to informal transport vehicles providing public transport services, commonly in the form of minibuses. The literature search used database keywords, backward snowballing, and prominent author searches, in relation to nine topics and six cities (Accra, Cape Town, Freetown, Harare, Kumasi and Maputo), and yielded 386 publications.

Findings - From the review of these publications, it is clear that the informal transport industry is complex, heterogeneous, and multi-sectoral in nature. Fierce 'in the market' competition for passengers, and the cash nature of businesses, creates problems for employment conditions, service quality, fleet renewal, and environmental impact. But the sector also offers real benefits and competitive value. Policy interventions to improve operating environments for informal transport vehicles have been relatively few, with most focussed on replacing them with formal mass transit. Encouragingly though, in some cities at least, policy positions have shifted from replacement to integration and upgrade.

A feature of the current body of knowledge is its geographical unevenness. There are parts of the sub-continent about which no publications were found, and there are inherent dangers in assuming contexts, operating practices, problems, and institutional capacities are similar. Therefore, in some cities, greater

depth of understanding is required, while in others, the basic features of the sector still need to be described.

Greater knowledge is required on the scale and nature of informal operations and businesses, vehicle acquisition practices, the political economies and governance contexts within which policy interventions occur, and the outcomes and lessons from past interventions.

Conclusion - The complex, heterogeneous and multi-sectoral nature of the industry has meant that attempts to introduce changes in practice or new technologies, that move the industry onto a more efficient, safe, and lower carbon path, have proven difficult to implement at scale. There are no transferable panacea solutions from within or outside the sub-continent. Grounded solutions are required, and in this regard the recent growth in research activity observed in the review (more than half of the publications were published within the past five years) is welcome.

Keywords	Informal transport; paratransit; public transport; urban mobility; carbon mitigation; gender; social inclusion; employment; safety
Funding	UKAid/ FCDO
Acknowledgements	The TRANSITIONS consortium would like to thank Brendan Finn for his time and inputs as advisor and reviewer.

Issue	Status	Author(s)	Reviewed By	Approved By	Issue Date
1	Final Draft for review	Roger Behrens; Simon Saddier; Laurie Pickup; Tim Durant	Brendan Finn; Jeffrey Turner; Mark Zuidgeest; Steve Wright	Laurie Pickup	February 2021
2	Final Issue	Roger Behrens; Simon Saddier; Laurie Pickup; Tim Durant	Jeffrey Turner	Laurie Pickup	March 2021
3	Publication	Roger Behrens; Simon Saddier; Laurie Pickup; Tim Durant	Jeffrey Turner	Laurie Pickup	June 2021

CONTENTS

APPENDICES

TABLES

FIGURES

ABBREVIATIONS/ACRONYMS

BRT	Bus Rapid Transit
CFC	Cashless Fare Collection
CNG	Compressed Natural Gas
DBSA	Development Bank of South Africa
DTI	Department of Trade and Industry
ECOWAS	Economic Community of West African States
EV	Electric Vehicle
FCDO	Foreign, Commonwealth and Development Office
GPS	Global Positioning System
HVT	High Volume Transport Applied Research Programme
ICE	Internal Combustion Engine
ICT	Information and Communication Technology
IEA	International Energy Agency
IMC	IMC Worldwide Ltd
NDoT	South Africa National Department of Transport
NMT	Non-Motorised Transport
OMT	Maputo Metropolitan Transport Observatory
SACCOs	Savings and Credit Cooperatives
SSA	Sub-Saharan Africa
SSATP	Sub-Saharan Africa Transport Policy Program
TMC	Transport Management Company
TRP	Taxi Recapitalisation Programme
UNEP	United Nations Environment Programme
WHO	World Health Organisation

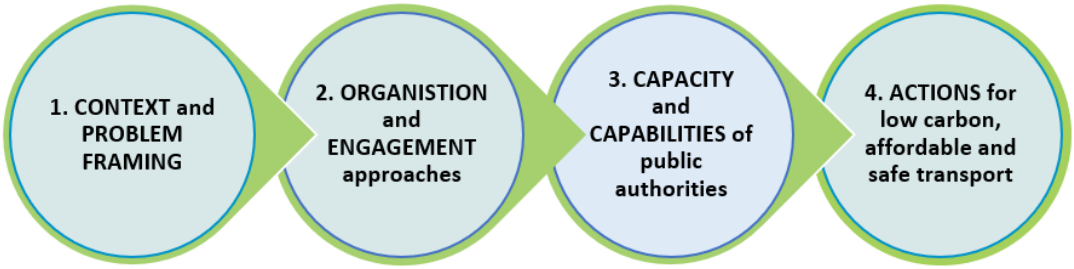
EXECUTIVE SUMMARY

TRANSITIONS – Transitioning the policy debate, stakeholder relations and informal transport services for a low carbon future

This Compendium Report is the first deliverable of TRANSITIONS, a project of the UK aid-funded High Volume Transport (HVT) applied research programme that focuses on the role of informal public transport[1] in Sub-Saharan Africa as a solution for mass transit in a low carbon future. Responding to the situation that informal transport has been a relatively under-investigated subject area, the project is based on two main stages of research:

- the 'state of knowledge' literature review reported in this summary compendium, covering six review cities; and
- primary research undertaken in five case cities: a western Africa cluster comprising Accra, Kumasi and Freetown; and a southern Africa cluster comprising Cape Town and Maputo.

The findings of this literature review contribute to the shaping of the TRANSITIONS research framework and Routemap Tool. As the final output of the project, the Routemap Tool will provide a concise guidance document for planning practitioners. This will be based upon a logical decision-making flow for appraising the situation in a given city and developing a package of appropriate actions to maximise the benefits of informal public transport, while also seeking to minimise the negative externalities of the sector. As currently envisaged, the Routemap Tool appraisal and decision-making stages are as follows:



The compendium report and summary of findings below therefore aligns with these four themes.

Method and bibliometric overview

The literature search used database keywords, backward snowballing, and prominent author searches, in relation to nine separate topics and six review cities (Accra, Cape Town, Freetown, Harare, Kumasi and Maputo), and yielded 386 publications. This exercise revealed that:

- The large majority of publications (67%) have been produced since 2013, indicating that informal transport is a field of recent and growing research interest.
- South Africa (36% of publications), Ghana (22%) and Kenya (13%) have received the greatest informal transport research attention and there are clearly many cities in SSA that have received little or no attention.
- Topics with the largest body of literature were found to be informal transport regulatory frameworks (27% of publications), followed by operating practices (18%), vehicles (13%), and businesses (12%).

Theme 1: Context and problem framing

Understanding the nature and true scale of informal transport networks in Sub-Saharan Africa (SSA), as well as having reliable evidence on the benefits and problems associated with the sector, provides the basis for informed decision-making. Key points reported in the literature are:

[1] TRANSITIONS focuses on informal public transport: services which are shared by multiple passengers and therefore individual passengers do not have autonomy over the route and time of service. In Sub-Saharan Africa these services are typically provided by midi- and mini-buses, and occasionally by sedan vehicles.

- GPS and mobile technologies have enabled researchers and practitioners to undertake large-scale data collection and mapping of informal transport networks, revealing the true extent and form of networks in some cities, notably: Nairobi, Cape Town, Maputo and Accra.
- Informal transport business owners are quick to respond to new demands for services and the literature highlights the benefits of flexibility, demand-responsiveness and catering to the needs of livelihoods in the urban informal economy, especially for women with the need to travel and accompany goods.
- High levels of informal transport 'supply' and competition, particularly on trunk routes, can however be self-defeating for operators. Congestion can result in low commercial speed and the potential for long passenger waiting times.
- The literature does reveal further negative externalities. Poor viability and high levels of competition also result in aggressive and unsafe driver behaviour, unfair labour relationships and poorly maintained vehicles that contribute to air quality problems. There is also some quantitative research highlighting negative aspects such as the level of exposure to sexual harassment amongst women.

Policy stances and regulatory cycles - Attitudes of public authorities towards informal transport are reflected in four main observed stances: 'prohibition' and the imposition of bans; 'acceptance' and no formal regulation; 'recognition' with regulation of certain operations, vehicle and employment aspects; and 'regulation' where entry to the market is also controlled. The capacity of the public authority is considered to play a large role in the stance adopted and the concept of a 'regulatory cycle' has been proposed, whereby: initiatives to provide affordable public transport are prone to failure, resulting in the growth of the informal transport sector to service demand. As competition in the informal sector increases, the quality of service falls, leading the public authority to consider regulatory action and provision of formal public transport again.

The literature review has revealed gaps in knowledge, that include:

- **Scale of fleets -** Little is known about the relative size of legal and illegal informal public transport vehicle fleets in many, if not most, SSA cities. There is limited information on the numbers of people employed, though a study of Nairobi estimated that 19,000 informal transport drivers are employed in the city.
- **Service types and efficiencies -** Little is known in many cities about the range of route and service types, including in the temporal dimension, and their service operating efficiencies/inefficiencies.
- **GHG emissions and air quality** - Little quantitative information is available on the potential emission reduction benefits in cities, if fleets were to adopt lower emission vehicles or alternative fuels.
- **User perspectives** – Limited quantitative research has been undertaken on the mobility patterns of informal transport users, especially amongst informal sector workers. There is little consistent mapping of negative aspects such as the level of exposure to sexual harassment amongst women.

Theme 2: Organisation and engagement approaches

For TRANSITIONS it is important to understand the organisational structure (or structures) of the informal public transport sector, from management, ownership and financial perspectives, in order to understand what actions might be suitable and through which channels the sector can be engaged. Studies of organisational structures were found for Ghana, Kenya, Nigeria and South Africa, demonstrating that collective organisation of informal public transport takes a variety of forms:

- National and regional associations are established in some countries to represent collective owner interests (e.g. the Matatu Owners Association in Kenya and South African National Taxi Council)
- Smaller route associations are a more widespread form of collective organisation, typically formed of vehicle owners, which provide for protection and self-regulation of local markets.
- Savings and Credit Cooperatives (SACCOs) and Transport Management Companies (TMCs) in Kenya have been a particular focus for study and have demonstrated some benefits of formalised employment, resulting in improved service quality, as well as financial benefits such as access to loans.
- The available literature reports ubiquitous informal, and often exploitative, employment conditions. The common 'target based' system provides insecure income and results in dangerous driving practices.

- Engagement between informal transport, government and development actors have commonly been based on four proposed outcomes: physical assets; restructuring of business; professional development/capacity building; and information and communication technologies.

Although the literature provides useful insights and examples of progressive collective organisation, there remain large gaps in understanding, including:

- Knowledge of the representativeness of owners' associations/drivers' unions of collective interests.
- There are no in-depth process studies and evaluation of engagement between government and informal public transport providers.
- Few data are available on the prevalence of alternative driver remuneration models and the before-and-after benefits (e.g. declared fare box revenue) when drivers employment has been formalised.
- Little is known about the approaches used to incentivise drivers to remain productive and demand responsive when remunerated through salaries.

Theme 3: Capacity and capabilities of public authorities

A city authority's ambitions and capacity to deliver formal public transport, as well as the available resources to effectively regulate and enforce the informal public transport sector, will have an important bearing on the types of measures that would be considered suitable. Three main policy approaches to informal transport reform adopted by governments are: comprehensive Bus Rapid Transit (BRT) implementation and paratransit assimilation; stepped, flexible paratransit to transition to bus system; and upgrade of existing services. Main findings from the literature are:

- Replacement of informal transport with BRT has received greatest traction amongst city governments and there are numerous studies on these initiatives in Accra, Cape Town, Dar es Salaam, Johannesburg, Lagos, Nairobi and Tshwane. Local resistance from informal transport providers is considered a core reason for why implementation has not diffused through SSA cities as hoped. Loss of autonomy, financial risks and lack of trust in government agencies are cited as reasons for this resistance.
- 'Hybridity' regulation seeks to support complementarity between formal and informal public transport and typologies include: route licences with financial rewards, area-based quantity licences, area-based concessions, area-based franchises, and route-based contracts. The experience of hybridity regulation at the Mitchells Plain interchange in Cape Town has been studied in particular detail.
- Complexity of regulatory regimes varies according to administrative capacity, from 'open market', through quality licensing (vehicle checks; driver qualifications), to quantity licensing that restrict market entry.
- Innovative forms of regulation in SSA include: university service contracting; Gautrain rail feeder services, Kenya Bus Services and Citi Hoppa franchises, and vehicle renewal franchising incentives in Dakar.
- Informal transport 'self-regulation' is a significant element in market entry control and protecting routes from competitors, which can on occasions become violent – e.g. the 'taxi wars' in South Africa.

Informed policy debate would benefit from further research on the following matters:

- Quantitative data on the operating costs and subsidy requirements of recently implemented BRT and the passenger demand preconditions for fiscally sustainable BRT, Buses with a High Level of Service (BHLS).
- Knowledge is required on appropriate 'hybridity' regulatory frameworks and on whether voluntary (incentivised) change will be easier to implement than mandatory (contracted or regulated) change.

Theme 4: Actions for low carbon, affordable and safe transport

Strategies to work with informal public transport operators could comprise a range of actions from physical infrastructure improvements, through controls on operations, fleet and vehicle improvements and business support. Knowledge on such measures is restricted to a limited number of cities and include:

- **Infrastructure and operating environment -** In Dar-es-Salaam integration between BRT and *daladala* services is accommodated in some interchanges and the provision of a bus lane for formal and informal public transport in Cape Town has been shown to have beneficial results.
- **Urban access restrictions and network transformation** Route licences have tended to be reactive on the part of city authorities, rather than based on proactive network planning. A city centre restriction on vehicle size in Dar es Salaam (buses with 25 or more seats only) was considered effective.
- **Fleet improvements** – Buying a vehicle requires substantial capital and there are very few instances of where acquisition has been supported through public or donor sector-provided capital, such as, for example, the unique South African Taxi Recapitalisation Program (TRP).
- **Business structures and strategies** – Operational practices, such as 'load and go' (resulting in 90% full buses) demonstrate how operational practices are influenced by financial imperatives. Transport cost modelling was found to show that feeder services are more profitable than trunk services, and the latter could only be improved by reductions in fleet sizes, where competition and congestion is self-defeating.
- **Passenger services –** Cashless Fare Collection (CFC) has been trialled but generally found to be unsuccessful in relation to informal public transport. Ride-hailing is beginning to emerge across the continent, including examples such as UberPOA for motor-tricycle taxi e-hailing services in Dar es Salaam.

The literature review has revealed numerous gaps in knowledge that would be beneficial to guide strategy planning and assessment of the role of informal public transport. One instructive example is that few quantitative data or simulations are available on the relative contributions of private cars and public transport vehicles of varying sizes to city centre congestion, to enable informed critical reflection on whether banning or restricting informal public transport vehicles is a rational or equitable policy response.

City 'state of knowledge' and main themes

A southern Africa city cluster of the TRANSITIONS project is made up of the following cities:

- **Cape Town, South Africa** – Cape Town is arguably the African city with the highest concentration of research on informal transport. Both the transport network and hierarchical organisational networks of the sector are relatively well understood. The implications of BRT implementation have been researched, resulting in the conclusion that this was more effective as an upgrade to existing formal public transport than as a replacement for the *minibus-taxis.* A linked area of study has been that of 'hybridity' regulation.
- **Harare, Zimbabwe** – The literature for Harare is scarce (13 publications in total) and mostly composed of academic publications. Researchers emphasise that informal public transport must be analysed against a backdrop of a now vast informal economy in the country. Operators have raised concerns about the multiplicity of conflicting regulation from national and local government, as well as corruption in policing of the sector. A further stream of research has focussed on safety aspects and dangerous driving behaviour observed in relation to *Kombis.*
- **Maputo, Mozambique** – The Metropolitan Transport Observatory (OMT) and its members have recently supplemented the literature, publishing a number of technical reports including valuable quantitative information. Minibus *chapas* are not completely informal as licensing is in place, and there are official communication and coordination channels with the authorities. The operation of *MyLoves,* which provide passenger services using flat-bed trucks, is completely informal. Researchers estimate that fuel constitutes 65% of operational costs and the imposition of fixed fares is thought to threaten viability. *Chapas* operation is also considered to be marred by (or mired in) police corruption, with 42% of trips subject to police stops.

In a recent attempt to do away with informality, the government of Zimbabwe banned all informal transport operations in July 2020. For this reason, TRANSITIONS will not conduct primary research in Harare.

The western Africa city cluster is made up of the following cities:

- **Accra, Ghana** – A significant share of the literature for Accra (approx. 20 publications) stems from the World Bank/AFD-funded Ghana Urban Transport Project launched with the aim to implement BRT. Based on use of GPS-enabled smartphones a first map of informal transport routes has been produced and service reliability on a sample of 65 routes has also been assessed. Research has been undertaken on the structure

of the *trotro* industry and its investors (including drivers saving for their own vehicles, as well as government officials).

- **Kumasi, Ghana** – Thanks to the presence of KNUST university, an equivalent level of research has been undertaken for Kumasi as for Accra. Recent research indicates that informal transport covers a quarter of the municipal network, suggesting an extensive network. In peak periods, operations are characterised by high demand and shortage of supply, resulting in fare hikes. Two recent studies looked at the determinants of drivers' behaviour on the road and found that the lack of adapted infrastructure and 'target system' pushes drivers to disrespect traffic rules.
- **Freetown, Sierra Leone** – The literature for Freetown is scarce and very recent (most publications from the last 2 years), composed of technical reports and working papers prepared in the context of donor-funded projects. It is estimated that informal public transport services make up over 80% of passenger transport trips, although motorcycle and motor-tricycle have been expanding rapidly in recent years, due to their ability to manoeuvre through heavy traffic. The industry is known to be structured around operator associations that establish branches in specific districts of the city.

City cluster gaps in knowledge

The literature review represents an important element of assessing the 'state of knowledge' in each city and refining the detailed primary research plan.

Southern Africa city cluster - In **Cape Town**, where a significant amount of research has already been conducted, priority should be given to documenting recent developments and public initiatives, furthering knowledge on less-studied topics, and to updating/complementing existing data. Despite the long-standing presence of the Taxi Recapitalisation Programme (TRP), publications on this subject are rare, as are studies of its impacts and dynamics. An important gap in this regard is the absence, inaccuracy and/or outdated nature of quantitative data on different types of vehicles in use (especially those which are not minibuses), and the quanta of ownership and workers belonging to or associated with the various local route associations. In the case of **Maputo**, minibus *chapas* operations benefit from more recent survey and analysis. However, it appears that there is almost no information available on *MyLoves*, a rapidly growing mode of informal collective transport. In addition, recurring tensions around the setting of public transport fares indicate a need to better understand dominant business models in the public transport industry (operating expenses, farebox revenue, financial flows, vehicle acquisition, etc.).

Western Africa city cluster - In the two Ghanaian cities, **Accra** and **Kumasi**, existing research on informal transport operations could be leveraged to develop a deeper understanding of operational practices, industry structure and dynamics, and fleet composition and emissions. Additionally, while it has been documented in Kumasi, users' perspectives on transport services have not been studied in Accra. In both cities, the experience and needs of female passengers has not been researched and constitutes an important gap in the literature. For **Freetown**, due to the dearth of general knowledge on informal transport, there are pressing research gaps in relation to the form of the transport network, its density and service characteristics. Equally important is the consolidation of knowledge on the industry structure and characteristics, including the role and organisation of unions at different geographic scales, dominant business models, relations between owners and drivers, and labour conditions. Additionally, some research on the experience, level of satisfaction, and main challenges met by passengers is critical to obtain a complete picture of the sector.

Conclusion

Regarding the state of knowledge, it is evident that informal transport is a growing research field, with more than half of the literature found published over the past five years. Knowledge of the field is therefore deepening and diversifying rapidly. It is clear from the review that the informal transport industry is complex, and that fierce 'in the market' competition for passengers, and the cash nature of businesses, creates problems for employment conditions, service quality, fleet renewal, and environmental impact. The scale and reach of informal transport service networks mean that Sub-Saharan Africa cities would simply not function without them. Yet policy interventions to improve operating environments for informal public transport vehicles have been relatively few, although encouragingly, in some cities at least, the policy position has shifted from replacement, to integration and upgrade.

1. INTRODUCTION

1.1 About TRANSITIONS

TRANSITIONS – Transitioning the policy debate, stakeholder relations and informal transport services for a low carbon future

The starting point for the TRANSITIONS applied research project was the recognition that, for the majority of Sub-Saharan African cities, informal transport is the true mass, collective form of transit meeting daily needs (informal transport is sometimes referred to as paratransit – see the box in this section for a definition of informal transport). In the context of the 'climate crisis', rapid urbanisation, increasing congestion and worsening air quality, the project therefore sets out to address two main research questions:

Looking ahead, what is the role of informal transport in cities in the global south? Informal transport services have evolved over time and respond in a dynamic manner to passenger needs, including those of the poorest travellers. In the majority of cases these transport services can be viewed as a response to institutional under-capacity or failure to provide formal public transport services, in the face of rapidly expanding urban population and geographic areas. The capacities of public authorities to implement, maintain and subsidise public transport services vary, and even where projects are planned and the prospects for delivery are good, the lead times can be long, geographic coverage may be limited, and there can be resistance from the existing informal transport operators whose livelihoods are threatened.

In these circumstances, TRANSITIONS begins with the proposition that informal transport operators are and could continue to be a large part of the solution for high volume transport, while acknowledging that there are serious negative externalities to be addressed.

How then can we enable a transition towards a clean, affordable, efficient and safe transport network involving informal transport? Taking into account the scale and organisation of the informal transport sector, and the capacities of the public sector, different combinations of actions could be considered. These range from infrastructure provision and appropriate access regulations, through to improved maintenance and operational practices, fleet renewal and business development support, as well as improved routing, passenger information and services. Understanding the channels for engagement with the diverse and often fragmented informal sector is also important if any such proposed actions are to be pursued.

With these points and possibilities in mind, the TRANSITIONS project seeks to inform and contribute to a transition in the policy debate around informal transport, as well as developing a planning and decision-making framework for practitioners. It is envisaged that this Routemap Tool will be structured based on the conceptual framework presented in Section 3.2, and that it will draw upon and be shaped by two main stages of research:

- the 'state of knowledge' literature review reported in this summary compendium; and
- primary research undertaken in five cities: a Western Africa cluster comprising Accra, Kumasi and Freetown; and a Southern Africa cluster comprising Cape Town and Maputo.

This report also features a literature review for Harare. Regrettably it will not be possible to undertake primary research in Harare, as originally planned, owing to the imposition of an informal transport ban in the city during the project timeframe.

Box: Definition of project scope and usage of term 'informal transport'

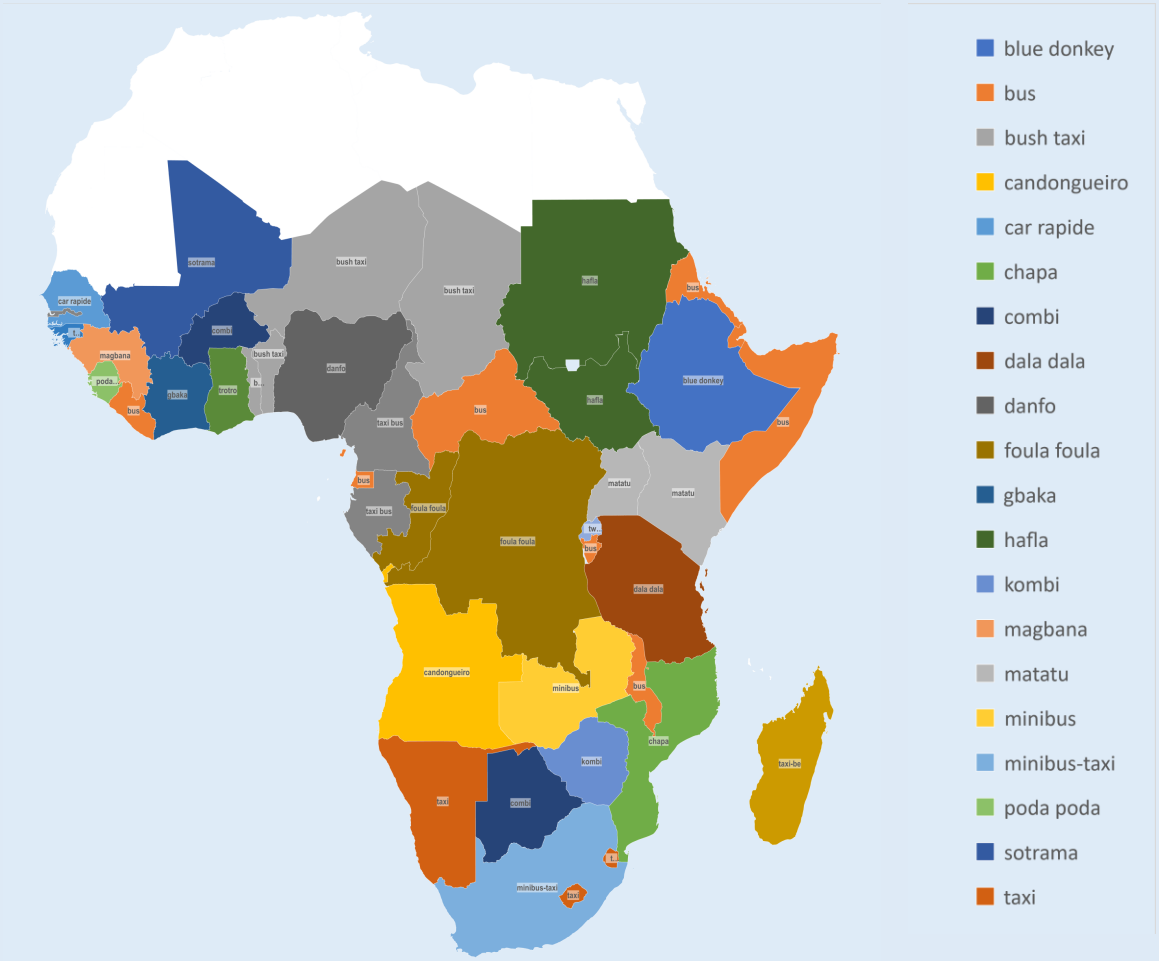
The scope of the project is 'informal transport' in Sub-Saharan Africa. The term 'informal transport' is defined as a flexible mode of passenger transportation that does not follow fixed schedules or service spans, and is provided by numerous small private businesses without contractual obligation to a regulatory authority. The degree to which these businesses operate with legal permission and are tax compliant, determines the extent to which they are unregulated and informal. Such informal transport operations span both public transport services (i.e. services which are shared by multiple passengers and therefore individual passengers do not have autonomy over the route and time of service), and for-hire services (i.e. services in which the passenger, or group of passengers, have exclusive temporary use of the vehicle, as

well as autonomy over the destination and time of service). In Sub-Saharan Africa the former are typically provided by midi- and mini-buses (see Figure 1), and occasionally by sedan vehicles, and the latter by two- and three-wheeler motorcycles. Given the low-carbon focus of the TRANSITIONS project, its scope is further limited to informal public transport services. Hence, while informal in nature, for-hire motorcycle-taxi businesses fall outside the core scope of the project.

Informal transport, paratransit and colloquialisms

The terms 'informal transport' and 'paratransit' are used interchangeably in the literature and both can be criticised – some services are formalised (for example in relation to tax compliance) and hence not well described as 'informal'; while 'paratransit' has evolved a particular meaning in the US, relating to provision of services for disabled people. TRANSITIONS utilises the term 'informal transport' for consistency, except where closely referencing the work of other authors. Additionally, informal transport services are known as *matatus, combis, dala dala* and *mini-bus taxi* and other popular names, depending on the country as indicated in the map below. These colloquial names are used throughout the literature review, reflecting the rich local vocabularies that have developed around these industries.

Figure 1 – Informal public transport colloquialisms



SOURCE: MAP BASED UPON AUTHORS' KNOWLEDGE AND MAP @FUNMIOYATOGUN (22/06/2018), TWITTER

1.2 Aim of the literature review

The 'state of knowledge' literature review performs an important role in the project, studying key themes and case cities in order to provide a foundation of information and assessment of important gaps. In this way this first stage of research informs the refinement and prioritisation of ongoing primary research in the cities.

Prior systematic Sub-Sahara African literature reviews that cover, at least in part, the scope of this compendium include:

- *Overview of public transport in Sub-Saharan Africa* – a comprehensive profiling of public transport modes (both formal and informal) by country, undertaken in 2008 (Trans-Africa Consortium 2008). This report represents more of a status quo description than a conventional review of research studies, and it now 13 years old.
- *Mobility and access in Sub-Saharan African cities: The state of knowledge and research environments* – a review of knowledge and research capacity in the field on 'mobility and access' in Sub-Saharan African cities, undertaken in 2015 (Behrens et al. 2015). This report had a broader scope than 'informal transport', and as will be illustrated in the later bibliometric analysis, even though more recent than the above, is now out of date because there has been a significant growth in publications on 'paratransit' over the past five years (it yielded 97 publications on paratransit, compared to 386 in this compendium report).

Prior systematic global reviews of informal transport that cover, in part, Sub-Saharan Africa include:

- *Informal transport in the developing world* – a seminal review of informal transport characteristics, undertaken in 2000 (Cervero 2000). This report draws from a variety of academic and grey literature. Its Africa chapter cites relatively few academic sources and is less detailed than its Asian and Latin American counterparts. It is also now, of course outdated.
- *Informal transport: A global perspective* – a brief international overview of informal transport characteristics, undertaken in 2007 (Cervero and Golub 2007), with particular attention to three cases in Thailand, Jamaica and Brazil.
- *An introduction to paratransit in Sub-Saharan African cities* – a situational review of the global paratransit literature, undertaken in 2015 (Behrens et al. 2016a). This assessment is now outdated for the reasons discussed above, and is not comprehensive enough to represent an accurate state of knowledge on the sub-continent.
- *Future of paratransit and shared mobility* – a global review on the future of paratransit and shared mobility modes, undertaken in 2020 (Cassius et al. (ITDP) 2021). This report had not been released at the time of writing, but its global focus is likely to mean its review of Sub-Saharan Africa literature is less comprehensive than the compendium report.

None of the prior reviews satisfy the aims of this compendium report, so the literature review presented here is warranted.

1.3 Structure of the compendium report

The report is divided into six chapters. In the following chapter, the literature review method is described.

In chapter 3 literature review findings in relation to four groups of themes are discussed:

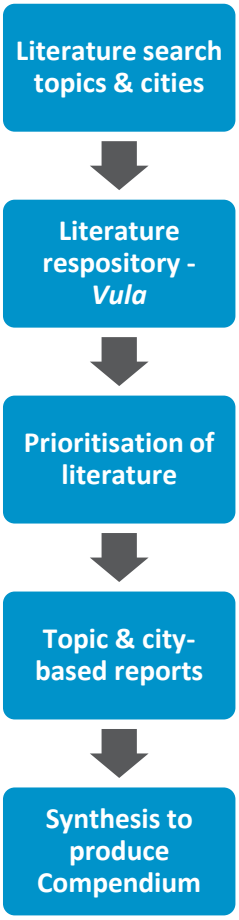
- The first group of themes relates to the problems associated with, and policy positions towards, informal transport in cities.
- The second group relates to engagement with, and the organisation of, informal transport.
- The third group relates to the capacity of public authorities to intervene in informal transport systems.
- The fourth group relates to the range of interventions that a public authority might consider in improving informal transport services.

In chapter 4 the state of knowledge across six case cities is compared. In chapter 5 gaps in knowledges are discussed, in relation to both themes and case cities. Finally, conclusions are drawn in chapter 6.

2. METHOD

The scope of the review was limited to literature on 'informal transport', as defined in Chapter 1, and to studies focused on, or relevant to, Sub-Saharan Africa. As indicated earlier, given the low-carbon focus of the TRANSITIONS project, the scope of the literature review is further limited to informal public transport services. Hence, while informal in nature, for-hire motorcycle-taxi businesses fall outside the core scope of the review, although there are refences to these services in relation to specific themes. For example, Cashless Fare Collection (CFC) and ride-hailing take-up is more advanced for motorcycle-based informal transport.

Figure 2 - Literature review stages



As illustrated in Figure 2, the phases of the review included:

- the (13-person) research team searching different search engines or databases for publications relevant to nine pre-specified topics and six case cities;
- the assembly of a repository of publications (in Vula, an online collaboration system);
- the prioritisation of literature for more detailed review, on the basis of publication date, and author prominence;
- the production of 15 individual review reports, identifying key themes and gaps in knowledge, on the pre-specified themes and case cities (see Appendix B); and
- the synthesis of literature review report findings into this compendium.

Searching took the form of keyword searches, backward snowballing from authoritative papers, and prominent author searches. Table 2-1 lists the themes and case cities reviewed, and their respective keywords that were combined into various Boolean and non-Boolean search terms.[2] Candidate publications included scholarly publications (i.e. journal papers, conference papers and book chapters), as well as 'grey literature' (i.e. project reports and topical articles in popular media) and unpublished university theses or dissertations. No time period limitations were imposed on the literature search. The search concentrated on English language publications, although nine French and 16 Portuguese publications were included in the review. The open-source reference management software, Zotero, was used to record bibliographic data.

Table 1 - Literature search keywords by topic and case city

Literature review topics	Keywords
	Africa; informal transport; paratransit ***+***
Informal transport businesses	*informal transit; businesses; cooperatives; labour*
Regulatory frameworks	*informal transit; regulation; self-regulation*
Operating practices	*operations; routes (lignes); frequency; headway; trotro; matatu; minibus taxi; transport artisanal; exploitation;*
Vehicles, fuels and acquisition	*public transport; vehicle; vehicle type; fuel; emissions; acquisition; finance*

[2] The search engines and databases searched included: Google Scholar; IEEE Xplore; Publish or Perish; Research Gate; Science Direct; Scopus; Southern African Transport Conference; Transport Research International Documentation; TRANweb; Web of Science; and the World Bank Open Knowledge Repository.

Literature review topics	Keywords
Environmental externalities	*GHG emissions; air pollution; particulate matter; traffic pollution; sustainable transport; respiratory diseases; black carbon*
Digital platforms	*informal transit; digital platforms fare collection mapping tracking passenger information ride hailing*
Methods and techniques of informal transport analysis	*modelling; data; tracking*
Informality	*informality; urban; infrastructure*
Gender and inclusion	*transport; employment; gender; women*
Case cities	**Keywords**
	case city name ***+***
Accra (Ghana)	*trotro; transport; transit; paratransit; minibus; mapping*
Cape Town (South Africa)	*informal transport; paratransit*
Freetown (Sierra Leone)	*mobility; informal transport; accessibility; operations; benefit; cost; motorcycle; minivan; tricycle; shared taxi*
Harare (Zimbabwe)	*mobility; informal public transport; paratransit*
Kumasi (Ghana)	*trotro (tro-tro); informal public transport; paratransit (para-transit); mini-bus (minibus); tricycles; motorcycles; Uber*
Maputo (Mozambique)	*Chapas, MyLove, informal transport; paratransit; license/licensing;*

3. THEMATIC STATE OF KNOWLEDGE FINDINGS

This chapter is divided into six sections:

- Section 3.1 analyses the size, age and focus of the publications uncovered in the literature search.
- Section 3.2 explains the conceptual framework used to synthesize the literature review findings.

Then, aligning with the four themes introduced in Section 1.3:

- Section 3.3 summarises current knowledge in relation to the nature of, the problems associated with, and policy positions towards, informal transport in cities.
- Section 3.4 summarises current knowledge in relation to the organisation of, and engagement with, informal transport.
- Section 3.5 summarises current knowledge in relation to the capacity of public authorities to intervene in informal transport systems.
- Section 3.6 summarises current knowledge in relation to the range of interventions that a public authority might consider in improving informal transport services.

3.1 Bibliometric overview

The nine thematic literature searches yielded 322 publications, and the six case city searches yielded 128. Overall, the literature search yielded 386 unique publications. Figure 3 illustrates the age distribution of publications. The earliest publications found relate to the emergence and nature of informal transport in Niger (Bourgeois and Piozin 1986), Kenya (Lees-Smith 1989), South Africa (Barolsky 1990, Khosa 1991, McCaul 1990) and Zimbabwe (Maunder and Mbara 1995). All but seven publications were, however, produced over the past three decades, with Cervero's seminal global overview of informal transport in 2000 perhaps serving as a catalyst for subsequent scholarly publication.[3] The large majority of publications found (67%) have been produced since 2013, indicating that informal transport is a field of recent and growing research interest.

Figure 3 - Publication dates

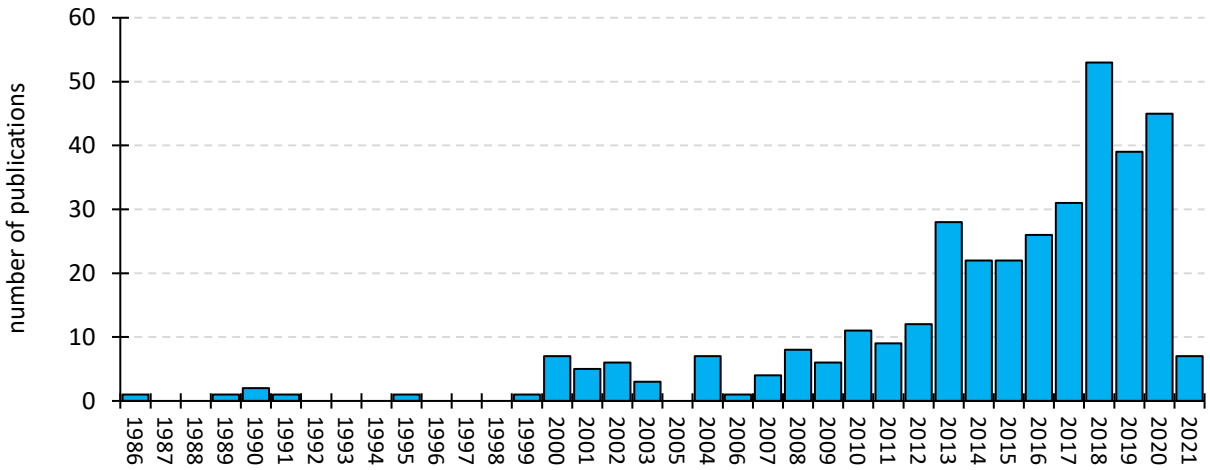


Figure 4 illustrates that most of the publications found were journal papers (36%), followed by 'grey literature' (primarily in the form of project reports by development agencies and research organisations) (30%), and conference papers (20%).

Figure 5 illustrates the relative size of the literature found in the different thematic search clusters. Disregarding the literature found in the case city searches, the theme with the largest body of literature was

[3] Backward snowballing of the chapter on Africa indicates that, at the time, the availability of information on informal public transport services was largely through 'grey literature'.

found to be informal transport regulatory frameworks (27%), followed by operating practices (18%), vehicles (13%), and informal transport businesses (12%).

Figure 4 - Publication type

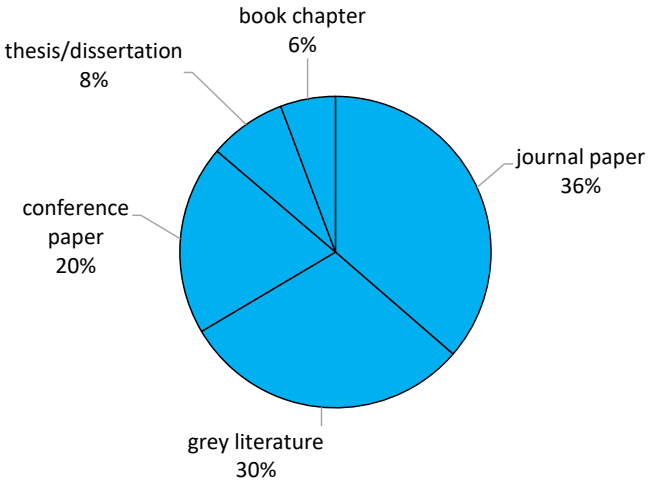
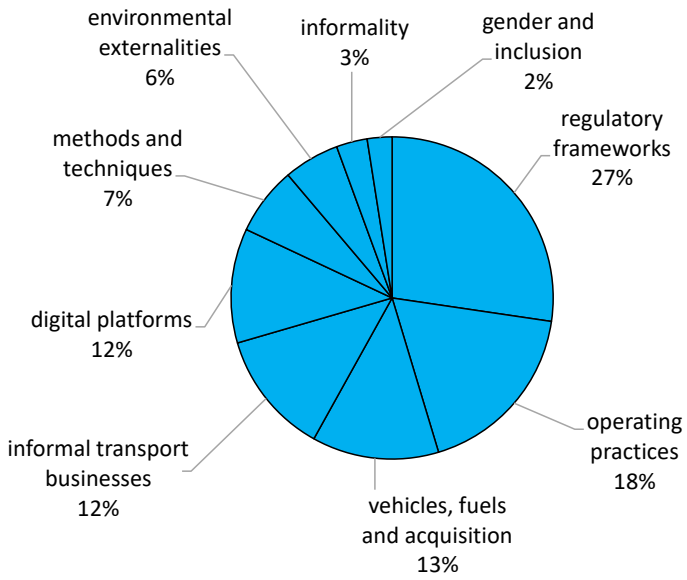


Figure 5 - Publication theme (excluding case city search)



With respect to the empirical context of the literature, 7% of the publications are relevant to informal transport in Sub-Saharan Africa, but not focussed on any particular geographical context. A further 16% of the publications are multi-country studies from across Sub-Saharan Africa (and in some cases beyond). Figure 6 illustrates the geographical distribution of the remaining 283 publications. This heat mapping reveals that South Africa (36%), Ghana (22%) and Kenya (13%) are the countries that have received the greatest informal transport research attention. There are clearly many cities on the sub-continent that have received little or no attention (at least in the body of work published in English). Of the 41 countries in mainland Sub-Saharan Africa, (excluding multi-country publications) 22 yielded no informal transport publications. Figure 7 illustrates a more disaggregated geographical distribution of publications by theme. The distributions confirm the dominance of the informal transport research focus on South Africa, Ghana and Kenya, as well as the paucity of publications across large parts of the sub-continent.

Figure 6 - Geographical focus (all publications)

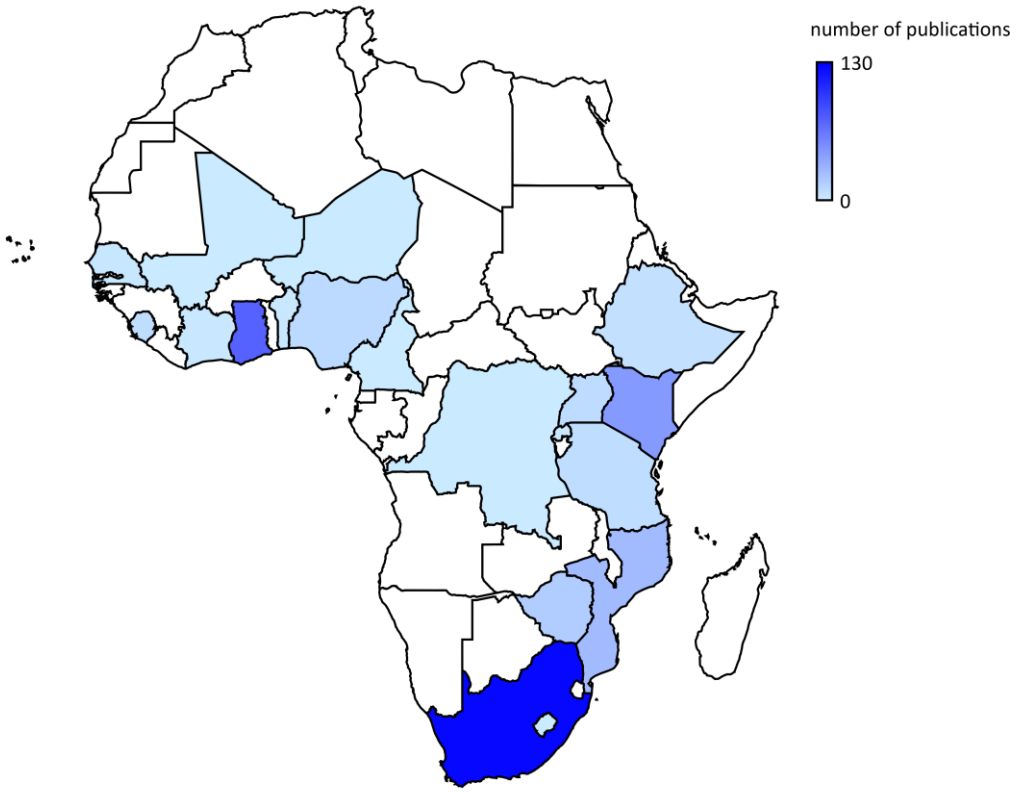
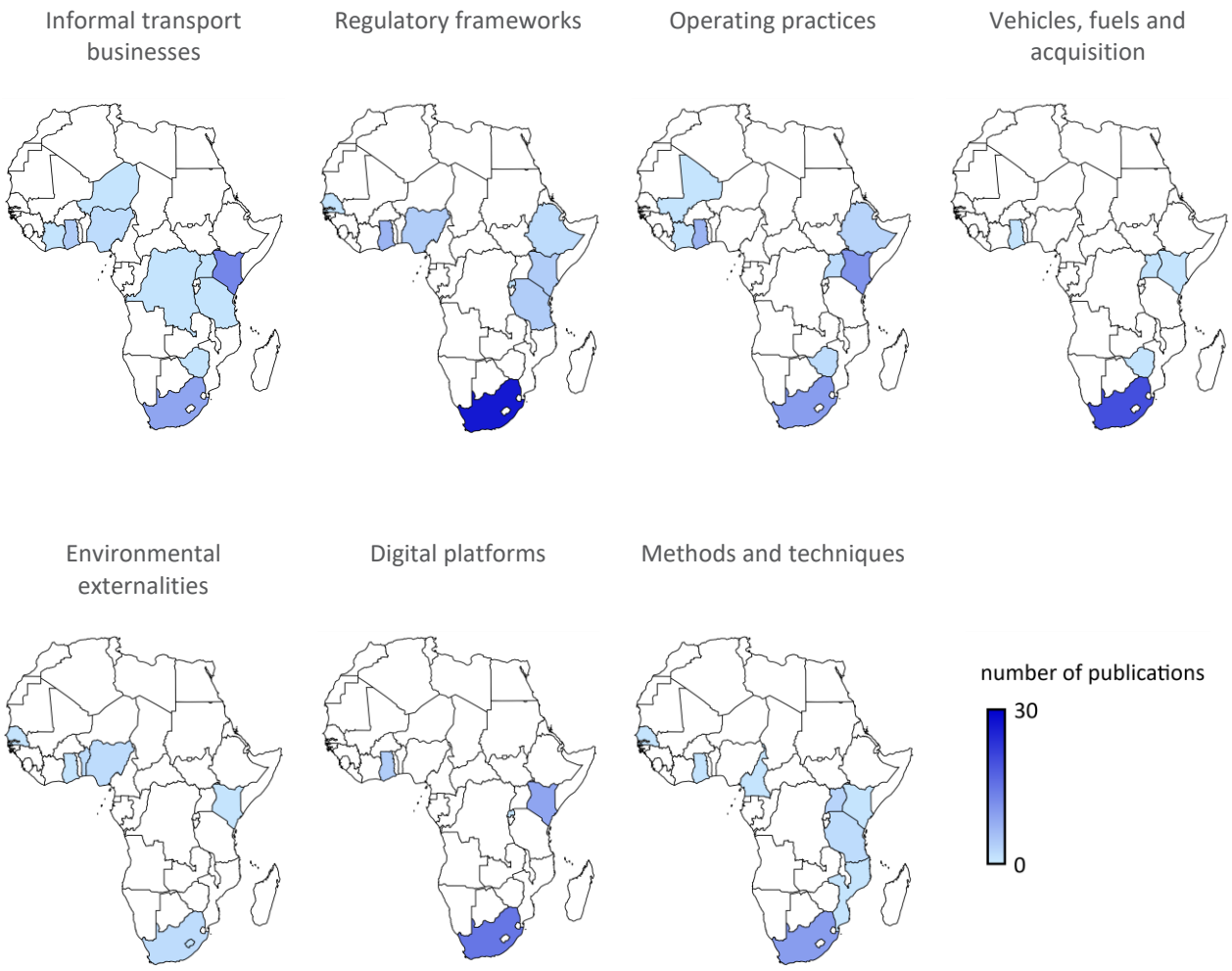


Figure 7 - Geographical focus, by theme



3.2 Conceptual framework

The literature review reported in this compendium document represents a first stage of research informing the preparation of the TRANSITIONS Routemap Tool, the final output of the project. It is intended that the Routemap Tool will bring together the findings and recommendations of the project in a concise guidance document, based upon a logical decision-making flow for appraising the situation in a given city and developing a package of appropriate actions.

For this reason, the findings from the thematic literature review themes (as presented in Section 2) have been re-structured and presented in the compendium in terms of the components of the Routemap Tool, as currently envisaged and shown in Table 2.

Through this exercise, the identification of gaps in knowledge in the literature feeds directly into the refinement of the primary research strategies in each of the TRANSITIONS cities.

Table 2 - TRANSITIONS Routemap Tool components

Context and problem framing	Organisation and engagement approaches	Capacity and capabilities of public authorities	Actions for low carbon, affordable and safe transport
• What is the current attitude of public authorities towards informal transport? • Is there information on the transport network and benefits of the informal sector? • Is there evidence of the negative externalities of the informal sector?	• What organisations and engagement structures are in place currently? • What is the organisational/financial make-up of the informal transport sector? • What changes/trends are occurring in the sector?	• What is the status of public transport services? • What is the status "stage in the cycle" of informal transport regulation and enforceability? • What level of support is currently available for informal transport?	• What are the comparative advantages of working with the informal sector/s? • Which actions have been deployed and how successful were they? • What package of integrated/interdependent actions have the best potential in the future?

A further elaborated version of this table, incorporating sub-sections and secondary layers of enquiry and questioning, is provided at Appendix A.

3.3 Theme 1: Context and problem framing

Understanding the nature and true scale of informal transport networks in Sub-Saharan Africa (SSA), as well as having reliable evidence on the benefits and problems associated with the sector, provides the basis for informed decision-making. This section summarises current knowledge in relation to: the nature of informal transport networks and operations in Sub-Saharan cities; problems and benefits commonly associated with informal transit services; and policy positions adopted towards informal transport.

3.3.1 Informal transport network

Informal transport networks have emerged organically in response to demand and opportunities, shaped by trial and error, the location of available terminals, and perhaps also coordination or 'turf wars' among operators. Over time, they may exhibit rigidities of their own, such as the establishment of terminals in consolidated parts of the city and the union/membership associated with key routes or corridors. As a result, in many cities the networks have stabilised, other than the areas of continued population/spatial expansion. They are understood by the people who learn how to navigate the mobility options. Now they can be mapped and presented as a network, and perhaps even optimised.

In an attempt to better understand the scope and nature of informal transport networks, researchers and practitioners across the African continent have embarked on large-scale data collection and mapping campaigns over the last decade. The combination of GPS and mobile technologies has simplified the acquisition of spatial data on public transport networks, as exemplified in Nairobi (Williams et al. 2015), Cape Town (Coetzee et al. 2018), Maputo (Klopp and Cavoli, 2019), and Accra (Saddier et al. 2016). These initiatives have described the spatial organisation of informal transport routes and provided insights into the accessibility of different parts of their city by public transport. They have also highlighted the challenges of maintaining an up-to-date transport map in cities where services are predominantly informal.

Building on these initial efforts, researchers have analysed the characteristics of routes and services. In Cape Town, du Preez et al. (2019) found that routes could be clustered based on service attributes (such as length, speed, stopping patterns, and connection to trunk services) and developed a typology of routes that could be used to guide public interventions. Also in Cape Town, Behrens et al. (2017a) analyse the mismatch between the arrival and departure times of informal and formal public transport services at a public transport interchange. Earlier research on operational and economic efficiency indicates that the modelled profitability of informal transport is higher on feeder/distributor services than on trunk services (Del Mistro and Behrens 2012).

In a similar vein, Saddier et al. (2017) and Saddier and Johnson (2018) use a combination of onboard surveys and departure counts to characterize *trotro* operations on a sample of routes in Accra. They find that informal transport services are reasonably reliable from the passenger's perspective but have a low productivity because of their internal organisation and a likely oversupply of vehicles. In Kampala, the inefficiencies of paratransit operations are characterized by long passenger waiting times, long hold-back times, and low commercial speed. The researchers (Ndibatya and Booysen 2020a) identify various potential gains in a series of areas including regulation, industry structure, fleet composition, scheduling, and fare system.

The research summarised in this sub-section illustrates the impact of recent developments in data acquisition and data transmission technologies on paratransit studies, epitomised by the proliferation of smartphones in African cities. These devices are increasingly affordable, transmit data in real time, and incorporate a range of sophisticated sensors (e.g. gyro sensors, accelerometers, GPS, etc.). Most entry-level models are now equipped with GPS chips, making them well suited tools to record spatial data. The miniaturization of GPS technology has also allowed the use of hand-held trackers – which tend to be more accurate than the ones embedded in smartphones – to map paratransit routes (for example, in Nairobi: Williams et al. 2015).

These technologies have typically been used with "active" data collection methods, whereby enumerators register specific events (e.g. the departure of a vehicle, a passenger boarding, etc.) on a portable device. While GPS trackers automatically record spatial coordinates every few seconds, the intervention of an enumerator is needed to qualify the event recorded and enrich raw spatial data. Less frequently employed "passive" methods consist of fitting a tracker on a vehicle without having an enumerator present onboard. This approach makes it possible to collect comprehensive movement data over a long period of time, as it does not require any physical intervention beyond the installation of the tracker (see for instance Ndibatya

and Booysen 2020a). However, it produces raw data that can be difficult to interpret as it misses useful information to understand the behaviour of the vehicle (e.g. presence of passengers onboard, traffic conditions, etc.).

Building on the possibilities offered by these technologies, several firms have developed their own data collection smartphone applications. On the African continent, various start-ups have designed applications dedicated to paratransit data collection and mapping (Transport for Cairo, GoMetro, WhereIsMyTransport).

3.3.2 Benefits and negative externalities

The informal transport sector offers benefits seldom associated with formal, fixed public transport modes. Informal transport business owners are quick to respond to new demands for service, and as a result penetrate many and diverse passenger markets within the city. They are, as Cervero and Golub (2007) note and Vanderschuren *et al.* (2021) demonstrate, the 'consummate gap fillers'. In the context of unprecedented forecast urbanisation on the sub-continent, 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.

Flexibility provided by informal public transport and the interaction with the informal urban economy are also key assets. For example, real time route deviations may provide the user with a more door to door service. Andreasen and Moller-Jensen (2017), in their study of accessibility in Dar-Es-Salaam, highlight this inter-connection when they highlight that "Many of those, who travel regularly outside of their settlements, have more diverse, irregular and shifting mobility patterns related to various kinds of informal livelihood activities associated with trading, freelancing and small-scale businesses". Joseph et al (2020) also highlight that informal public transport frequently responds well to the mobility demands of individuals engaged in the informal economy. They report that more than 70% of the households in Dar-es-Salaam, who depend on informal livelihoods, use the informal modes of transport such as minibuses, motorcycles and tricycles as their primary mode (Joseph et al, 2020). The interaction between the informal urban economy and the informal transport system is also reflected in the need, as shown by a number of studies (e.g. Turner & Kwakye, 1998; Joseph et al. 2020), for those engaged in such informal sector livelihoods to travel with goods. The majority of such passengers are women. The provision of both a passenger and small freight distribution service is a further benefit of informal public transport.

This demand-responsiveness, service innovation and coverage is achieved free of direct operator subsidisation. The informal transport industry also offers an important source of income and poverty alleviation to a segment of the population that often finds itself superfluous to the formal economy. This is demonstrated by the work of Kamau (2018) who has estimated that there around 19,000 drivers working across Nairobi's informal public transport sector. Informal public transport is, it is suggested, the fourth largest informal economy sector in the city. Whilst not providing figures for total employment in the sector involving all related employment activities including maintenance and terminal staff, the work does suggest that at least 20 percent of those working in the sector are women. Few of these are women drivers, but mostly employed in other activities including conductors. It is further suggested that this is a high proportion of women relative to informal transport in other regional cities, but is argued that the organisation of operators into Savings and Credit Cooperatives (SACCOs) in Nairobi has created a conducive environment for more women to be employed. Informal transport also has problems however, often linked to ease of market entry, 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, aggressive driver behaviour, unsafe operations and unfair labour relations. 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 passenger needs. Informal transport operations have also caused significant externalities: old and poorly maintained vehicles tend to be heavy emitters of air pollutants; and boarding and aligning practices that spill into traffic lanes reduce already limited road capacities considerably. (Behrens et al 2016). Despite the challenges of business viability, it is argued that affordability is an issue for the predominately low-income passengers that are served by informal transport. The work of Diaz Olvera et al (2008), drawing together work across a number of African cities,

highlights that transport expenditure constitutes a significant household expenditure. Furthermore, they argue that there are considerable inequalities between households and that regular use of motorized transport is often unaffordable for poor populations.

Negative externalities

Of particular relevance to the TRANSITIONS project is the impact of informal transport on emissions with respect to global carbon dioxide concentrations and climate change impacts, and with respect to localised air pollution and public health problems. The literature reviewed indicates, unsurprisingly, that the advanced age and poor condition of many of the informal transport vehicles in operation worsens emissions (Ndibatya and Booysen 2020a, Nare and Kamakate 2017). Understanding the severity of emissions is hampered, however, by the lack of air quality monitoring capabilities in many Sub-Saharan African countries. Schwela (2006), for instance, found that, of 27 Sub-Saharan African countries studied, only five had monitoring systems for particulate matter. The few studies that have quantified emissions specifically among informal transport vehicles, have shown that larger passenger capacities have per capita emission advantages (Gopaul et al 2019), that conversion to electric vehicle technologies would offer emission reductions (Kane 2016), and that fleet rationalisation through scheduling would also offer reductions (Coetzee *et al* 2019). More general studies of transport sector emission across all travel modes have demonstrated links between fuel type and reduced emissions (Adoléhoumé 2004), reduced vehicle kilometres travelled and reduced emissions (Thambian and Diab 2011, Tongwane et al 2015). Other studies have found a relationship between particulate matter and traffic density (Linden et al 2012, Etyemezian et al 2005, Doumbia et al 2012). Numerous studies have observed links between localised air pollution and health problems (Coker and Kizito 2018, Mustapha et al 2011, Sylla et al 2017).

Studies have repeatedly shown that sexual harassment on public transport is a widespread experience for women globally (FIA Foundation, 2016) and that it is as common a feature of cities across Africa where informal transport predominates as it is in cities with formal transport systems. Overcrowded vehicles and poorly regulated public spaces characteristic of informal provision allow touching, groping and other forms of harassment of women to occur unchecked. For example, the FIA Foundation report, Safe and Sound, (FIA Foundation, 2016) reports significant perceptions of insecurity within Cape Town from riding informal transport vehicles as well as walking to and waiting at bus stop for rides. Almost 70 per cent of women in a survey conducted in Egypt, by the European Bank of Reconstruction and Development (EBRD, 2016), were dissuaded from using public transport to commute to work because of safety concerns. These concerns were mostly a response to a high incidence of sexual harassment in public transport. Concerns of sexual harassment also extended to women workers in informal transport. In Kenya, a study revealed that 76% of women informal transport workers have either experienced or witnessed sexual harassment at their place of work (FLONE, 2018). One element of harassment is often experienced by young people, especially young women. Porter and Turner (2019) highlight that young people travelling to education, in locations where they are entitled to reduced fares on informal public transport, are frequently barred by operators and drivers from travelling on minibuses, often with the threat of violence.

3.3.3 Attitudes and policy

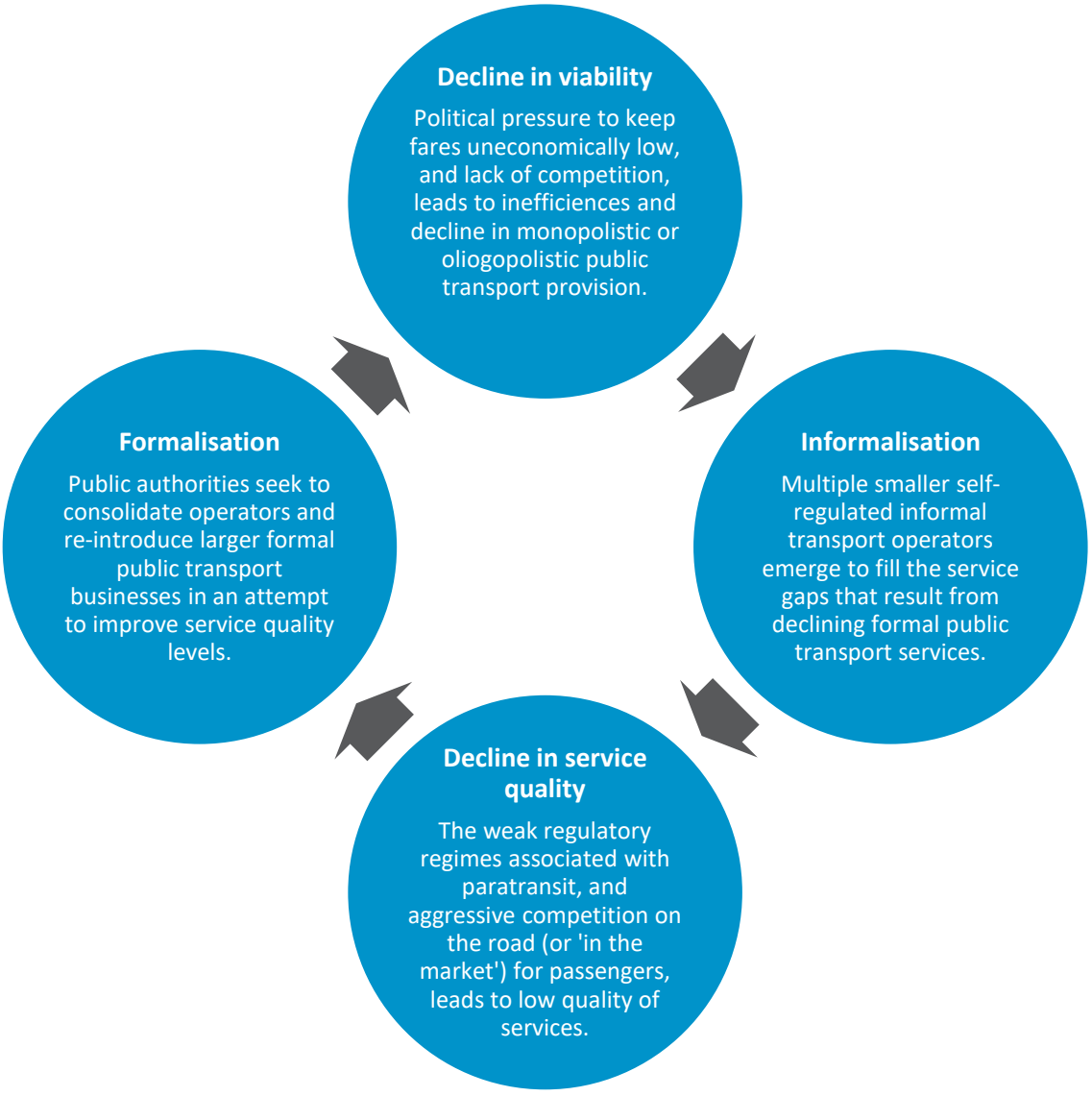
The attitudes of public authorities towards informal transport are reflected in the policy positions they adopt. In an early categorisation of policy positions, Cervero (2000) identified four main choices for public authorities:

- (1) ‘prohibition’ (banning informal transport services to protect formal operators from competition);
- (2) ‘acceptance’ (accepting the presence of informal transport services, but doing nothing);
- (3) ‘recognition’ (unrestricted market entry, but regulating areas of operation, and service, vehicle and employment standards); and
- (4) ‘regulation’ (regulating both market entry, and areas of operation and operating standards).

Cervero and Golub (2007) argue that these choices are constrained in practice by contextual factors, notably the capacity and resources of the regulatory authority.

A later publication by Gwilliam (2008) argued that these policy options are less choices, but more part of a 'regulatory cycle' (see Figure 8). In essence, the cycle involves the following phases: (1) political pressure to keep public transport fares uneconomically low, and a lack of competition, lead to inefficiencies and decline in monopolistic or oligarchical public transport undertakings; (2) multiple smaller self-regulated informal transport operators emerge to fill the service gaps that result from declining formal public transport services; (3) the weak regulatory regimes associated with informal transport, and aggressive 'in-the-market' competition, lead to poor quality of service; and (4) public authorities seek to reduce the number of operators and reintroduce large formal public transport businesses in an attempt to improve service quality levels. The cycle is repeated once the efficiencies of larger formal public transport undertakings begin to decline due either to a lack of competition or a failure in regulatory enforcement. Wilkinson (2010) argued that this cycle is not necessarily observable, nor a sequential progression, in all contexts, however. Some Sub-Saharan African cities have, for instance, until recently been in phase 3 for many decades, and the successive phase has either comprised a move towards formal business formation (phase 4), further informalisation (phase 2), or a mixture of the two as the market niche once occupied by the formalised services is filled by new informal entrants (Finn and Mulley 2011; Finn and Walters 2010).

Figure 8 - The 'regulatory cycle' (adapted from Gwilliam 2008)



More recently, Schalekamp et al. (2010, 2016) and Schalekamp and Behrens (2010) identified three main policy approaches to informal transport reform:

- (1) ‘comprehensive Bus Rapid Transit (BRT) implementation and paratransit assimilation’ (incumbent informal transport operators are comprehensively replaced by BRT services in corridor phases, and either compensated for exiting the market or corporatized into contracted formal bus companies), as advanced by Gauthier and Weinstock (2010); Wright (2004); Wright and Hook (2007);
- (2) ‘stepped, flexible paratransit transition to bus system improvement’ (a formalised bus network results from flexible and reversable incremental improvements, including variations of: ceding management of vehicles and drivers to a professional entity; introducing a centralised fare collection system in which revenue is disbursed to operators; purchasing a collectively owned vehicle fleet; rationalising vehicle and driver operations to improve cost-efficiencies; and contracting the resulting formalised bus company to operate service), as advanced by Browning (2001), Hitge and Van Dijk (2012), Moody et al. (2014), and Plano (2019); and
- (3) ‘upgrade of existing services’ (less ‘radical’ public intervention is directed towards upgrading existing services provided by incumbent operators, through the formulation and enforcement of rules and standards concerning operating areas, driver qualifications, vehicle roadworthiness and employment practices), as advanced by Lomme (2008), and Shittu (2014).

The attitudes of the informal transport industry are reflected in their willingness to participate in public authority reform initiatives. As will be discussed later, the most common contemporary public authority intervention has been BRT implementation and paratransit assimilation. Publications documenting the responses of incumbent operators to these initiatives, illustrate that the industry is both comprised of multiple stakeholders, with varying vested interests in the status quo, and typically distrustful of, and resistant to, change. This is illustrated in experiences in Accra (Poku-Boansi and Marsden 2018), Cape Town (Schalekamp 2015, Schalekamp and Behrens 2010, Schalekamp and McLachlan 2016), Dar es Salaam (Rizzo 2014), Johannesburg (Asimeng and Heinrichs 2021), and Lagos (Asimeng and Heinrichs 2021, Nguyen and Pojani 2018).

3.4 Theme 2: Organisation and engagement approaches

For TRANSITIONS it is important to understand the organisational structure (or structures) of the informal public transport sector, from management, ownership and financial perspectives, in order to understand what actions might be suitable and through which channels the sector can be engaged. This section summarises current knowledge in relation to: the collective organisation of, and labour relations within, informal transport businesses; and engagement with incumbent informal transport operators.

3.4.1 Organisational and financial models

Informal transport operators are organised within the context of complex political economies. Research publications using political economy methods to study transport informality present a less benign and micro-level view of informality, than that presented in the more organic, collaborative notion of 'people as infrastructure' (Simone 2004). Instead, these studies take a more structural and political view of informality (e.g. Rizzo 2011, Xiao and Adebayo 2020). They highlight the importance of structural factors, such as explicit neglect of enforcing regulation and deliberate privatisation of economic sectors, that create explicitly informalised workers and employees. Within this more structural view there is a characterisation of a clear link between the formal and informal urban economy in the form of a more symbiotic, inter-dependent linkage, with the former needing the latter in order to maximise a return on capital within the formal economy.

Published studies of informal transport collective organisation were found for Ghana, Kenya, Nigeria and South Africa. These studies demonstrate that collective organisation in Sub-Saharan African cities takes a variety of forms. Informal transport businesses organise collectively at varying geographical scales and with differing levels of public authority sanction and support. In some countries there are national or regional associations established to represent collective owner interests (e.g. the Matatu Owners Association and Matatu Welfare Association in Kenya), some of which are supported and sanctioned by government agencies (e.g. the South African National Taxi Council) (Klopp and Mitullah 2016; McCormick et al. 2016). Finn et al. (2011) describe the Ghana Private Road Transport Union (GPRTU), a particularly powerful national self-regulatory entity, which organises more than 80% of the *trotro,* or minibus, sector through assuming control of access to terminals and service routes, as well as leasing buses to members.

A more ubiquitous form of collective organisation are smaller route associations, formed by operators to protect and self-regulate their markets. In most associations, membership is composed exclusively of vehicle owners, but some include vehicle drivers as well. Examples include the National Union of Road Transport Workers (NURTW) in Nigeria (Agbiboa 2020), which has developed to become a large organisation (circa 100,000 membership) formed through the merger of a number of existing unions/associations. NURTW dominates the urban and small vehicles sector, while the owner-centric Road Transport Employers Association of Nigeria (RTEAN) dominates the inter-urban and large bus sectors (Mobereola 2009). Regulatory authorities sometimes require membership of a collective organisation in licensing regimes. In South Africa, for instance, affiliation to a registered route association is a mandatory requirement for an operating license, as is membership of either a savings and credit cooperative or a transport management company for a public service vehicle license in Kenya (Behrens et al. 2017b).

Savings and Credit Cooperatives (SACCOs) and Transport Management Companies (TMCs) in Kenya have been a particular focus of study. Behrens et al. (2017b) explored the organisation of inter-city matatu SACCOs differentiated by improved service, regulatory compliance and technology adoption, through (n=10) SACCO case study research. They found that most of the case study SACCOs achieved service quality improvements by shifting from the 'target system' (see next section) to *matatu* driver salaries, and by requiring a form of vehicle depreciation costing through compulsory contributions to the SACCO's capital savings from which vehicle acquisition and repair loans can be derived. Gathungu et al. (2018) explored the impact of *matatu* SACCO membership on financial performance, through a (n=140) survey of matatu SACCO investors, and an analysis of SACCO financial reports. They found that SACCO members were better able to accumulate savings, and were able to access bigger loans, than would otherwise be the case. Plano (2020) explored the organisation of TMCs, through (n=2) TMC case study research (Kenya Bus Services and Citi Hoppa). He found that in the TMCs, vehicle owners assume the role of a franchisee, and that driver recruitment, training and (salary) payment was centrally managed by the TMC, with associated benefits for passenger comfort as driver behaviour is not influenced by the 'target system'.

Labour conditions, remuneration approaches and driver behaviour

The available literature reports ubiquitous informal employment conditions, which are often exploitative in nature. In some instances, the driver is also the vehicle owner (Clayborne 2012), while in others vehicle owners and drivers have kinship links (Rizzo 2002), but in the large majority of cases there is commercial employment relationship between a business owner and a vehicle crew. Driver remuneration is most commonly based on a 'target system' in which drivers keep cash fare revenue less fuel (and, if applicable, conductor and minor maintenance) expenses and a daily or weekly vehicle rental payment to the owner (McCormick et al. 2015; Schalekamp and Saddier 2020). Alternative, less common, remuneration models take the form of a commission based upon an agreed portion of weekly farebox revenue (Joubert 2013), and salaries (typically with a ridership bonus incentive, as in the case of TMCs in Nairobi) (Behrens et al. 2017b, Plano 2020).

Published studies of informal transport employment conditions were found in Ghana, Kenya, Nigeria, South Africa and Tanzania. In one of the earliest studies, Rizzo (2002) examined exploitative labour relations amongst *daladala* minibus businesses in Dar es Salaam, through a (n=668) survey of drivers and conductors. His analysis revealed 83% of respondents were employed casually, without any recorded agreement on wages or conditions of service, and remunerated on the basis of the target system. The ability of vehicle crews to negotiate the daily target was found to be severely curtailed by high levels of prevailing unemployment and labour turnover. More recently, Agbiboa (2016, 2020) undertook eight months of ethnographic fieldwork to study the experiences and micropolitics of *danfo* minibus crews in Lagos, revealing that working conditions were both insecure and dangerous. A review by Ingle (2009) found similarly exploitative and insecure employment conditions amongst minibus-taxi drivers in South Africa.

Ommeh et al. (2013) explored employment relationships through (n=15) qualitative interviews with *matatu* business owners on Nairobi, concluding that exploitative and insecure labour conditions have a negative impact on regulatory compliance (in relation to operating permissions and traffic laws). A review by Boateng (2020) reached similar conclusions regarding the causes of non-compliance amongst Ghanaian *trotro* drivers. He concluded that non-compliance is driven by a working environment characterised by intense 'in-the-market' competition, job insecurity, non-negotiable daily targets, and harassment for bribes from police officers.

3.4.2 Engagement context

There are multiple actors with interests in the informal transport sector. In any one city these actors might include:

- informal transport representative bodies, owners and workers;
- local, regional or national government entities in transport,
- vehicle financiers and other functional areas (e.g. vehicle repair and servicing garages, fuel stations); and
- national or international development agencies and finance institutions (see also the section on organisational and financial models).

Engagement in the context of this compendium refers to interactions between these stakeholders. Such engagement might be through direct means such as meetings, forums or negotiation processes, or take place indirectly through legislation, planning documents and the like that is proposed by some parties and which elicit some responses or actions from other parties. The aim of such engagements is to manage the status quo, or to introduce improvements – or "reforms" – to informal transport businesses, the services they render, or how they compete with one another (see Schalekamp, Golub and Behrens (2016) for a deeper discussion on such reform).

In reflecting on informal transport reform processes that have taken place in African cities in the 21st century, engagements between informal transport, government and development actors have commonly had four outcomes on the agenda:

- **Physical assets -** The first of these outcomes has been to improve physical assets in the sector, thus targeting i) vehicle fleets, amongst others to achieve safety, air pollution, or passenger capacity gains, and ii) infrastructure provision or upgrades at termini, on-street boarding or roadway facilities.

- **Restructuring of businesses** - The second desired outcome has been to restructure informal transport businesses by consolidating the typically large number of small and micro enterprises into companies or cooperatives. Expectations of such an outcome included benefitting from efficiencies of scale and reducing the number of parties who need to be part of engagement processes.
- **Professional development / capacity building** - The third outcome has been to take informal transport and government sector actors through professional development (or "capacity building") programmes, e.g. to retrain drivers to operate a new type of vehicle, for business owners to understand the workings of a new corporate structure, or for civil servants to reorient policy or planning to achieve financial and environmental sustainability aims.
- **Information and Communication Technologies (ICT)** - A last outcome has been to introduce information and communication technologies somewhere in the informal transport system, often aided by mobile phones. The intent of such technology introduction has included facilitating cashless fare payment, collecting operational data, and providing passengers with service information.

The aforementioned outcomes are usually part of government or development-agency led public transport reform projects. The most notable cluster of such projects has been the installation of BRT in a variety of cities on the continent. The largest such endeavour has been in South Africa, where informal operators were expected to be the operators of the new bus services. Achieving this shift has required engagements around all four of the above outcomes, which has made for complex exchanges, but with limited success (see the section on regulation for more on this). A smaller cluster of projects – where informal transport businesses lay at the core – have been fleet upgrading programmes, such as those in Maputo and Dakar, which included the first three outcomes. Also part of the last cluster is South Africa's minibus replacement programme, which initially aimed to achieve the first two outcomes, but in practice centred only on fleet renewal.

Despite what are likely to have been difficult and time-consuming engagement processes, little has been written on how these processes unfolded over time, who was involved, or how the processes changed and outcome expectations were amended in response to disagreements. More studies are needed of the likes of Van Schalkwyk (2011) investigation into how South Africa's minibus replacement programme came into being over the period 1998-2008, or Schalekamp (2015) analysis of the engagement process that led to the establishment of the first cohort of informal transport-based BRT operating companies in Cape Town during the period 2008-2015. Aside from such detailed reports and their geographical focus on South Africa, it is largely left to popular media channels to spread information and insight into the complexity and challenges of engagement, which has its drawbacks in terms of consistency and comprehensiveness.

Finally, as Cervero (2000) points out (and as described in Section 3.3.3) there is a spectrum of public sector positions on informal transport that determine where engagement starts and the various actors' openness to such engagement – again contributing to complexity and timeframe. Different courses of action are also necessary depending on the particular contexts of different cities, and which actors have the greatest political and financial clout. There are no best practices: timeframes and outcomes of informal transport reform engagements are not certain in any city due to the complex relationships and interactions between human factors and the physical environment.

3.5 Theme 3: Capacity and capabilities of public authorities

A city authority's ambitions and capacity to deliver formal public transport, as well as the available resources to effectively regulate and enforce the informal public transport sector, will have an important bearing on the types of measures that would be considered suitable. This section summarises current knowledge in relation to: prevailing public transport planning processes and their treatment of incumbent informal transport services; and prevailing informal transport regulatory frameworks.

3.5.1 Public transport planning and integration

As outlined in section 3.3.1, three main policy approaches to informal transport reform are identified:

- 'comprehensive BRT implementation and paratransit assimilation',
- 'stepped, flexible paratransit transition to bus system improvement' and
- 'upgrade of existing services'

At least until recently, replacement of informal transport with BRT services has received the greatest traction amongst city governments. Numerous published studies reflecting on the experiences of these BRT projects were found, in: Accra (Agyemang 2015, Poku-Boansi and Marsden 2018); Cape Town (Diallo 2019, McLachlan 2010, Rayle 2017, Schalekamp and McLachlan 2016); Dar es Salaam (Chengula and Kombe 2017, Morten *et al.* 2020, Rizzo 2014); Johannesburg (Asimeng and Heinrichs 2020, Klopp et al. 2019, McLachlan 2010, Venter 2013); Lagos (Asimeng and Heinrichs 2021, Klopp et al. 2019; Nguyen and Pojani 2018); Nairobi (Klopp et al. 2019, Stokes 2019); and Tshwane (Manuel and Behrens 2018).

These studies demonstrate that, while travel time savings and service reliability benefits have frequently been observed as a result of the investment into dedicated bus lanes and rapid-boarding station facilities (see, for example, Chengula and Kombe 2017; Morten et al. 2020, and Rayle 2017), BRT implementation has not diffused through Sub-Saharan African cities as widely as originally hoped. While Nguyen and Pojani (2018) demonstrated that the reasons for this are varied and complex, a core reason emerging from the literature is that BRT projects have typically encountered considerable local resistance. Asimeng and Heinrichs (2020) explored the reasons why informal transport operators resist, or show little interest in, BRT (in case studies of Bogota, Mexico City, Johannesburg and Lagos), concluding that such resistance or indifference is based upon concerns relating to loss of autonomy and business flexibility, financial and economic risks, and a lack of trust in the government agencies that initiate projects.

There would appear to a reasonable consensus in the most recent literature (2015-2020) that the main lesson to be derived from the BRT experience in Sub-Saharan Africa is that contextually grounded policy solutions (that may or may not take the form of BRT) are required, that seek complementarity with, rather than seek to comprehensively replace, existing informal transport services (Behrens and Salazar-Ferro 2015; Fabianski and Kerkhof 2019, Klopp et al. 2019; Poku-Boansi and Marsden 2018).

Published studies of 'hybridity' regulation, or, in other words, studies seeking regulatory frameworks supportive of complementarity between informal transport services and formal bus or train services, were found in Nigeria (Alcorn and Karner 2020), South Africa and Tanzania (Mfinanga 2013). While there is precedence for other forms of informal-formal service integration (for example, various forms of shared routes and peak-lopping, see Behrens et al. 2016b), the studies undertaken focus on trunk-feeder arrangements in which informal transport services feed to, and distribute from, interchanges with formal trunk services. The common rationale for this focus is that the lower vehicle operating costs of smaller informal transport services make them better suited to lower volume and lower frequency neighbourhood routes, and the lower labour costs of larger buses and trains make them better suited to higher volume and higher frequency trunk routes (Del Mistro and Behrens 2015).

Behrens et al. 2016b undertook (n=5) international case studies to explore alternative approaches to feeder and distributor service hybridity regulation, identifying: route licenses with financial rewards; area-based quantity licenses; area-based concessions; area-based franchises; and route-based contracts. The potential for two of these regulatory approaches were explored further in publications on Cape Town, specifically the Mitchells Plain public transport interchange. Mitchells Plain presents a useful case study, as it has *minibus-taxi* associations that have, for decades, exclusively provided feeder and distributor services.

One collection of publications explored financial rewards within the prevailing route licensing regime. These publications investigated: trunk-distributor service complementarity through analysis of (n=4,024) vehicle departure records (Behrens et al. 2017a); the willingness of drivers to provide evening service to match those of trains and large buses through a (n=79) stated choice survey (Plano et al. 2018; 2019; 2020); the willingness of vehicle owners to accept policy interventions to lengthen evening service spans through focus groups and (n=16) qualitative interviews (Plano et al. 2020); and the cost of these policy interventions to the regulatory authority (Plano et al. 2020). These studies found informal transport services stop operating around three hours before the latest arriving trunk service. It was found that increased income is the overriding choice attribute in determining driver willingness to provide evening service (without additional security, ZAR 22.89/hour [~GBP 1.37] required for a 70% probability). Apart from an increase in evening fare, which is a matter for paratransit associations to decide, the policy interventions that emerged as most promising for the regulatory authority to consider were an operating deficit payment (a payment to cover operating deficit plus a small profit), in conjunction with improved interchange security. These interventions were estimated to be less costly and require fewer onerous changes from status quo operations, than previous plans to eliminate informal transport through corporatization and BRT implementation.

Another investigation explored the prospects of route-based contracts with one of the minibus-taxi associations operating out of the Mitchells Plain interchange, with a view to ultimately forming a transport operating company capable of contracting with the regulatory authority (Saddier et al. 2019). The association participated in a self-financing pilot project which introduced scheduled services and moved driver remuneration from commissions to salaries. This enabled a rationalisation of vehicles (from 78 to 38), a 45% reduction in fuel consumption, and a reduction in driver working hours (from 12 to 7.5). A (n=732) before and (n=693) after passenger survey found that, overall, passengers where significantly more satisfied with the quality of service after improvements (mean Likert rating increased from 3.3 to 4.7). On its own initiative, the same association previously introduced centralised fleet management, salaried drivers and profit disbursements in 2013, which lasted for about 18 months before disputes over profit sharing and salaries led to a reversion back to the old business model (Klopp and Schalekamp 2018, Schalekamp and Klopp 2018).

3.5.2 Informal transport regulation and institutional framework

In most Sub-Saharan African cities, informal transport operations are subjected to one of two regulatory systems. The first takes the form of 'self-regulation' imposed by operator associations (Finn *et al.* 2011; Gwilliam 2011). The primary purposes of self-regulation are usually market entry control, although this is often related more to kinship and community than to balancing supply with demand, and protecting routes from competitors. On occasions, particularly when the market is over-traded and alternative avenues of formal and informal sector income generation are limited, route protection can become violent as drivers compete for passengers 'in the market' to meet their daily farebox revenue targets, and associations seek to protect their routes and remove competitors from the market (e.g. the 'taxi wars' in South Africa following market entry deregulation in the late-1980s(Sekhonyane and Dugard 2004) (Cervero and Golub 2007; Woolf and Joubert 2013). In some cities, operator associations collude in the setting of fares (McCormick et al. 2016), while in others, drivers engage in opportunistic dynamic pricing (Salazar Ferro 2015).

The second regulatory system takes the form of the rules imposed by the public authority. Figure 9 summarises the array of regulatory regimes identified in the general literature on bus regulation (Gwilliam 2002, Fox 2000; Meakin 2004a, 2004b). Regimes applied to informal transport are generally those related to 'in-the-market' competition (Bayliss 2002).

The complexity of regulatory regimes varies widely, according to the powers, capacity and resources of the authority (Cervero and Golub 2007, Finn 2008, Wilkinson 2008). In the least resourced contexts, open markets prevail, and regulation is reduced to whatever traffic law enforcement may exist (Gwilliam 2011). Common regulatory regimes in Sub-Saharan Africa focus on quality licensing relating to, inter alia, vehicle specification and driver qualification, and quantity licensing (Benmaamar 2003; McCormick et al. 2016). Regulatory authorities sometimes require membership of an association or cooperative in licensing applications (Behrens et al. 2017b, Orero and McCormick 2013). In the absence of adequate market entry enforcement, quantity licensing defaults to a form of quality licensing. As Finn et al. (2011) note, in the absence of adequate enforcement, sometimes these licensing schemes amount to little more than income-generating mechanisms

for the authority. Some regulatory authorities also set fares (e.g. *chapas* fares in Maputo and *daladala* fares Dar es Salaam) (Gwilliam 2011).

Beyond licensing, innovative Sub-Saharan African regulation regimes found in the literature search include:

- Moja Cruise, Durban - a (currently stalled) monthly performance incentive initiative in Durban, operating within a route licensing regime, within which minibus-taxi associations and operators will be rewarded for improved vehicle maintenance, driver behaviour, passenger treatment, and instituting written driver employment agreements (Klopp and Schalekamp 2018; Schalekamp and Klopp 2018);
- University Bus Network, Cape Town – a service contracting with minibus-taxi associations to provide services as part of a university bus network in Cape Town (Behrens et al. 2016b; Klopp and Schalekamp 2018); and
- Gautrain feeder services – operating in the Gauteng city region (Schalekamp 2015);
- Kenya Bus Services and Citi Hoppa - franchise agreements concerning branding and operating rules between the transport management companies and vehicle owners in Nairobi (McCormick et al. 2013; Plano 2020); and
- Vehicle renewal, Dakar – where franchising of operations is a precondition for accessing vehicle renewal funding (Benmaarmar 2003; Kumar and Diou, 2010).

Figure 9 – Alternative regulatory regimes

			No competition	Competition for the market	Competition in the market	Negotiated or tendered
monopoly	public monopoly	authority owns and operates the system				
	private monopoly	authority awards one operator exclusive rights to operate the system				
	oligopoly	authority awards a small group of large operators control of (parts of) the system, who do not compete				
contracting	management contracts	authority owns system, hires management				
	gross cost service contracts	revenue goes to authority, bidders compete for production cost, the authority takes the commercial risk				
	net cost service contracts	revenue goes to operator, bidders compete for cost and revenue, operators take the commercial risk				
	performance-based contracts	remuneration that rewards operators for, and incentivizes, good performance				
franchising		authority awards exclusive area/route rights to operators, and takes the lead in specifying the nature of the service and assumes most commercial risk				
concessions		authority awards exclusive area/route rights to operators, and operators take the lead in specifying the nature of the service and the authority assumes little commercial risk				
licensing	quantity licensing	the number of vehicles allowed to operate in an area or route is limited by the authority to control competition and attach value to the license				
	quality licensing	anyone with a licence can operate, provided they comply with quality conditions				
open market		anyone can operate, subject to general laws				

3.6 Theme 4: Actions for low carbon, affordable and safe transport

Strategies to work with informal public transport operators could comprise a range of actions from physical infrastructure improvements, through controls on operations, fleet and vehicle improvements and business support. This section summarises current knowledge in relation to: infrastructure provision to improve the operating environment of informal transport services; the rationalisation of route networks and vehicle sizes; vehicle technologies, quality controls and fleet renewal; and informal transport business development and capacity building.

3.6.1 Infrastructure and operating environment

Hubs/interchanges for integrating public transport and informal transport

Most Sub-Saharan African literature on infrastructure provision to improve operating environments focusses on public transport interchanges that facilitate passenger waiting and vehicle transfer. A statutory requirement for integrated transport planning has compelled South African city authorities to consider modal integration in service routing and the siting of stations and public transport interchanges (Venter et al. 2020). Thus, some authorities have invested in the upgrade of terminal and transfer facilities (Verster 2010). Some South African studies have explored the detailed design and functioning of minibus-taxi terminal facilities (Pienaar 1998; Van Biljon and Venter 2013). More recently, research attention has turned to modal integration and transfer, particularly in relation to BRT projects. A recent study on 'first and last mile' connectivity to and from rail and BRT services in Gauteng observed reasonable integration with other modes (Venter 2020), although integration with informal transport services remains weak (Adewumi and Allopi 2014). In Dar es Salaam integration between BRT and *daladala* services is accommodated in some end-of-line terminals and in-line stations, but here too integration with informal feeder routes remains largely incomplete (Chengula and Kombe 2017; Venter et al. 2020).

Road space prioritisation

There is limited evidence of road space prioritisation for informal transport vehicles through bus lanes or intersection priority provision. The only relevant publication that surfaced in the literature search is a paper documenting the impacts of an 11 kilometre inbound open bus lane, shared by formal buses and informal minibus-taxis, in Cape Town (Tichauer and Watters 2008). The analysis revealed a before-after decrease in mean travel time for public transport vehicles from 33 to 14 minutes, and an increase in the proportion of public transport vehicles in traffic stream from 56% to 63%.

Informal transport operations management

Another means of improving informal transport operations, if not the operating environment, is through the adoption of vehicle tracking technologies, which have the potential to facilitate better service availability assessment and to introduce improved fleet management practices. The adoption of vehicle tracking technologies to monitor vehicles in service has been become fairly widespread in Kenya at least (Behrens et al. 2017), but most publications have focussed on the uptake of vehicle tracking applications for the purposes of network mapping and service coverage assessment (see Section 3.3.1). There are no cases of advanced vehicle management assignment and routing, based on GPS tracking and software/app-assisted management, reported in the literature.

3.6.2 Urban access restrictions and network transformation

Informal transport route assignment

Few publications relating to the rationalisation of informal transport route networks and vehicle sizes were found in the literature search. Public authority route configuration tends to be historical and reactive in nature, in the sense that routes are often established informally by operators and operating permission is then sought from the authority afterwards, and operating permission is typically considered by the authority in response to applications from operators, rather than through systematic and proactive network supply and demand analysis.

Beyond simulations of the benefits of potential route optimisation (Coetzee et al. 2019; Neumann *et al.* 2015), the only instance of implemented route rationalisation found in the literature search, is the recent case of

Mitchells Plain in Cape Town, in the context of the introduction of scheduled services in association with rationalised service routes (from 3 to 5 routes) and vehicle fleets (from 78 to 32 vehicles) (Saddier *et al.* 2019).

City centre access bans

Public authority route modifications have taken the form of city centre, or even whole city (as in the recent case of Harare), informal transport bans, as documented in papers on Nairobi (Heinze 2018) and Kigali (Goodfellow 2015). In the case of Kigali, Goodfellow (2015) reports that following the ban on bicycle- and motorcycle-taxis in 2006, a public outcry led to a quick reversal, but with strengthened regulatory control.

Restrictions on informal transport vehicle sizes/passenger capacities

Publications on vehicle size rationalisation were found in Nairobi, in relation to the proposed phasing out of smaller minibus vehicles (Ommeh et al. 2015), and in Dakar, in relation to a vehicle renewal scheme (Kumar and Diou 2010). In Nairobi, Ommeh et al. (2015) report that after two controversial years of attempting to implement a government directive, to completely phase out 14-seater matatus in favour of larger vehicles, the directive was rescinded. Greater success is reported by Kumar and Diou (2010) in Dakar, where a fleet scrapping and renewal financing initiative in 2005 attached formalisation and professionalisation conditions related to collectivisation, concession agreements, route allocations, ticketing, and fare-setting. Among these conditions was a requirement for the new minibuses to operate with fewer than 50 seats and have two lateral doors. Some 505 vehicles where replaced.

Additionally, a city centre restriction on vehicle size in Dar es Salaam was considered effective as the public authority has the capacity to enforce the restriction and *daladala* operators had the financial capacity to purchase larger vehicles. Section 12(1) of the Transport Licensing (Road Passenger Transport Vehicle) Regulations of 2007 stated: “A passenger vehicle of less than twenty-five passengers’ capacity shall not be licenced of allowed to operate into the Central Business District of a City”. *Daladala* owners, who had previously been operating typical minibuses, purchased larger vehicles of at least 25 seat capacity. Many of these vehicles were purchased new. As Dar es Salaam continued to expand rapidly with many underserved residential areas, the displaced minibuses were shifted to operate in these locations. Among other things, this transformation demonstrated that the sector actually had the organisational and financial capacity to invest in superior vehicles, but it required the right conditions and stimuli to do so.

3.6.3 Fleet and fuel improvements

Literature focusing on informal transport vehicles is scarce, as databases maintained by the authorities rarely allow for a precise tally of public transport vehicles. Even in South Africa, which boasts an advanced regulatory framework, figures diverge significantly when trying to quantify the fleet of informal transport vehicles. The Global Labour Institute (Spooner and Manga, 2019) reports that the national informal transport council (Santaco) registered 123,000 business owners with a fleet of up to 250,000 minibuses; by contrast, government official statistics put the latter figure at 130,996. This section therefore combines information on general fleet and fuel characteristics with specific reference to informal transport vehicles where available.

Vehicle acquisition, ownership and financial considerations

A small number of studies capture details of ownership and vehicle acquisition dynamics in the informal transport sector. At the continental and regional scale, Schalekamp and Saddier (2020?) note owners’ limited financial capacity to purchase new vehicles and undertake proper maintenance. Buying a vehicle in general requires relatively substantial capital, which necessitates a finance facility or pooling funds from different sources, the latter of which encourages some concentration of ownership. In very few instances, acquisition has been bolstered by public or donor sector-provided capital for vehicle upgrading, notably in South Africa and Senegal. McCormick et al. (2016) also note the uniqueness of the South African Taxi Recapitalisation Program (TRP). They add that initial capital to set up a business may also come from owners’ savings, often accrued from wages while being a vehicle driver in the sector, as financial institutions often extract punitive interest rates due to high perceived risk of business (Kumar and Diou 2010).

With a more specific geographic focus, Sebola (2014) notes that, in South Africa, the TRP capital contribution does not always match the deposit requirement for a financed new minibus, which creates an affordability problem for some owners. If such operators go out of business as a result of revenue shortfall, drivers can lose their employment. New vehicle maintenance also requires greater technical expertise, which further

raises the cost of doing business; alternatively, the service regime impacts on reliability and safety. Beyond South Africa, Finn (2012) reports that, in Accra, informal transport vehicles in the 14-18-seat range are all imported as used vehicles to Ghana. These vehicles are usually owned by individuals in personal capacity, with little evidence of concentration of ownership by individuals or companies in this city.

Vehicle supply channels

While Schalekamp and Saddier (2020) point out that informal transport vehicle fleets in general are composed of used imports from outside Africa, there is little quantitative or qualitative data that characterises supply channels for the informal transport sector. Publications referred to general production or import markets for vehicles. As reported in AIEC (2020), South Africa is the only vehicle manufacturing country in Sub-Saharan Africa, with the rest of Africa being South Africa's second-largest automotive export market (after the EU). Amongst the 2019 top 10 African export destinations were the following case countries: Zimbabwe (3rd), Mozambique (5th) and Ghana (10th). Other export channels were predominantly used vehicles – from Japan via the UAE to Malawi, Mozambique and Zimbabwe and from the USA to Ghana and Sierra Leone (Baskin 2018). The EU also exported used vehicles to Ghana and Sierra Leone, mainly through Rotterdam's port. The various market shares for used light duty vehicles by origin exported to Africa in 2018 were the EU (73%), Japan (18%) and USA (9%) (UNEP 2020).

Quantitative data that relates to informal sector vehicle supply was available through South Africa's electronic National Traffic Information System (eNaTIS 2020), indicating a currently registered vehicle population in the Western Cape Province, in which Cape Town is located, as follows: 37,450 minibuses, 1,297,502 passenger cars, 340,309 light delivery vehicles and panel vans, and 7,160 buses and midi-buses. All these vehicle classes include some proportion of vehicles in use in the informal transport sector, though the proportion is not known. This also the case for the statistics in WHO (2018), indicating the following vehicle populations: Mozambique's total vehicle fleet was 698,864 (2016 data); Zimbabwe has 953,852 light vehicles and 15,007 buses (2017); Ghana had 1,171,169 light vehicles, 210,997 buses (2017). This source does not provide information for Sierra Leone.

Fuel supply and related fleet quality controls

In the context of this theme, fleet quality controls refer to measures to manage engine/motive technology and vehicle age in order to control emissions resulting from fuel (or other energy consumption) at a fleet level. A distinction is made between South Africa and other case countries – the former's local vehicle manufacturing changes the dynamics of quality control as vehicles and fuels are locally produced as opposed to being dependent on global import-export flows. Abdoun (2018) captures facets of this distinction in a comparative analysis of fuel sulphur limits, Euro emissions standards, import restrictions/bans (based on new/used, age, roadworthiness), and tax incentives (based on age, engine capacity and emissions). His results correspond with UNEP's (2020) ranking of environmental emissions regulation as being very weak in all case countries except South Africa (primarily due to the latters' ban on used imports), though Kamau (2017) specifically notes that Ghana's efforts to adopt cleaner fuels are on track. With relevance to the case countries beyond South Africa, Baskin (2018) notes a direct correlation between basic import restrictions and increases in cleaner and more technologically advanced fleets. UNEP (2020) adds that in 2021 ECOWAS countries will introduce minimum requirements for used vehicles, though most vehicles currently exported from the Netherlands to ECOWAS states will not meet these standards.

In its Africa Energy Outlook, the IEA (2019) flags that in Sub-Saharan Africa the transport sector is the largest consumer of fossil oil, at 60% of this region's total oil use, with demand projected to grow at 3.5% p.a. between 2018 and 2040. Oil refining capacity across the whole of Africa could theoretically supply ¾ of the continent's oil needs, but most refineries have simple configurations, low upgrading capabilities and are poorly maintained.

Fuel choices and motive technologies

The only government policy or strategy document that was found that explicitly proposes climate change responses for the informal transport sector was South Africa's Green Transport Strategy (National Department of Transport [NDoT] 2018). The document states that the national government had started a process to engage with the informal transport sector to promote the use of cleaner fuels (no process details given). The NDoT proposed to convert minibuses into dual-fuel vehicles to be able to use CNG (Compressed

Natural Gas), and to work with public and donor agencies based in the country (DBSA, DTI, IDC) to secure funding for vehicle conversion and fuel station retrofitting. The NDoT also noted a need for it (and regional and local governments) to aggressively promote the benefits of CNG to the informal transport sector.

Kumalo (2019) and Montmasson-Clair et al. (2020) promote the scope for EV (Electric Vehicle) uptake in South Africa. Both make mention of informal transport minibuses as a promising market – though, as with Emslie et al. (2014), without comparison to other alternative fuel or motive technology options. Kumalo (2019) argues that a good business case can be built for minibuses electrification as these vehicles tend to travel in peak times with long standing or idle periods in between that provide sufficient recharging opportunities. She notes that obstacles to uptake include access to finance to fund the capital cost difference between ICE and EV, as well as the need to invest in charging infrastructure. Montmasson-Claire et al. 2020 note that there are limited EV minibus options in the global market, but that a current trend of delivery van electrification is likely to lead to such technology becoming available in minibuses in future, seeing as the two vehicle types are closely linked (see the OICA [2020] vehicle type definitions listed in the introduction). Their report flags adoption obstacles as being higher import tariffs for lighter vehicles (<2000kg), which includes minibuses, and the absence of local demand to stimulate supply.

3.6.4 Business development

Understanding informal transport as a commercial business, as well as how different business strategies influence driver behaviour, provides insights to how supporting actions for businesses may bring about positive change. These may take the form of promoting certain organisational structures, provision of financing schemes and direct incentives for drivers.

Business structures and strategies

One stream of the research reviewed takes the perspective of informal transport as businesses run by entrepreneurs seeking to make a profit. Although operational practices are not at the centre of this approach, profitability is highly dependent on the organisation and performance of the services. The available literature reports a variety of business strategies, ranging from illegal and uninsured owner-drivers surviving day-to-day on unbanked cash revenue, to cooperatives with collectively owned midi-buses, to small bus fleet owners operating under transport management company franchises (Jennings et al. 2016; McCormick et al. 2016). Perhaps because Nairobi is a microcosm of the diversity of informal transport businesses across the region, published studies of business strategies have been concentrated in Kenya. A study by McCormick et al. (2013), based on qualitative interviews, identified eight elements of matatu business strategy:

- business ownership and investment;
- financing; routes and vehicle types;
- pricing;
- operations;
- promotion and advertising;
- customer relations; and
- business linkages and networking.

They concluded that these elements are present in varying degrees and combinations, and that each *matatu* business develops its own unique strategy by combining the elements in different ways.

Some of the first studies in this field, carried out by SSATP in the early 2000's, reveal how operational practices are influenced by financial imperatives. The Abidjan case study (SSATP 2000), based on both secondary data and field surveys carried out by the authors, found that average load factors are very high (close to 90%) because of the load-and-go system followed by operators, whereby vehicles only depart their station of origin once all their seats are occupied. Adopting an alternative research methodology, Behrens and Del Mistro (2015) used household travel survey data to develop a transport cost model to test the assumption that trunk services would be more profitable than feeder and distributor services for informal transport operators. The results pointed to the opposite conclusion: modelled profitability is higher for feeder/distributor services and could only be improved on trunk services by a reduction in fleet size. Ndibatya

and Booysen (2020a) undertook onboard surveys (with GPS trackers) and interviews with drivers to analyse operational characteristics and compute a driver profitability index. They found paratransit operations in Kampala to be quite inefficient, with long passenger waiting times, long hold-back times, and low commercial speed. These studies reveal that competition and the resulting congestion are self-defeating for the industry.

As summarised in section 3.4.1, Savings and Credit Cooperatives (SACCOs) and Transport Management Companies (TMCs) in Kenya have been a particular focus of study and provide a positive example of how changes in business structures have realised beneficial effects. Behrens et al. (2017b) explored the organisation of inter-city matatu SACCOs and found that in most cases service quality improvements were achieved by shifting from the 'target system' for drivers to matatu driver salaries.

Employment conditions and driver behaviour

Various studies, including in Dar es Salaam, Lagos and South Africa, have demonstrated that informal transport drivers are often subjected to exploitative and unsafe employment conditions, with remuneration most commonly based on a 'target system' (see section 3.4.1). This compels drivers to collect passengers, regardless of road safety circumstances of doing so, and in competition with other vehicles.

As informal transport drivers are often blamed for not adhering to road safety standards and driving recklessly, sub-streams of research have explored: the behavioural determinant of paratransit operations; and the effects of driver training, combined with vehicle tracking and financial incentives. Nafuko and Hinton (2003) interviewed 143 *matatu* drivers in Kenya and used a regression analysis which revealed that working hours and years of professional experience have a significant effect on the likelihood of being involved in an accident. In the same vein of research, Booysen and Ebot Eno Akpa (2014) use GPS data from minibus taxis on inter-city services in South Africa to analyse their speed profile. They find that vehicles generally do not respect speed limits and that speed is dependent on route-section, direction of travel, departure time, and whether the driver is also the owner.

At least two studies have been undertaken that demonstrate the positive effects on driver behaviour from deploying digital monitoring devices. Research by Kelly, Lane and Schoenholzer (2018) involved cooperation with fleet owners in Nairobi and the introduction of monitoring devices to 255 minibuses. The device provides real time information to the owner of the minibus about the productivity and safety of the driver. In conclusion it was found that the monitoring technology eases labour contracting frictions by improving the contract that owners offer their drivers. The drivers were found to respond by driving in ways that are less damaging to the vehicle, reducing their under-reporting of revenue and meeting their targets more often, resulting in higher profits for the firm. In the second study, Janmohammed et al. (2019) reports on the Safe Travel To School (STTS) programme that aims to provide safer travel for child passengers in Cape Town by monitoring driver performance through a tracking device installed in each vehicle and rewarding good driver performance. The programme started with 78 drivers recruited in 2015 and expanded to 800 drivers from 16 districts of Cape Town. Financial incentives are paid out across four quarters each year, rewarding drivers with the best performances and those who have improved their driving during the 3-month period.

3.6.5 Passenger services

As people's mobility options expand, such as the increasing offer of motorcycle taxis, providing high quality passenger information and safe, comfortable journeys becomes of increasing importance for the long-term survival of the industry.

Passenger information systems

A logical next step from undertaking mapping of city transport networks (typically based on GPS-tracking of vehicles – see section 3.3.1) is the provision of passenger information services. Klopp et al. (2019) cite Accra and Nairobi as examples from Sub-Saharan Africa of where digital information has been utilised in this way. Open data published by the DigitalMatatu initiative provides the basis for journey planning in Google Maps. Abbeyquaye (2017) reports on a hackathon, the Accra TroTro Apps Challenge (held in 2016) that attracted over 100 hackers, although results from tests of the app/s developed showed that the journey planning results were often longer than those that *trotro* users currently use.

Cashless Fare Collection (CFC)

Implementation and passenger up-take of cashless fare collection is considered to have benefits for both transport operators and the passengers, but there are limited examples of successful deployment. Aruho and Behrens (2019) advise that there paper-, mobile-phone and card-based approaches are the main categories of CFC, while Schalekamp et al. (2017) compares nine CFC systems and finds that near-field communication (NFC) technology paired with a mobile phone offers the most adequate functionalities. Benefits for passengers include payment convenience and the potential for integrated payment across modes (Hart and Kelly, 2019). For authorities and operators, the expected advantages are: formalisation of labour conditions and benefits; organisation and increase in taxes; farebox transparency and trust, helping to reduce 'revenue evaporation' and coarse business practices such as the 'target system' described above; government support and single entity control; and operational time savings along with reduced tensions with passengers (Aruho and Behrens 2019; Aruho et al. 2021 citing Lubanga et al. 2017).

In order to understand the reasons for failure of CFC initiatives, Aruho et al. (2021) undertook an exploratory study of the experiences of four card-based schemes amongst *matatus* in Nairobi. Implementation challenges were found to be: limited awareness of the cards and faulty card readers; lack of agreements with banks for charges and swift processing; absence of clear data protection rules; limited operator trust in the technology; and the role of cash as a facilitator for bribery and collusion. In an earlier paper, Aruho and Behrens (2019) describe several case studies, including the ill-fated FairCard system introduced in Pietermartizburg (South Africa) that was withdrawn after the scheme prompted protests, as well as the successful example of the TapandGo initiative launched with the KBS bus company in Kigali, Rwanda in 2015. TapandGo patronage grew from 300,000 in 2016 to 1.2 million subscribers in December 2017, but this scheme applies to the operation of large buses by three companies, as minibuses were banned from the city.

Ride-hailing

Ride-hailing is most commonly associated with smartphone app-enabled taxis-style services for individual users, which fall outside the scope of this research. Advancement of ride-hailing businesses and the technologies deployed are, nevertheless, of research relevance and importance for TRANSITIONS for a number of reasons:

- Ride-hailing encompasses service offers for collective transport (e.g. UberPool) that utilise journey-planning algorithms to link the trip requests of multiple passengers and enable collective transport. This form of technology deployment aligns with the demand responsive nature of informal transport.
- Deployment of app-based ride-hailing supports CFC, so is of comparative interest with respect to take-up by operators and passengers.
- Ride-hailing could be viewed as both a disruptive competitor and/or supportive technology platform for informal transport.

The transformative potential of ride-hailing is recognised in the literature (ACC E-Taxi 2019) and researchers have sought to understand the number and penetration rates of business ventures entering the African market. Boutueil and Quillerier (2020) present a study of ride hailing apps across the African continent, distinguishing between international apps (founded on other continents) and apps founded in Africa. Their main findings can be summarised as: international platforms (e.g. Uber, Bolt, Careem) tend to be established only in the largest and most stable metropolitan areas; northern and southern Africa have experienced the higher growth in the number of services; and locally-founded platforms display a higher rate of business foundation and also failure. Aruho and Behrens (2019, citing Techmoran 2018) draw attention to the UberPOA motor-tricycle taxi e-hailing service offered in Dar-es-Salaam, which is of particular interest as it incorporates many of the driver tracking features described in section 3.6.4 and it enables CFC. The UberPOA platform enables payment by electronic transfer and the app displays the name and photograph of the driver, the registration number of the vehicle, and a driver rating. For driver registration, Uber requires a national identification card, a police clearance certificate, a vehicle inspection report and Public Service Vehicle (PSV) insurance. The motor tricycle drivers' location and speed behaviour is also monitored using Uber telematic technology, to ensure compliance with Uber safety standards.

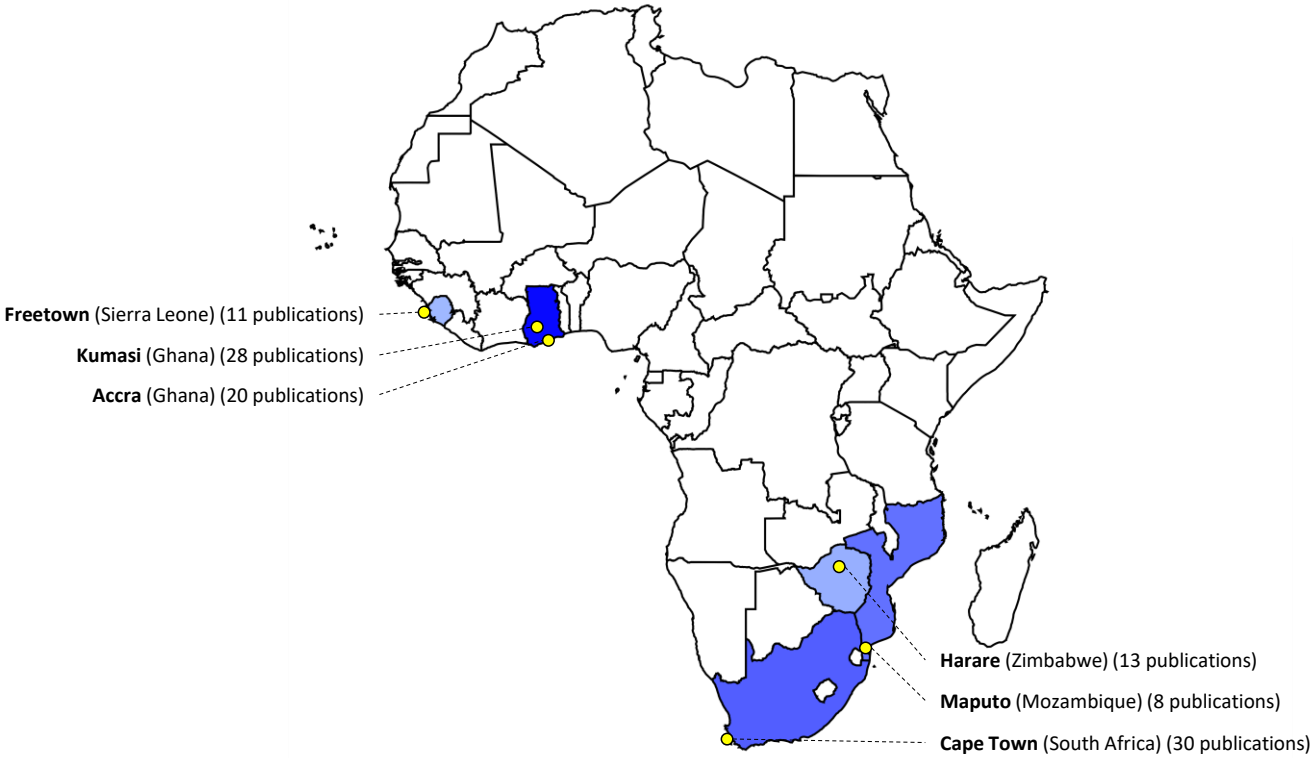
4. CASE CITY STATE OF KNOWLEDGE COMPARISON

This chapter is divided into two sections. Section 4.1 discusses the distribution of literature across the west and southern case city clusters. Section 4.2 summarises and compares the state of knowledge across the six case cities.

4.1 Bibliometric overview

The case cities included in this project are grouped into two clusters: western Africa and southern Africa. Each cluster comprises of a lead city, on which significant research has been conducted, and follower cities, where the situation of informal transport is less well documented.

Figure 10 - Case cities



4.1.1 Western Africa city cluster

The western Africa cluster is composed of Accra (Ghana – lead city), Kumasi (Ghana – follower city), and Freetown (Sierra Leone – follower city). Although Kumasi was included in this project as a "follower city", the review of literature reveals that is roughly on par with Accra in terms of knowledge availability. While Accra is the largest metropolitan area in the country with a population of over four million, Kumasi is almost comparable in scale with over 3 million inhabitants. In addition, Kumasi hosts the main engineering university in Ghana (the Kwame Nkrumah University of Science and Technology), which is the main centre of academic research in transport at the national level. This explains why the amount of scientific literature on informal transport is comparable between the two cities (approximately 20 publications) – accounting for the fact that some references cover both cities and excluding news media articles. In stark contrast, the literature on informal transport in Freetown is scarce and mainly composed of technical reports and working papers prepared in the context of donor-funded projects. At the time of writing, only one academic paper on this subject had been submitted for publication in a peer-reviewed journal and was forthcoming. The literature on Freetown is also quite recent, with most relevant documents published in the last two years or still in press. In comparison, the literature on Accra and Kumasi starts in the late 2000's but is highly concentrated in the second half of the 2010's. A significant share of this literature stems from the WB/AFD-funded Ghana Urban Transport Project launched in 2007 with the aim to implement a BRT system in Accra.

4.1.2 Southern Africa city cluster

The southern Africa cluster is composed of Cape Town (South Africa – lead city), Harare (Zimbabwe – follower city) and Maputo (Mozambique – follower city). A sharp contrast exists between the leader and follower cities in terms of academic publications on informal transport. Cape Town counts over thirty publications, mostly academic (including journal articles, peer-reviewed conference papers, and Master's and PhD theses) and is arguably the African city with the highest concentration of research on informal transport. This is due to the existence of a research centre with a strong interest in this thematic area at the University of Cape Town, combined with a favourable local context characterised by the development of a BRT system and innovative approaches to the integration of informal transport.

In Maputo, the literature around informal transport is mainly composed of technical reports, academic theses, and conference papers. A few peer-reviewed articles (for example Tembe et al. 2018; Mendonça 2014; Tembe and Matusse 2020) have also been published, although only one of them (Klopp and Cavoli 2019) focuses specifically on informal transport services. The Metropolitan Transport Observatory (OMT) and its members have published a number of technical reports including valuable quantitative information drawn from survey results. Approximately 40% of the documents identified through this review are in English, while the rest is written in Portuguese.

The literature on informal transport in Harare is scarce (13 publications were identified in total), and mostly composed of academic publications (journal articles, conference papers, and one book journal). It primarily emanates from researchers affiliated with the University of Zimbabwe and neighbouring countries (South Africa and Namibia).

The distribution of the literature presented above suggests that the main factors driving publications on informal transport are:

- the existence of an academic institution with a department or research centre specialised in transport studies (in Cape Town and Kumasi); and
- the launch of large-scale public transport improvement projects (in Accra, Freetown, and Cape Town).

4.2 Main themes by city

While some of the themes covered in the literature are the same across cities, specific thematic areas or approaches have been particularly developed in certain cities. Research on all cities includes a description of informal transport services and operating practices, albeit with varying levels of detail. Publications on Freetown provide a general overview of these characteristics (World Bank 2019; Oviedo et al. 2021), while a detailed description of the network and services is available in Cape Town (du Preez et al. 2019) and Accra (Saddier et al. 2016 and 2017). A second category of research found across all cities is composed of socio-economic and behavioural studies, focusing on the preferences and attitudes of informal transport users and operators. This research spans drivers' perceived indiscipline on the road (Boateng 2020), the demographic attributes of crews (Oviedo et al. 2021; Koroma 2020), and passengers' satisfaction levels (Agyemang 2013; Behrens et al. 2018).

The following sub-sections outlines the main subject areas and findings of research in each city.

4.2.1 Western Africa research cluster

Accra

One of the specificities of the literature on Accra is the relative weight of publications stemming from the data collection campaign led by municipal authorities (e.g. Saddier et al. 2016; Dumedah and Eshun 2020). The organisation of surveys using GPS-enabled smartphones has yielded valuable insight into the operations of the informal transport industry in Accra. Based on the results of this exercise, Saddier et al. (2016) established the first map of informal transport routes in Accra and developed indicators to assess service reliability on a sample of 65 routes in terms of travel time, waiting time, and route itinerary (Saddier et al. 2017). Building on these publicly-released datasets, other researchers explored the use of smartphone-based technology by applying it to trip planning for informal transport users (Abbeyquaye 2017) or the development of a real-time passenger information system (Adu 2018). Despite contributing to congestion because of their erratic

stopping patterns (Agyapong and Ojo 2018) and suffering from operational inefficiencies (Saddier and Johnson 2018), informal transport services in Accra remain more competitive than their formal alternatives because of their flexibility (Agyemang 2015).

Research focusing on the socio-economic characteristics of the informal transport industry includes a doctoral thesis by Clayborne (2012), which analyses the ownership structure of the *trotro* industry and its entrepreneurs. As reported in other cities, these entrepreneurs include workers saving up to start their own business, as well as government officials and investors from the diaspora attracted by the promise of a rapid return on investment.

Kumasi

Informal transport (composed of minibuses and shared sedans) represents between a quarter and a third of vehicular traffic in Kumasi, while carrying approximately half of all motorized transport users (Gbeckor-Kove, 2010). The majority of government employees use these modes of transport, particularly for relatively short trips – under 5km (Amoh-Gyimah and Aidoo 2013). A recent case study focusing on one of the municipalities of the Greater Kumasi metropolitan area (Dumedah and Eshun 2020) found that the informal transport routes cover a quarter of the municipal road network – indicating an extensive network.

In the peak periods, operations are characterised by high demand and a shortage of supply (Poku-Boansi and Adarkwa 2011), which results in passenger exploitation and fare hikes. These negative characteristics are generally tied to a deficit of public regulation resulting in loose self-regulation by operator groups (Fouracre 1994; Salifu 2004; Finn and Mulley 2011). This regulatory gap has, in turn, be linked to the weaknesses of the prevailing institutional framework (Poku-Boansi and Marsden 2018; Finn et al. 2009).

Two recent studies looked at the determinants of drivers' behaviour on the road and found that the lack of adapted infrastructure (for boarding and alighting) and industry business model (the "target system") pushed drivers to disrespect traffic rules (Boateng 2020). On the passengers' side, research on user satisfaction revealed that the quality of service offered by informal transport operators falls short of their users' expectations (Sam et al. 2018; Agyemang 2013; Aidoo et al. 2013). This can be explained by the fact that the provision of transport services responds to a profit-maximisation logic, as demonstrated by Poku-Boansi and Adarkwa (2011).

Freetown

It is estimated that informal transport services make up over 80% of passenger transport trips in Freetown (World Bank 2019). However, there is limited knowledge on the sector as a whole and information on the different transport modes is either sparse or non-existent. Like other African cities, the informal transport sector in Freetown has developed organically over time, filling in gaps left behind by a declining public service operator (Seery 2020). While taxi and minibuses were historically the dominant modes of informal transport, motor bikes and tricycles have been expanding rapidly in recent years, leveraging their ability to manoeuvre through heavy traffic and the hilly topography of the city (Koroma et al. 2020).

Several studies have analysed public transport through the prism of accessibility – both spatial and physical. Because transport services in Freetown are mostly routed to connect the outer city with a "spatially concentrated centre", a greater proportion of people living in the hilly and outer areas do not have adequate access to the routes used by informal transport services (Oviedo et al. 2021). In addition, Froment et al. (2020) observes that insufficient informal transport services cause long queues, especially during the rainy season, with operator response times slowing down. Finally, Koroma et al. (2020) found that access to transport services presents specific challenges for women and persons with disabilities due to their different transport needs and the high incidence of sexual harassment in public transport.

The industry is structured around operator associations called unions, representing different interest groups (for example, the Motorbike Rider's Union, the Motor Driver's Union etc.). These associations have established branches in specific sections of the city where they supervise the activities of their members, similar to the organisation observed in Ghana (World Bank 2019). The labour force employed by the industry consists predominantly of young men (21 to 30 years) who dropped out of school – mostly at secondary level (Oviedo et al, 2021). The transport sector thus constitutes an important source of employment for unqualified

workers, but also offers a brief economic respite for a few graduates who are still battling to secure rewarding jobs (Koroma et al. 2020).

4.2.2 Southern Africa research cluster

Cape Town

The wealth of research available on informal transport in Cape Town can be summarised around three main themes.

The first theme is centred on the characteristics and dynamics of informal transport operation. Du Preez et al. (2019) recorded digital operational data and identified 3 route types: trunk, intermediate and feeder/distributor. Schalekamp (2015) notes the sector's multiple hierarchical levels: owner-drivers; employed drivers and conductors in the vehicle; business owners/license-holders; route associations; provincial representative bodies and a parallel system of umbrella associations ("mother bodies"); and the government-recognised South African National Taxi Association (Santaco). The sector brings employment to poor and peripheral parts of the city, on a large scale due to its labour-intensive nature (e.g. one vehicle typically needs at least one driver), and serves different economic markets and gaps in the formal service network (Lesteven and Boutueil 2018). Two publications also make linkages between the informal transport sector and informal settlements ("townships") in Cape Town (Teffo et al. 2019; Rink 2020).

The second theme revolves around the implementation and impacts of the BRT programme. Anciano and Piper (2020); Boutueil et al. (2020); Diallo (2019) and Schalekamp and Behrens (2013) discuss the politics of BRT implementation in Cape Town. These sources point out that BRT policy paved the way for the local government to direct public transport reform, which opened new channels of engagement at a municipal (as opposed to national) level with informal transport operators. Against this backgrounds, Rayle (2017) and Rayle and Palacios (2017) report on passengers' experiences of BRT at a time when a pilot second-phase service had been launched running in parallel to rail and conventional bus services. Their findings are complementary to the above, suggesting that BRT in Cape Town was more effective as an upgrade to existing formal modes of public transport than as a replacement for informal transport.

The third theme consists of explorations of reform policies and processes as alternatives to full-scale BRT implementation. Lesteven and Boutueil (2018) note that this hybrid approach of combining BRT and informal transport resulted from the cross-fertilisation of ideas between the University of Cape Town (UCT), the municipal government and consultants in Cape Town. A decade ago, UCT's Schalekamp and Behrens (2010) suggested that BRT with informal operator assimilation was only one of many reform approaches. Salazar-Ferro et al. (2012) built on this argument to propose three potential operational outcomes: informal operators form new companies to run new services (including BRT if appropriate); transformation from the outset anticipates formal-informal hybridity; or public authorities accept that informal transport transformation was not possible. Del Mistro and Behrens (2015) modelled the cost of informal operators providing feeder vs. direct (feeder and trunk as one trip) services. Other studies on hybridity include Behrens et al. (2017a) on trunk-feeder integration, Behrens et al. (2018) on passenger transfer experiences, Plano et al. (2018) on driver behaviour change and Plano et al. (2020) on owner behaviour change.

Harare

The informal public transport sector in Harare must be analysed against the backdrop of a highly informal economy. Formerly an industrialised country, Zimbabwe is now a vast informal economy after the collapse of its once-thriving manufacturing and agricultural sectors (Thondhlana, 2020), with informal unemployment estimated at 90% (Muchadenyika, 2018). According to the International Monetary Fund (Medina and Schneider (2018), Zimbabwe is the largest informal economy in Africa and second largest in the world. Following the liberalisation of the transport sector in 1993, vehicle capacity increased and passenger waiting time reduced (Maunder and Mbara, 1995). Mbara et al (2014), found an ambivalence among the commuters interviewed in Harare, who valued the flexibility of informal transport but criticized its lack of reliability and comfort. In a recent attempt to do away with informality, the government of Zimbabwe banned all informal transport operations in July 2020, with the intention of replacing them with imported high-capacity buses.

Another stream of research focuses on transport operations and driver behaviour. Dumba (2017) observed dangerous driving behaviour exemplified by driving in the opposite direction down one-way streets, and

dropping passengers off anywhere en route. Dube and Chirisa (2012), described how *kombis* drive over the speed limit, change routes and make unauthorised U-turns. According to the Traffic Police, commuter omnibus drivers were major causes of accidents due to driving without care and attention, fatigue resulting from long driving hours, excessive speeding and failing to give way (Maunder and Mbara. 1995:18). Informal transport is described as a major cause of negative externalities such as congestion, intersection bottlenecks, noise at terminal locations and pollution (Mbara et al. 2014; Dube and Chrisa. 2012; Machadenyika 2018).

A last stream of research looked at the structure and regulation of the informal transport industry. According to Matamanda et al. (2020), a large part of the public transport fleet is owned by political elites and senior police officers also owned a sizeable number of commuter omnibuses. Matamanda et al. (2020) also discovered from commuter omnibus drivers that they saw no point in registering vehicles as the police invariably find reasons to fine them. Most of these fines are not accounted for and end up in the hands of some officials. Operators have also raised concerns about the multiplicity of regulatory institutions from both central and local government who have a host of conflicting instruments and requirements resulting in increased costs of doing business (Mbara et al. 2014). Dube and Chrisa. (2012) looked at the role of rank marshals in the context of transport informality. Rank marshals are voluntary informal workers aged between 15 and 40 years (Muchadenyika, 2018), who claim ownership of ranks and take responsibility for directing passenger loadings as well as the sequencing of departing vehicles. Their relationship with commuters is often stained due to their aggressiveness when loading passengers (Ibid).

Maputo

The urban mobility sector is still undergoing a process of consolidation in the Maputo metropolitan area. The accumulated knowledge is limited, although the concern for transport issues is growing and has led experts and specialists from other sectors to carry out research on the matter. The minibuses providing semi-formal transport services to the urban population of Maputo are called *chapas*. They are not completely informal as most of them have official licenses, a sign in the windshield indicating the name of the route on which they operate, and official communication and coordination channels with municipal and national authorities. They co-exist on the streets of Maputo with another type of collective transport, called *MyLove*, which are fully informal open-bed trucks not designed for passenger transport but used for that purpose.

Although there are relatively few academic publications on Maputo, an important amount of data on informal transport services has been collected by the Metropolitan Transport Observatory (OMT). The last surveys carried out by OMT (2020) recorded 37 *chapas* routes operated by 963 vehicles (most of them 15-seaters). The adjacent municipality of Matola had 1,406 *chapas* running on 98 routes. The *chapas* compete with almost 400 buses operated by cooperatives and municipal transport companies working on a Metropolitan Structural Network (REM), coordinated by the Transport Metropolitan Agency (AMT). The cooperatives are formed by 150 members who manage one to six buses, leased by the government. *Chapas* operators are grouped into associations, which control routes to ensure that vehicles are licensed and that their drivers comply with regulations (Barros 2018).

As in other cities on the continent, a large data collection effort was organised to map the *chapas* network in Maputo. This has been documented and compared to the one followed in Nairobi by Klopp and Cavoli (2019).

The *chapas* sector is marred by corruption, with 42% of trips subjected to police stops, resulting in the payment of a bribe in 80% of the cases (Coughlin 2019). Corruption is also estimated to account for 13% of the cost of operation licenses (Vieira et al. 2014). Among operators, illegal ones are those who contribute most to acts of corruption and clientelism in the sector through their interactions with the traffic police (Barros, 2018.

In the wake of deadly riots following the increase of transport fare by 50% in 2008, researchers have studied fare levels and their correlation with fuel prices (Matos 2008; Pereira et al. 2013). Viera et al. (2014) estimates that fuel constitutes 65% of operational costs, and operators claim that the fixed fare imposed by the authorities does not allow them to break even. Although the adjusted cost of transport has decreased in the last 13 years, it accounts for 25% of households' budget on average.

Table 3 - Case city profiles

	Accra (Ghana)	Cape Town (South Africa)	Freetown (Sierra Leone)	Harare (Zimbabwe)	Kumasi (Ghana)	Maputo (Mozambique)
City population, in millions (2020 UN population data)	2.51 *Population data limited to the Accra metropolis*	4.62	1.20	1.53	3.35	1.10
Annual pop. growth rate (UN 2020-2025 projections)	2.07 %	1.84 %	2.87 %	1.30%	3.74 %	2.05 %
Projected 2035 population (UN)	3.63	5.85	1.85	2.14	5.33	1.81
City area (sq. km)	1,494 (2016)	2,461	-	-	-	-
City density (persons/ha)	25 (2010)	15.3	152	18.5	-	3.6
Local informal transport names	trotro (minibus) okada (motorcycle)	minibus-taxi (minibus) amaphela (saloon car)	poda poda (minibus) taxi (sedan) okada (motorcycle) kekeh (motor-tricycle)	kombi (minibus) mshikashika (sedan)	trotro (minibus) okada (motorcycle) pragia (motor-tricycle)	chapa (minibus)
Informal transport vehicle fleet						
legal minibus vehicles	11,195	7,767	5,500 (WB, 2017)	-	-	4 000
Illegal minibus vehicles	-	2 644 – 6 468	-	-	-	-
sedan vehicles	22,208	605	-	-	-	-
motor(tri)cycle-taxis	-	-	-	-	-	-
Vehicle owner associations	Ghana Private Road Transport Union (GPRTU), Progressive Transport Owners Association (PROTOA), Ghana Co-operative Transport Association (GCTA)	2 national bodies (SANTACO, NTA) 1 provincial body (WC SANTACO) 6 'mother bodies' 102 route associations	Indigenous Transport Owners Association	4 kombi associations Greater Harare Association of Commuter Omnibus Operators - GHACO	Ghana Private Road Transport Union (GPRTU), Progressive Transport Owners Association (PROTOA), Ghana Co-operative Transport Association (GCTA) Ghana road transport Coordinating Council (GRTCC)	12 associations: 4 in Maputo City; 2 in Matola City; 1 in Boane city, 5 in Marracuene district

	Accra (Ghana)	Cape Town (South Africa)	Freetown (Sierra Leone)	Harare (Zimbabwe)	Kumasi (Ghana)	Maputo (Mozambique)
Driver associations/unions	Ghana road transport Coordinating Council (GRTCC))	None	Motor Driver's and General Transport Workers Union (SLMDGTWU), Commercial Bike Riders (okada) Association, Sierra Leone Tricycle Union (SLTU), Poda-Poda and Bus Owners Association,	-	-	-
Regulatory authority(s)	Greater Accra Passenger Transport Executive (GAPTE), Departments of Transport of the Metropolitan, Municipal and District Assemblies (MMDAs)	Provincial Regulatory Entity (PGWC), City of Cape Town	Sierra Leone Road Safety Authority (SLRSA)	Harare City Council	Departments of Transport of the Metropolitan, Municipal and District Assemblies (MMDAs)	MMDAs; Autarquias
Licencing	Permit type A (1 year)	route operating license (7 years)	Route operating licence (commercial transport)	-	-	-
Routes	315 (originating from Accra Metropolitan Assembly only)	792	124	-	-	-
Mode share (work trips) (%)		(2013 household survey)	(ITP and WB, 2017)			
informal transport (public)	62,2	19	55	-	70	33
informal transport (for-hire)	5,6	0	30	-		
formal transport (bus)	9,9	10	9	-	2	9
formal transport (BRT)	0	1	-	-	-	-

	Accra (Ghana)	Cape Town (South Africa)	Freetown (Sierra Leone)	Harare (Zimbabwe)	Kumasi (Ghana)	Maputo (Mozambique)
formal transport (heavy rail)	0,1	9	-	-	-	-
formal transport (light rail)	0	0	-	-	-	-
motor car (driver and passenger)	21,2	38	-	-	25	10,
Non-Motorised Transport (NMT)		17	-	-	3	46
Other	1,1	6	-	-	-	2

5. DISCUSSION

This chapter is divided into two sections. Section 5.1 reflects on the gaps in knowledge in the literature themes reviewed in Chapter 3. Section 5.2 reflects on the relative gaps in knowledge across the case cities clusters in west and southern Africa presented in Chapter 4.

5.1 Thematic gaps in knowledge

5.1.1 Theme 1: Context and problem framing

Gaps in knowledge in the 'context and problem framing' pillar of the TRANSITIONS Research and Routemap Framework (provided at Appendix A) are identified in relation to its three components.

Regarding 'informal transport networks', some evident gaps in knowledge include the following:

- Little is known about the relative size of legal and illegal informal public transport vehicle fleets in many, if not most, Sub-Saharan African cities. Unregulated saloon cars, providing shared ride services, are particularly undetected in the available data, as is the growth of motorcycle taxis in relation to minibuses. Few longitudinal fleet size and mode use datasets are available to establish: whether the growth in 2-wheelers is in parallel to, or at the expense of, 4-wheelers; and how this relates to overall population growth.
- Little is known in many cities about the range of informal transport route and service types provided, how they interact with each other and with other travel modes (including for-hire services), boarding and alighting locations (e.g. at home as a positive, or on a freeway as a negative), goods carrying practices, how passengers transfer between services, and the degree of route complementarity or duplication in city-wide public transport networks.
- The emerging informal transport route mapping practices provide valuable insight into service coverage, but little is known about temporal patterns of service supply (i.e. service span and service frequency reliability).
- Little quantitative and comparable data are available on informal transport service operating inefficiencies. To reflect on the potential benefits of possible policy interventions, greater insight is required into indicators like off-peak passenger waiting times under 'fill-and-go' vehicle departure practices, the extent of vehicle dead kilometres, and daily vehicle productivity.

Regarding 'benefits and negative externalities, important gaps in knowledge include the following:

- Few quantitative data are available on passenger quality of service measures. To reflect on the potential benefits of possible policy interventions (including the building of behavioural and system models for analysis and forecasting), greater insight is required into indicators like waiting and transfer times, service frequency and span reliability, and vehicle overcrowding.
- Greater insight is needed into why informal transport services have endured in cases where competing bus rapid transit services, with comparable fares, newer vehicles, and comfortable stations, have been introduced to replace them. It will be instructive to know what attributes informal transport passengers value most in informal transport services (e.g. demand responsiveness through route deviation, greater goods carrying ability and on-demand stopping).
- Little quantitative information is available on the potential emission reduction benefits in corridors or cities, if informal transport fleets were to adopt lower emission vehicles or alternative fuels.

These research topics, to understand passenger perspectives and the benefits of informal transport in providing affordable everyday mobility, together with the potential for emissions reductions from the vehicle fleet, are considered high priority areas for primary research within the TRANSITIONS project.

Regarding 'attitudes and policy', some evident gaps in knowledge include the following:

- Knowledge of the attitudes towards potential policy interventions of the full array of stakeholders involved in the provision and utilisation of informal transport services, from associations, to owners, to drivers, to auxiliary service providers, is incomplete. Consideration of appropriate policy actions will require insight

into what vested interests exist, how powerful are they, and the degree to which they present path dependencies.

- Only partial insight is available of the broader governance context within which informal transport services are provided, particularly with respect to instances of regulatory capture, and any vested interests of government officials responsible for planning, licensing, and enforcement.

5.1.2 Theme 2: Organisation and engagement approaches

Gaps in knowledge in the 'organisation and engagement approaches' pillar of the routemap are identified in relation to its two components.

Regarding 'organisational and financial models', some evident gaps in knowledge include the following:

- Few data are available on the prevalence of alternative driver remuneration models. It is commonly assumed that the 'target system' is ubiquitous across Sub-Saharan Africa, but the relative extent of alternative remuneration models (e.g. commissions and fixed wages) is poorly understood.
- Little is known of the before-and-after labour condition benefits, and changes in declared fare box revenue, in instances where drivers have shifted from the 'target system' to salaries.
- Little is known of the effectiveness of, and the mechanisms to, incentivize drivers to remain productive and demand responsive when remunerated through salaries.

Given the link between employment conditions, the potential socioeconomic benefits of supporting informal transport in the future, as well as established connection with safe (and unsafe) driving behaviour, this is viewed as a priority area for primary research by the TRANSITIONS project.

Regarding 'engagement context', some evident gaps in knowledge include the following:

- Little is known of how best to engage multiple stakeholders in a meaningful way, that enables effective collaboration in policy formulation, and leads to a greater willingness to accept policy interventions.
- Greater insight is needed into how representative owner associations and driver unions are of collective interests, and whether productive engagement can occur with these representative bodies, or whether it should target individual business in a more atomised way.

5.1.3 Theme 3: Capacity and capabilities of public authorities

Gaps in knowledge in the 'capacity and capabilities of public authorities' pillar of the routemap are identified in relation to two of its three components.

Regarding 'public transport planning and integration', some evident gaps in knowledge include the following:

- Few quantitative data are available on the operating costs and fare box recovery ratios, and any associated operating cost subsidisation, for recently implemented Sub-Saharan BRT corridors, to provide insight into the scalability and sustainability of these systems.
- Greater understanding is required of the passenger demand preconditions (e.g. ridership, directional flows, trip lengths and seat renewal) for feasible investment into scalable and fiscally sustainable mass transit modes, to enable better mode investment alternatives analysis appropriate to Sub-Saharan city contexts (i.e. comparisons that go beyond BRT and light rail investment, and include Buses with a High Level of Service (BHLS) and improving the services of incumbent informal transport operators).

Regarding 'informal transport regulation and institutional framework', some evident gaps in knowledge include the following:

- Knowledge is required on the preconditions for effective regulatory institutions (e.g. enabling legislation, funding, and human resources), to enable assessments of institutional capacities and their limitations.
- Knowledge is required on appropriate regulatory frameworks for 'hybridity' (e.g. shifts from route- to area-licensing, incentivisation, or scheduled services), and on whether voluntary (incentivised) change in informal transport operations will be easier to implement than mandatory (contracted or regulated) change.

5.1.4 Theme 4: Actions for low carbon, affordable and safe transport

Gaps in knowledge in the 'actions for low carbon, affordable and safe transport' pillar of the routemap are identified in relation to its five components.

Regarding 'infrastructure and operating environment', some evident gaps in knowledge include the following:

- Greater understanding is required, perhaps through microsimulation modelling methods, of road space prioritisation measures (for both links and intersections) suited to informal public transport vehicles in Sub-Saharan African contexts, and the conditions under which they are warranted.
- Little is known of the impacts (on passenger satisfaction, traffic congestion, etc.) of the provision bus stop facilities to encourage predictable informal transport vehicle stopping patterns in cities like Gaborone and Maputo.
- Information on safety for vulnerable road user groups in and around interchanges is lacking and could lead to improvements in walking and cycling infrastructure in these busy locations.
- Further understanding is required of the potential for improved, real-time data collection through more advanced GPS, smartphone tools and floating car data (e.g. TomTom), in parallel with deployment of fleet management software, to enable efficient vehicle deployment.

Regarding 'urban access restrictions and network transformation', some evident gaps in knowledge include the following:

- Greater understanding is required, perhaps through further statistical analysis of available vehicle tracking data and agent-based modelling, of potential route optimisation in relation to operating efficiency (e.g. reduced dead kilometres and increased vehicle productivity), mode integration, and service coverage, and the implications this would have for regulatory regimes, informal transport business viability, and employment levels.
- Few quantitative data or simulations are available on the relative contributions of private cars and public transport vehicles of varying sizes to city centre traffic congestion, to enable informed critical reflection on whether banning public transport vehicles is a rational and equitable policy response to city centre congestion.

Regarding 'fleet renewal and quality controls', some evident gaps in knowledge include the following:

- Little investigation has been undertaken into vehicle acquisition practices and finance arrangements, and their implications for rates of fleet renewal and vehicle roadworthiness, and little is known of good practices regarding vehicle deprivation costing and preparation for fleet renewal vehicle acquisition. Insight is needed into the real lending risk to financial institutions, what vehicle finance terms are fair, and what reasonable scrapping allowances are when financial terms are unaffordable to operators.
- Little investigation has been undertaken into the range of potential reforms (e.g. business management, third party insurance, depreciation costing, driver behaviour, vehicle maintenance, emissions reduction, etc.) that might accompany public sector assistance in vehicle finance.

Regarding 'business development', some evident gaps in knowledge include the following:

- Little is known about how (and whether) income and expenditure is tracked and analysed within cash-based informal transport businesses, and what good practice examples there are informal transport business management.
- Greater understanding is required of how cash flows through informal transport businesses, and how business developments like cashless fare collection, salaried drivers, and collective fleet management might impact the relative income of different stakeholders (i.e. associations, owners, and drivers). Similarly, little quantitative data are available on the tax implications of business formalisation (e.g. ticketing trails, banked income, and labour compliance), and what stakeholder attitudes are to the trade-offs associated with these changes.

Regarding 'passenger services', some evident gaps in knowledge include the following:

- Little investigation has been undertaken into the impacts of technology adoption (e.g. ride hailing, vehicle tracking, speed governors, CFC) on both passenger quality of service, and informal transport operating efficiencies and revenues. With respect to ride-hailing in particular, little assessment has been made of its vehicle productivity impacts and regulatory implications (i.e. when operating licenses are route-based).
- Knowledge is required on what drives the diffusion of technologies, and why some informal transport businesses adopt technologies, and others do not.
- Little is known about priority passenger information needs. Much research has assumed information priorities relates to route availability and coverage, but perhaps other attributes are as, or more, important (e.g. fare, vehicle type, security, or reliability).

5.2 Case city gaps in knowledge

5.2.1 Western Africa cluster

In the two Ghanaian cities, Accra and Kumasi, existing research on informal transport operations could be leveraged to develop a deeper understanding of operational practices, industry structure and dynamics, and fleet composition and emissions. In Accra, most of the data on routes and services has been collected by the Department of Transport of Accra Metropolitan Assembly (AMA) and only covers services originating within the boundaries of the assembly, which only represents a fraction of the metropolitan area. Research on operating practices therefore needs to be extended to other assemblies, in particular at the fringes of the metropolis, where the characteristics of informal transport routes are likely to differ significantly from those found in the urban core. In Kumasi, there is a need for a more systematic description and analysis of transport services, building on existing studies. In particular, it would be important to better understand the current balance between supply and demand to guide potential regulatory interventions, in the wake of previous work on this topic (Poku-Boansi and Adarkwa 2011). Kumasi is known for hosting the biggest open-air market in western Africa, which is currently undergoing major transformations with the development of a large in indoor market in the city centre. Understanding how the reconfiguration of this major trip generator/attractor has impacted the informal transport of passengers and goods and its links to the informal economy would also be critical. Finally, while it has been documented in Kumasi, users' perspectives on transport services have not been studied in Accra. In both cities, the experience and needs of female passengers has not been researched and constitutes an important gap in the literature.

In Freetown, due to the dearth of general knowledge on informal transport, the most pressing research gap consists in documenting the nature, extent, and main operational attributes of existing transport services. This includes a spatial description of the network (route itineraries and stopping points), information about the services (departure headway, operating hours, fares), and the performance of the system (passenger volumes, vehicle occupancy, number of rotations per day). Equally important is the consolidation of knowledge on the industry structure and characteristics, including the role and organisation of unions at different geographic scales, dominant business models, relations between owners and drivers, and labour conditions. Additionally, some research on the experience, level of satisfaction, and main challenges met by passengers is critical to obtain a complete picture of the sector.

5.2.2 Southern Africa cluster

In Cape Town, where a significant amount of research has already been conducted, priority should be given to documenting recent developments and public initiatives, furthering knowledge on less-studied topics, and updating/complementing existing data. First, against the background of a radical public sector institutional change, efforts should be made to identify potential institutional or developmental partners, and their roles, in maintaining and building momentum for research and action around informal transport reform that has developed in Cape Town in the last decade. Second, despite the long-standing presence of the Taxi Recapitalisation Programme (TRP), publications on this subject are rare, as are studies of its impacts and dynamics. As one of the largest cities in South Africa where the TRP is likely to have had significant traction, this is significant gap in understanding informal sector business and reform dynamics.

Third, even in a well-researched city like Cape Town, there is a need to collect and make accessible up-to-date data on the informal transport sector if reform alternatives are to be analysed. An important gap in this regard is the absence, inaccuracy and/or outdated nature of quantitative data on different types of vehicles in

use (especially those which are not minibuses), the size and number of businesses running such vehicles, and the quanta of ownership and workers belonging to or associated with the various local route associations. The financial revenues and costs of these businesses – or at least a sample of them – are also important to understanding the potential financial impact of any service or organisational changes, whether at the localised or city-wide levels. Operational research on route deviation and practices such as unsafe passenger alighting, would also be of value. In geographical terms, existing studies are geographically relatively concentrated, and there would be much value in duplicating the methodologies already applied but in different parts of the city.

Limited research has been conducted in both Maputo and Harare, but the gaps in the literature on these two cities point to different needs. In Maputo, because of the existence of a metropolitan transport authority and of a transport observatory, minibus *chapas* operations have been surveyed and analysed – although mainly from a transport planning and regulatory perspective. However, it appears that there is almost no information available on *MyLoves*, a rapidly growing mode of informal collective transport. In addition, recurring tensions around the setting of public transport fares indicates a need to better understand dominant the business models in the public transport industry (operating expenses, farebox revenue, financial flows, vehicle acquisition, etc.). While Harare could also benefit from similar in-depth studies, it lacks up-to-date baseline data describing the structure of its transport network and the composition of the fleet. Unfortunately, the recent imposition of a ban on commuter omnibuses makes it difficult to carry out further research on the sector for the time being.

6. CONCLUSION

This compendium report set out to review the state of knowledge in the field of informal public transport in Sub-Saharan Africa, and to identify important gaps in knowledge from the perspective of formulating policy interventions with prospects of success.

Regarding the state of knowledge, it is evident that informal transport is a growing research field, with more than half of the literature found published over the past five years. Knowledge of the field is therefore deepening and diversifying rapidly. It is clear from the review that the informal transport industry is complex, heterogeneous and multi-sectoral in nature. Fierce 'in the market' competition for passengers, and the cash nature of businesses, creates problems for employment conditions, service quality, fleet renewal, and environmental impact. But the sector also offers real benefits and competitive value. The scale and reach of informal transport service networks mean that Sub-Saharan Africa cities would simply not function without them. Yet policy interventions to improve operating environments for informal public transport vehicles have been relatively few. Most planning resources have instead been focussed on replacing informal transport with BRT, but, encouragingly, in some cities at least, the policy position has shifted from replacement, to integration and upgrade. The complex, heterogeneous and multi-sectoral nature of the industry has meant that attempts to introduce changes in practice or new technologies, that move the industry onto a more efficient, safe and lower carbon path, have proven difficult to implement at scale. It is clear that there are no transferable panacea solutions from within or outside the continent, although valuable lessons can be drawn from previous initiatives (with positive or negative results). Grounded solutions are required, and hence the recent growth in research activity is welcome.

Regarding gaps in knowledge for the formulation of policy interventions with prospects of success, greater knowledge of political economies and governance contexts is required. Given the difficulties of intervening in multi-stakeholder systems with an array of differing vested interests, understanding the outcomes and lessons from past policy interventions is essential. Such knowledge gained from practical experiences is important to stimulate grounded solutions, but policy intervention experiences tend to be poorly documented. Significant knowledge gaps in the scale and nature of operations and businesses also exist, and understanding these is essential for the consideration of appropriate and feasible policy interventions. The gaps highlighted in this compendium report are only, in part, a product of research capacity, but also because of the difficulties inherent in undertaking empirical observations in a context characterised by a mistrust of authorities and competitors, and a desire to sometimes avoid scrutiny. A clear feature of the current body of knowledge is its geographical unevenness. There are parts of the continent about which no publications were found, and there are inherent dangers in assuming contexts, operating practices, problems and institutional capacities are similar. Therefore, in some cities, greater depth of understanding is required, while in others, the basic features of the sector still need to be described.

Of the above research gaps, the next phase of the TRANSITIONS project will contribute to filling some of the geographical unevenness in knowledge found, particularly through the Freetown and Maputo case cities. It will also serve to document the experiences of policy interventions in the case cities, so as to contribute to the body of knowledge on policy options and lessons derived from implementation. The case study research will also offer the opportunity to collect comparable data on the scale and nature of informal transport operations and businesses. But, of course, the case city phase will not be able to address all research gaps identified in this compendium report.

As stated in Section 1.1, the TRANSITIONS project sets out to understand the role of informal transport in enabling a transition to a clean and efficient, affordable and safe transport network. The literature review has been an important exercise in informing how the primary research resources within the project can be prioritised with these aims in mind. As a result of the work, the following recommendations will be carried forward into detailed research planning for each city: CLEAN and EFFICIENT – there is a clear gap in knowledge on vehicle emissions and quality standards, and how these might be improved through alternative vehicle procurement and maintenance approaches; AFFORDABLE – the needs, preferences and aspirations of passengers have been subject to limited research and it is important to understand the benefits that informal transport provides in comparison with alternatives, also addressing the social inclusion and gender aspects of the research; SAFE – a clear link between driver remuneration approaches, in particular the 'target system', and dangerous driving behaviours has been established. Understanding the employment conditions present

in each of the cities is therefore the basis for formulating appropriate measures to improve road safety. City research plans will be developed in order to ensure consistency of research across the project in relation to these key topics, while also seeking to address linked local priorities, such as the implications of Government fare setting in Maputo for passenger affordability and informal transport business viability.

As an overarching layer, further research will also be needed to explore the political economies and governance surrounding the regulation and improvement of informal transport services, and the willingness of stakeholders to accept change.

REFERENCES

Abbeyquaye, A., 2017. Building a map-based transit planner for the tro-tro system in Accra.Thesis, Ashesi University College.

Abdoun, A., 2018. Fuel quality and emission standard developments in Africa. Africa Clean Mobility Week 2018. Nairobi, UN Environment.

ACC, 2019. Provocation 2: E-Taxi. A novel vision for affordable, safe and integrated transport. Chapter in The Integration Syndicate: Shifting Cape Town's socio-spatial debate. Available at: https://www.africancentreforcities.net/wp-content/uploads/2019/10/IS_Publication_Official.pdf

Adewumi, E.O., Allopi, D., 2014. An appropriate Bus Rapid Transit System. Available at: https://openscholar.dut.ac.za/handle/10321/1290 .

Adoléhoumé, A., 2004. La problématique des transports urbains et la réduction de la pollution de l'air due aux transports motorisés en Afrique subsaharienne, in: Colloque Développement Durable, Leçons et Perspectives. pp. 1–7.

Adu, A.K.N., 2018. A real-time passenger information system for public transit systems in Accra. Thesis, Ashesi University.

Agbiboa, D.E., 2016. 'No condition is permanent': Informal transport workers and labour precarity in Africa's largest city. International Journal Urban Regional 40, 936–957. Available at: https://doi.org/10.1111/1468-2427.12440.

Agbiboa, D.E., 2020. Between cooperation and conflict: the national union of road transport workers in Lagos, Nigeria. Crime Law Social Change 73, 605–622. Available at: https://doi.org/10.1007/s10611-019-09878-x.

Agyapong, F., Ojo, T.K., 2018. Managing traffic congestion in the Accra Central Market, Ghana. Journal of Urban Management 7, 85–96. Available at https://doi.org/10.1016/j.jum.2018.04.002.

Agyemang, W., 2013. Measurement of service quality of 'Trotro' as public transportation in Ghana: A case study of the city of Kumasi. Presented at the 32nd Annual Southern African Transport Conference, July 2013, Pretoria, South Africa.

Agyemang, E., 2015. The bus rapid transit system in the Greater Accra Metropolitan Area, Ghana: Looking back to look forward. Norsk Geografisk Tidsskrift - Norwegian Journal of Geography 69, 28–37. Available at: https://doi.org/10.1080/00291951.2014.992808.

Agyemang, E., 2015. Transportation System as a climate mitigation strategy for the Greater Accra Metropolitan Area (GAMA). Thesis, University of Ghana.

Aidoo, E., Monkah, J., Afukaar, F., 2013. Passenger's satisfaction with public bus transport services in Ghana: A case study of Kumasi–Accra route. Theoretical and Empirical Researches in Urban Management 8, 5–17.

Alcorn, L., Karner, A., 2020. Integrating formal and informal transit into one hybrid passenger transport system in Lagos, Nigeria. Transportation. Available at: https://doi.org/10.1007/s11116-020-10099-8.

Amoh-Gyimah, R., Aidoo, E.N., 2013. Mode of transport to work by government employees in the Kumasi metropolis, Ghana. Journal of Transport Geography 31, 35–43. Available at: https://doi.org/10.1016/j.jtrangeo.2013.05.008.

Andreasen, M.H., Moller-Jensen, L., 2017. Access to the city: Mobility patterns, transport and accessibility in peripheral settlements of Dar es Salaam. Journal of Transport Geography 62, 20-29.

Anciano, F., Piper, L., 2020. Cape Town's taxi violence—rooted in attempts to govern competition.

Aruho, T., Behrens, R., 2019. Cashless fare collection in Sub-Saharan African paratransit: A review of experiences. Presented at the 38th Southern African Transport Conference, July 2019, Pretoria, South Africa.

Aruho, T., Behrens, R., Mitullah, W., Kamau, A., 2021. A case study of cashless fare collection initiatives in the matatu industry in Nairobi.

Asimeng, E.T., Heinrichs, D., 2021. Why do paratransit operators resist participation in bus rapid transit? Case evidence from Bogota, Mexico City, Johannesburg and Lagos. Transport Reviews 41, 115–135. Available at: https://doi.org/10.1080/01441647.2020.1818872.

AIEC (Automotive Industry Export Council) , 2020: Automotive Export Manual – 2020 – South Africa.

Barolsky Joel, 1990. Follow that taxi: success story of informal sector. Indicator South Africa 7, 59–63. Available at: https://doi.org/10.10520/AJA0259188X_1626.

Barros, J. 2018., "Políticas Públicas de Transporte Rodoviário de Passageiros e seu impacto no desenvolvimento socioeconómico de Moçambique". Universidade de Lisboa. Editado por Publifix Edições.

Baskin, A., 2018. Slide presentation: Africa Used Vehicle Report.

Bayliss, D., 2002. Review: Urban public transport competition.

Behrens, R., McCormick, D., Mfinanga, D., 2016a. An introduction to paratransit in Sub-Saharan African cities, pp1-25, In Behrens, R., McCormick, D. and Mfinanga, D. (eds), Paratransit in African cities: Operations, regulation and reform, Routledge, New York.

Behrens, R., Salazar Ferro, P., Golub, A., 2016b. International case studies of hybrid public transport system regulation and complementarity. In Behrens, R., McCormick, D., Mfinanga, D. (eds), *Paratransit in African cities: Operations, regulation and reform*, Routledge, New York.

Behrens, R., Hawver, H., Birungi, C., Zuidgeest, M., 2017a. Case study investigation of unscheduled feeder and scheduled trunk service relationships in Cape Town. Presented at the 36th Annual Southern African Transport Conference, 2017, Pretoria, South Africa.

Behrens, R., McCormick, D., Orero, R., Ommeh, M., 2017b. Improving paratransit service: Lessons from inter-city matatu cooperatives in Kenya. Transport Policy 53, 79–88. Available at: https://doi.org/10.1016/j.tranpol.2016.09.003.

Behrens, R., Muchaka, P., Salazar-Ferro, P., Schalekamp, H., Zuidgeest, M., 2015. Mobility and access in Sub-Saharan African cities: The state of knowledge and research environments. Workshop proceedings for Volvo Research and Educational Foundations (VREF).

Behrens, R., Salazar-Ferro, P., 2016. Barriers to comprehensive paratransit replacement, Paratransit in African Cities. Routledge. Available at: https://doi.org/10.4324/9781315849515-16.

Behrens, R., Dodgen, S., Fusire, T., Mukhuba, T., 2018. Passenger satisfaction with minibus-taxi feeder services at the Mitchells Plain public transport interchange in Cape Town. Presented at the 37th Annual Southern African Transport Conference, 9-12 July 2018, Pretoria, South Africa.

Benmaamar, M. 2003. Urban transport services in Sub-Saharan Africa: Improving Vehicle Operations. World Bank and Economic Commission for Africa / SSATP Working Paper No. 75

Boateng, F.G., 2020. "Indiscipline" in context: a political-economic grounding for dangerous driving behaviors among tro-tro drivers in Ghana. Humanity Social Science Community 7, 8. Available at: https://doi.org/10.1057/s41599-020-0502-8.

Booysen, M.J., Ebot Ena Akpa, N.A., 2014. Minibus driving behaviour on the Cape Town to Mthatha route. Presented at the 33rd Annual Southern African Transport Conference, 7-10 July 2014 Pretoria, South Africa.

Bourgeois, F., Piozin, F., 1986. The "Redheads" of Niamey: An original way of providing urban transport, Transport reviews, Vol. 6, No.4, pp. 331-346.

Boutueil, V., Quillerier, T., 2020. The rise of paratransit digital platforms in large African Metropolises: Competitive 2 strategies between international and local platforms.

Boutueil, V., Lesteven, G., Nemett, L., 2020. Toward the integration of paratransit in transportation planning in African cities. Transportation Research Record 2674, 995–1004. Available at: https://doi.org/10.1177/0361198120933270.

Browning, P., 2001. Wealth on wheels ? - The minibus-taxi, economic and empowerment and the new passenger transport policy. Presented at the 20th Annual South African Transport Conference, 16 - 20 July 2001, Pretoria, South Africa.

Cassius et al. (ITDP), 2021. Future of paratransit and shared mobility: mapping report.

Cervero, R., 2000. Informal transport in the developing world. UN-Habitat.

Cervero, R., Golub, A., 2007. Informal transport: A global perspective. Transport Policy 14, 445–457. Available at: https://doi.org/10.1016/j.tranpol.2007.04.011.

Cervero, R., Golub, A., 2011. Informal public transport: A global perspective. Urban Transport in the Developing World: A Handbook of Policy and Practice 488–518.

Chengula, D., Kombe, K., 2017. Assessment of the effectiveness of Dar Es Salaam Bus Rapid Transit (DBRT) system in Tanzania. International Journal of Sciences: Basic and Applied Research (IJSBAR) 36, 10–30.

Clayborne, D.D., 2012. Owner-drivers in the tro-tro Industry: A look at jitney service provision in Accra, Ghana. UCLA.

Coetzee, J., Krogscheepers, C., Spotten, J., 2018. Mapping minibus-taxi operations at a metropolitan scale – methodologies for unprecedented data collection using a smartphone application and data management techniques. Presented at the 37th Annual Southern African Transport Conference Pretoria, South Africa.

Coetzee, J., Zhuwaki, N., Blagus, D., 2019. Demand-responsive transit design methods and applications for minibus taxi hybrid models in South Africa. Presented at the 38th Annual Southern African Transport Conference, 9-12 July 2018, Pretoria, South Africa.

Coker, E., Kizito, S., 2018. A narrative review on the human health effects of ambient air pollution in Sub-Saharan Africa: An urgent need for health effects studies. IJERPH 15, 427. Available at: https://doi.org/10.3390/ijerph15030427.

Coughlin, P., 2019. “Chapas, Polícias e Fiscais. Perigos, Abusos e Cultura em Maputo e Matola”

Del Mistro, R., Behrens, R., 2012. The impact of service type and route length on the operating cost per passenger and revenue of paratransit operations: Results of a public transport cost model. Presented at the CODATU XV conference: The role of urban mobility in (re) shaping cities, 22 to 25 October 2012, Addis Ababa, Ethiopia.

Del Mistro, R., Behrens, R., 2015. Integrating the informal with the formal: An estimation of the impacts of a shift from paratransit line-haul to feeder service provision in Cape Town. Case Studies on Transport Policy 3, 271–277. Available at: https://doi.org/10.1016/j.cstp.2014.10.001.

Diallo, F., 2019. The politics of the Bus Rapid Transit (BRT) implementation in Cape Town, South Africa.

Diaz Olvera, L. et al. 2008. Household transport expenditure in Sub-Saharan Africa cities: measurement and analysis. Journal of Transport Geography 16, pp. 1-13

Doumbia, E.H.T., Liousse, C., Galy-Lacaux, C., Ndiaye, S.A., Diop, B., Ouafo, M., Assamoi, E.M., Gardrat, E., Castera, P., Rosset, R., Akpo, A., Sigha, L., 2012. Real time black carbon. measurements in West and Central Africa urban sites. Atmospheric Environment 54, 529–537. Available at: https://doi.org/10.1016/j.atmosenv.2012.02.005.

du Preez, D., Zuidgeest, M., Behrens, R., 2019. A quantitative clustering analysis of paratransit route typology and operating attributes in Cape Town. Journal of Transport Geography 80, 102493. Available at: https://doi.org/10.1016/j.jtrangeo.2019.102493.

Dube, D., Chirisa, I., 2012. The informal city: Assessing its scope, variants and direction in Harare, Zimbabwe. Pp. 22.

Dumba, S., 2017. Informal public transport driver behaviour and regulatory policy linkage: An expose. Journal of Transport and Supply Chain Management. Available at: https://doi.org/10.4102/jtscm.v11i0.315

Dumedah, G., Eshun, G., 2020. The case of Paratransit - 'Trotro' service data as a credible location addressing of road networks in Ghana. Journal of Transport Geography 84. Available at: https://doi.org/10.1016/j.jtrangeo.2020.102688.

EBRD, 2016. Safe transport for all: Issues and operational lessons from the Egyption National Railways.

Emslie, L.D., Taylor, A.B., Goosen, R., 2014. The use of compressed gas in public transport in South Africa. Presented at the 33rd Annual Southern African Transport Conference, Pretoria, South Africa.

eNaTIS (electronic National Traffic Information System), 2020: Live vehicle population.

Etyemezian, V., Tesfaye, M., Yimer, A., Chow, J. C., Mesfin, D., Nega, T., et al. (2005). Results from a pilot-scale air quality study in Addis Ababa, Ethiopia. Atmospheric Environment, 39, 7849–7860.

Fabianski, C., Kerkhof, A., 2019. Transforming cities with Bus Rapid Transit (BRT) systems: How to integrate BRT?

FIA Foundation, 2016. Safe and sound: International research on women's personal safety on public transport.

Finn, B., 2008. Market role and regulation of extensive urban minibus services as large bus service capacity is restored – Case studies from Ghana, Georgia and Kazakhstan. Research in Transportation Economics 22, 118–125. Available at: https://doi.org/10.1016/j.retrec.2008.05.012.

Finn, B., Arthur, B.A., Gyamera, S., 2009. New regulatory framework for urban passenger transport in Ghanian cities. Presented at the 11th Conference on Competition and Ownership in Land Passenger Transport. Delft University of Technology, the Netherlands, pp. 1–14.

Finn, B., 2012. Towards large-scale flexible transport services: A practical perspective from the domain of paratransit. Research in Transportation Business & Management 3, 39-49

Finn, B., Walters, J., 2010. Workshop report – Public transport markets in development. Research in Transportation Economics 29, 354–361. Available at: https://doi.org/10.1016/j.retrec.2010.07.045.

Finn, B., Kumarage, A., Gyamera, S., 2011. Organizational structure, ownership and dynamics on control in the informal local road passenger transport sector. Presented at the 12th Conference on competition and ownership in land passenger Transport, South Africa.

Finn, B., Mulley, C., 2011. Urban bus services in developing countries and countries in transition: A framework for regulatory and institutional developments. JPT 14, 89–107. Available at: https://doi.org/10.5038/2375-0901.14.4.5.

FLONE, 2018. Report on gender equity assessment of Nairobi's public minibus transport services. FLONE Initiative

Fouracre, P.R., Kwakye, E.A., Okyere, J.N., Silcock, D.T., 1994. Public transport in Ghanaian cities — a case of union power. Transport Reviews 14, 45–61. Available at: https://doi.org/10.1080/01441649408716865.

Fox, H., 2000. Review of urban public transport competition, Department for International Development.

Froment, E., Clifton, J., Masroor, S.M., Kwong, N., Rodríguez, N., Asvanon, R., Osmani, V., Sánchez-Aizcorbe, V., 2020. Driving Freetown Towards Enhanced Mobility: Emerging opportunities from health crises for improved access to livelihoods.

Gathungu, J., Wasike, S., Bor, G., 2018. Effect of public transport SACCO management on financial performance of matatu investors in Kenya: A case of matatu SACCOS in Kajiado North Sub-County, Kenya. International Journal of Research in Management 08, 11.

Gauthier, A., Weinstock, A., 2010. Africa transforming paratransit into BRT. Built environment 36, 317–327. Available at: https://doi.org/10.2148/benv.36.3.317.

Gbeckor-Kove, M.S., 2010. Improving public passenger transportation in Kumasi by use of High Occupancy Vehicles (HOVs)-case study of Metro Mass Transport (MMT) bus operations on three routes. PhD Thesis, Kwame Nkrumah University of Science and Technology.

Goodfellow, T., 2015. Taming the "Rogue" Sector: Studying State Effectiveness in Africa through Informal Transport Politics. Comparative Politics 47, 127–147.

Gopaul, A., Friedrich, E., Stretch, D., 2019. Public Transportation and Greenhouse Gas Emissions: A Case Study of the e Thekwini Municipality, South Africa. Current Trends in Civil & Structural Engineering. Available at: https://irispublishers.com/ctcse/fulltext/public-transportation-and-greenhouse-gas-emissions-a-case-study-of-the-e-thekwini-municipality-south-africa.ID.000553.php (accessed 2.6.21).

Gwilliam, K., 2002. Cities on the move: a World Bank urban transport strategy review. The World Bank.

Gwilliam, K., 2008. Bus transport: Is there a regulatory cycle? Transportation Research Part A: Policy and Practice 42, 1183–1194. Available at: https://doi.org/10.1016/j.tra.2008.05.001.

Gwilliam, K., 2011. Africa's Transport Infrastructure: Mainstreaming maintenance and management. The World Bank. Available at: https://doi.org/10.1596/978-0-8213-8456-5.

Hart, M., Kelly, A., 2019. Convenience and simplicity for the commuter is at the heart of open architecture payment technologies. Presented at the 38th Annual Southern African Transport Conference 8th-11th July 2019, Pretoria, South Africa.

Heinze, R., 2018. Fighting over Urban Space: Matatu Infrastructure and Bus Stations in Nairobi, 1960–2000. Africa Today 65, 3–22.

Hitge, G., Van Dijk, E.N.R., 2012. Incremental approach to public transport system improvements. Presented at the 31st Annual Southern African Transport Conference, 9-12 July 2012.

Ingle, M., 2009. A historical overview of problems associated with the formalization of the South African minibus taxi industry. School for Basic Sciences, Vaal Triangle Campus, North-West University.

Janmohammed, A., Niekerk, A.V., Samuels, R., Naidoo, M., As, S.V., 2019. Engaging minibus taxi drivers in the quest for child safer roads. Global Health Innovation 2. Available at: https://doi.org/10.15641/ghi.v2i1.728

Jennings, G., Bruun, E., Browning, P., Orero, R., 2016. Strategy options for paratransit business development and service improvement, in: Paratransit in African Cities.

Joseph, L. et al. 2020. Activity participation and perceptions on informal public transport and bus rapid transit in Dar es Salaam. Transportation Research Record 2674(11), pp. 573-583

Joubert, J.W., 2013. Gauteng: Paratransit—perpetual pain or potent potential?, in: megacity mobility culture. Springer, pp. 107–126.

Kamau, H., 2017. Brief on the PCFV used vehicle working Group, Presentation prepared for the Partnership for Clean Fuels and Vehicles (PCFV).

Kamau, A., 2018. Women Transport Workers: Social Protection and Labour Issues. In Proceedings of the Eastern Africa Women in Transportation Conference, Nairobi, Kenya, 22–23 November 2018.

Kane, L., 2016. What do we mean by low carbon transport? Understanding how people move in Cape Town. Open Streets Briefing Paper.

Kelley, E.M., Lane, G., Schoenholzer, D., 2018. The Impact of monitoring technologies on contracts and employee behavior: Experimental evidence from Kenya's transit industry 90.

Khosa, MM (1991) - 'Capital accumulation in the taxi industry', in E Preston-Whyte and C Rogerson - 'Capital accumulation in the taxi industry', in E Preston-Whyte and C Rogerson (eds) - South Africa's Informal Economy (Cape Town: Oxford University Press).

Klopp, J., Mitullah, W., 2016. Politics, policy and paratransit: A view from Nairobi, Paratransit in African Cities. Routledge. Available at: https://doi.org/10.4324/9781315849515-11.

Klopp, J., Schalekamp, H., 2018. A review of minibus-taxi reform initiatives in South African cities. World Bank Draft version 2.

Klopp, J.M., Cavoli, C., 2019. Mapping minibuses in Maputo and Nairobi: engaging paratransit in transportation planning in African cities. Transport Reviews 39, 657–676. Available at: https://doi.org/10.1080/01441647.2019.1598513.

Klopp, J.M., Harber, J., April, M.Q., 2019. Governance of metropolitan transport background paper: A review of BRT as public transport reform in African cities. VREF research synthesis project.

Koroma, B., Macarthy, J.M., Yusuf, Y., Sellu, S.A., Oviedo, D., Cavoli, C., Jones, P., Levy, C., 2020. City profile: Freetown. Baseline conditions on mobility, accessibility and land use assessment. T-SUM. UCL

Kumalo, K., 2019. Electric vehicles: market intelligence report, commissioned by GreenCape.

Kumar, A., Diou, C., 2010. Bus renewal scheme in Dakar: before and after. The World Bank: SSATP discussion paper no. 11, Urban transport series.

Lee-Smith, D., 1989. "Urban Management in Nairobi: A Case Study if the Matatu Mode of Public Transit", in African Cities in Crisis: Managing Rapid Growth, Richard E. Stern and Rodney R. White (eds.), Boulder: Westview Press.

Lesteven, G., Boutueil, V., 2018. Is paratransit a key asset for a sustainable urban mobility system? Insights from three African cities. Presented at the 2018 TRB Annual Meeting, HAL, Washington, D.C., UnitedStates.

Lindén, J., Boman, J., Holmer, B., Thorsson, S., Eliasson, I., 2012. Intra-urban air pollution in a rapidly growing Sahelian city. Environment International 40, 51–62. https://doi.org/10.1016/j.envint.2011.11.005.

Lomme, R., 2008. Should South African minibus taxis be scrapped? Formalizing informal urban transport in a developing country. Proceedings of the CODATU XIII Conference, 12-14 November Ho Chi Minh City.

Lubanga, J.M., Gakobo, T., Kimando, L.N., 2017. Factors influencing adoption of epayment system in Kenyan public transport : A case of matatu plying Nairobi-Kitengela route. International Academic Journal of Human. Resources. Business Administration 2, pp27–48.

Manuel, M., Behrens, R., 2018. Success and delay in IPTN projects: A case study analysis of three South African cities.

Matamanda, A.R., Chirisa, I., Dzvimbo, M.A., Chinozvina, Q.L., 2020. The political economy of Zimbabwean urban informality since 2000–A contemporary governance dilemma. Development Southern Africa 37, 694–707.

Matos, A. 2008. Maputo Public Transport Fare Impact. II Congresso de Engenharia de Moçambique. V Congresso Luso Moçambicano de Engenharia. Art.48.

Matos, A.S., 2012. Transporte publico passageiros, acidentes rodoviarios versus combate à pobreza em Moçambique.

Maunder, D.A.C., Mbara, T.C., 1995. The initial effects of introducing commuter omnibus services in Harare, Zimbabwe. TRL Report. Pp. 21.

Mbara, T., Dumba, S., Mukwashi, T., 2014. Multi-stakeholder dialogue on formal and informal forms of public transport in Harare, Zimbabwe: Convergence or divergence perspective. Journal of Transport and Supply Chain Management .

McCaul, C., No easy ride: The rise and future of the black taxi industry. Institute of Race Relations, Johannesburg, South Africa (1990)

McCormick, D., Mitullah, W., Chitere, P., Orero, R., Ommeh, M., 2015. Matatu business strategies in Nairobi. Routledge. Available at: https://doi.org/10.4324/9781315849515-13.

McCormick, D., Mitullah, W., Chitere, P., Orero, R., Ommeh, M., 2013. Paratransit business strategies: A bird's-eye view of matatus in Nairobi. JPT 16, 135–152. Available at: https://doi.org/10.5038/2375-0901.16.2.7.

McCormick, D., Schalekamp, H., Mfinanga, D., 2016. The nature of paratransit operations, in: Paratransit in African Cities. pp. 59–78.

McLachlan, N., 2010. The introduction of bus rapid transit systems in South African cities–Participation of the minibus taxi industry–a model for sustainability or a recipe for failure. Presented at the CODATU XIV Conference 24 - 27 October 2010, Buenos Aires.

Meakin, R., 2004a. Bus regulation and planning. GTZ sustainable transport: A sourcebook for policy-makers in developing countries. Deutsche Gesellschaft fur Technische Zusammenarbeit.

Meakin, R., 2004b. Training course: Bus regulation and planning – bus sector reform. Deutsche Gesellschaft fur Technische Zusammenarbeit.

Medina, L., Schneider, F., 2018. Shadow Economies Around the World: What Did We Learn Over the Last 20 Years? International Monetary Fund Working Papers 18, 1. Available at: https://doi.org/10.5089/9781484338636.001.

Mendonça, I.N. de, 2014. Mobilidade urbana na área metropolitana de Maputo: análise dos órgãos de gestão do planeamento e mobilidade urbana, arranjos institucionais e insumos para a sua efectiva articulação. J. Transp. Lit. 8, 244–270. https://doi.org/10.1590/S2238-10312014000200011.

Mfinanga, D., 2013. Gauging the potential for integrating paratransit operators into the Dar es Salaam BRT feeder system through own capital. Tanzania Journal for Population studies and Development.

Mobereola, D., 2009. Lagos Bus Rapid Transit: Africa 's first BRT scheme. SSATP Discussion Paper No. 9, Urban Transport Series. Available at: /paper/Lagos-Bus-Rapid-Transit-Africa-%E2%80%99-s-first-BRT-scheme-Mobereola/1c3d552188e3c9cb64338e12ab3626010983e4ef (accessed 2.7.21).

Montmasson-Clair, G., Dane, A., Moshikaro, L., 2020. Harnessing electric vehicles for industrial development in South Africa 154.

Moody, M., Esson, R., Von Der Heyden, C., Laing, K., 2014. Public transport transformation: An incremental approach to delivering public transport systems in South Africa.

Morten, M., Bryan, G., Siddiqi, B., Balboni, C., 2020. Evaluating the impacts of the Dar es Salaam Bus Rapid Transit System (No. 110), Impact evaluation report.

Muchadenyika, D., 2018. Informal transport, politics and power in Harare, in: Transport, Transgression and Politics in African Cities: The Rhythm of Chaos. Routledge New York and London, pp. 68.

Mustapha, B.A., Blangiardo, M., Briggs, D.J., Hansell, A.L., 2011. Traffic air pollution and other risk factors for respiratory illness in schoolchildren in the Niger-Delta region of Nigeria. Environmental Health Perspectives 119, 1478–1482.Available at: https://doi.org/10.1289/ehp.1003099.

Nafukho, F.M., Hinton, B.E., 2003. Determining the relationship between drivers' level of education, training, working conditions, and job performance in Kenya. Human Resource Development Quarterly 14, 265–283. Available at: https://doi.org/10.1002/hrdq.1066.

Naré, H., Kamakaté, F., 2017. Developing a roadmap for the adoption of clean fuel and vehicle standards in Southern and Western Africa. International Council of Clean Transport (ICCT). Washington, DC.

NDoT (National Department of Transport), 2018: Green Transport Strategy for South Africa (2018-2050)

Ndibatya, I., Booysen, M.J., 2020a. Minibus taxis in Kampala's paratransit system: Operations, economics and efficiency. Journal of Transport Geography 88, 102853. Available at: https://doi.org/10.1016/j.jtrangeo.2020.102853.

Ndibatya, I., Booysen, M.J. , 2020b. Transforming paratransit in Africa's congested Cities: An ICT-enabled Integrated Demand Responsive Transport (iDRT) approach, in: Conference: IEEE IST-Africa 2020. Presented at the Conference: IEEE IST-Africa 2020, Uganda, Kampala.

Neumann, A., Röder, D., Joubert, J.W., 2015. Towards a simulation of minibuses in South Africa. JTLU 8, 137. Available at: https://doi.org/10.5198/jtlu.2015.390.

Nguyen, M.H., Pojani, D., 2018. Why do some BRT systems in the Global South fail to perform or expand? in: Advances in transport policy and planning. Elsevier, pp. 35–61. Available at: https://doi.org/10.1016/bs.atpp.2018.07.005.

OICA, 2020. OICA (International Organization of Motor Vehicle Manufacturers), vehicle type definitions.

Ommeh, M.S., Chitere, P., Orero, R., Mitullah, W., McCormick, D., 2015. The politics behind the phasing out of the 14-seater matatu in Kenya. Available at: /paper/The-politics-behind-the-phasing-out-of-the-matatu-Ommeh-Chitere/ae2360868c605a351ffdf0d149a1da7cfbb7e9a6 (accessed 2.7.21).

Ommeh, M., McCormick, D., Mitullah, W., Orero, R., Chitere, P., 2013. Paratransit labour and regulatory compliance.

OMT. 2020., "Contagem de chapas e autocarros – 2020". Agência Metropolitana de Transporte e Observatório da Mobilidade e Transporte de Moçambique. Written by Romero, J.

Orero, R., McCormick, D., 2013. Cooperatives involvement in the paratransit sector: Experiences and lessons in Nairobi. Presented at the 32nd Southern African Transport Conference, 8-11 July 2013, Pretoria.

Oviedo, D., Asare Okyere, S., Nieto, M., Kita, M., Kusi, L.F., Yusuf, Y., Koroma,B., 2021. Walking off the beaten path: Everyday walking environment and practices in informal settlements in Freetown. Research in Transportation Business & Management.

Pereira, C., Sambo, M., Chaimite, E., 2013. As "revoltas do pão" de 2008 e 2010 na imprensa. Boletim IDeIAS 58.

Pienaar, W.J., 1998. The economic evaluation of bus and minibus taxi terminals and transfer facilities Thesis,University of Stellenbosch.

Plano, C., 2019. Policy reflection on 'big-bang' public transport formalisation and reform, and the need for alternative approaches. Ph.D thesis, University of Cape Town, South Africa.

Plano, C., 2020. Improving paratransit service: Lessons from transport management companies in Nairobi, Kenya, Case Studies on Transport Policy.

Plano, C., Behrens, R., Zuidgeest, M., 2020. Towards evening paratransit services to complement scheduled public transport in Cape Town: A driver attitudinal survey of alternative policy interventions. Transportation Research Part A: Policy and Practice 132, 273–289.

Plano, C., Behrens, R., Zuidgeest, M., 2018. Towards a stated choice methodology to determine minibus-taxi driver willingness to provide off-peak feeder service. Presented at the 37th Southern African Transport Conference, July 2018, Pretoria.

Plano, C., Behrens, R., Zuidgeest, M., 2019. Incentivizing Off-Peak Minibus-Taxi Feeder Service: Driver Perspectives on Reform Approaches. Presented at the 38th Southern African Transport Conference, 8th to 11th July 2019, Pretoria, Southern African Transport Conference.

Plano, C., Behrens, R., Zuidgeest, M., 2020. Towards evening paratransit services to complement scheduled public transport in Cape Town: Driver attitudinal survey of alternative policy interventions. Transportation Research Part A: Policy and Practice, 132, 273-289.

Poku-Boansi, M., Adarkwa, K.K., (2011). An analysis of the supply of urban public transport services in Kumasi, Ghana.

Poku-Boansi, M., Marsden, G., 2018. Bus rapid transit systems as a governance reform project. Journal of Transport Geography 70, 193–202. Available at: https://doi.org/10.1016/j.jtrangeo.2018.06.005.

Porter G, Turner J., 2019. Meeting Young People's Mobility and Transport Needs: Review and Prospect. Sustainability. 6;11(22):6193. Available at: http://dx.doi.org/10.3390/su11226193 Rayle, L., 2017. Bus rapid transit as formalization: Accessibility impacts of transport reform in Cape Town, South Africa. Thesis, UC Berkeley.

Rayle, L., Palacios, M.S., 2017. The impact of Bus Rapid Transit on travel time in two cities. Presented at the Transportation Research Board 96th Annual Meeting.

Rink, B., 2020. Capturing amaphela: Negotiating township politics through shared mobility. Geoforum S0016718520301603. Available at: https://doi.org/10.1016/j.geoforum.2020.06.010

Rizzo, M., 2002. Being taken for a ride: privatisation of the Dar es Salaam transport system 1983–1998. J. Mod. Afr. Stud. 40, 133–157. Available at: https://doi.org/10.1017/S0022278X01003846.

Rizzo, M., 2011. 'Life is war': Informal transport workers and neoliberalism in Tanzania 1998-2009: informal transport workers and neoliberalism in Tanzania. Development and Change 42, 1179–1206. https://doi.org/10.1111/j.1467-7660.2011.01726.

Rizzo, M., 2014. The political economy of an urban megaproject: The bus rapid transit project in Tanzania. African Affairs, 114(455), 249–270.

Saddier, S. and Johnson, A., 2018. Understanding the operational characteristics of paratransit services in Accra, Ghana, a case study. 37th Annual Southern African Transport Conference (SATC 2018)

Saddier, S., Patterson, Z., Johnson, A., Chan, M., 2016. Mapping the jitney network with smartphones in Accra, Ghana: The AccraMobile experiment. Transportation Research Record 2581, 113–122. Available at: https://doi.org/10.3141/2581-14.

Saddier, S., Patterson, Z., Johnson, A., Wiseman, N., 2017. Fickle or flexible?: Assessing paratransit reliability with smartphones in Accra, Ghana. Transportation Research Record 2650, 9–17. https://doi.org/10.3141/2650-02.

Saddier, S., McLachlan, N., Dass, D., 2019. Measuring the evolution of passenger satisfaction following the introduction of scheduled services: The case of the 7th Avenue Minibus-taxi Association in Mitchells Plain. Presented at the 38th Southern African Transport Conference, 8th to 11th July 2019 Pretoria, South Africa.

Salazar Ferro, P. 2015. Paratransit: A key element in a dual system, CODATU, Agence Française de Développement.

Salazar-Ferro, P., Behrens, R., Golub, A., 2012. Planned and paratransit service integration through trunk and feeder arrangements: An international review. Presented at the 31st Southern African Transport Conference, 9-12 July 2012, Pretoria, South Africa.

Salazar-Ferro, P., Behrens, R., 2015. From direct to trunk-and-feeder public transport services in the Urban South: Territorial implications. The Journal of Transport and Land Use 8(1), 123-136

Salifu, M., 2004. Transport deregulation and sustainability of the urban bus transit initiative in Ghana. Presented at the CODATU XI: world congress: 22 - 24 April 2004, Bucharest, Romania.

Sam, E.F., Hamidu, O., Daniels, S., 2018. SERVQUAL analysis of public bus transport services in Kumasi metropolis, Ghana: Core user perspectives. Case Studies on Transport Policy 6, 25–31. Available at: https://doi.org/10.1016/j.cstp.2017.12.004.

Schalekamp, H., 2015. Paratransit operators' participation in public transport reform in Cape Town: a qualitative investigation of their business aspirations and attitudes to reform. Ph.D thesis, University of Cape Town.

Schalekamp, H., Behrens, R., 2010. Engaging paratransit on public transport reform initiatives in South Africa: A critique of policy and an investigation of appropriate engagement approaches. Research in Transportation Economics, Reforming Public Transport throughout the World 29, 371–378. Available at: https://doi.org/10.1016/j.retrec.2010.07.047.

Schalekamp, H., Behrens, R., Wilkinson, P., 2010. Regulating minibus-taxis: a critical review of progress and a possible way forward. Presented at the 29th Annual Southern African Transport Conference, Pretoria, South Africa.

Schalekamp, H., Behrens, R., 2013. Engaging the paratransit sector in Cape Town on public transport reform: Progress, process and risks. Research in Transportation Economics 39, 185–190. Available at: https://doi.org/10.1016/j.retrec.2012.06.012.

Schalekamp, H., Golub, A., Behrens, R., 2016. Approaches to paratransit reform in: Paratransit in African Cities: Operations, Regulation and Reform 100–124.

Schalekamp, H., McLachlan, N., 2016. Minibus-taxi operator reforms, engagement and attitudes in Cape Town, Paratransit in African Cities. Routledge. Available at: https://doi.org/10.4324/9781315849515-15

Schalekamp, H., & Klopp, J. (2018). Beyond BRT: Innovation in minibus-taxi reform in South African cities. Presented at 37th Southern African Transport Conference, July 2018, Pretoria.

Schalekamp, H., Saddier, S., 2020. Emerging business models and service options in the shared transport sector in African cities. VREF for the Mobility and Access in African Cities (MAC) initiative, The state of knowledge and research. Gothenburg, Sweden: Volvo Research and Educational Foundations 28.

Schwela, D., 2006. Review of urban air quality in Sub-Saharan Africa region - air quality profile of SSA countries. World Bank.

Sebola, M.P., 2014. Recapitalizing mini-bus taxis for effective public transportation in South Africa: the urban rural transport connection problem. Presented at the Urban transport 2014, The Algarve, Portugal, pp. 125–135. Available at: https://doi.org/10.2495/UT140111.

Seery, J., 2020. Supporting growth by improving public transport in Sierra Leone - Integrated Transport Planning. Available at: https://www.itpworld.net/news-and-views/2020/supporting-growth-by-improving-public-transport-in-sierra-leone.

Sekhonyane, M, Dugard, J., 2004, A violent legacy: The taxi industry and government at loggerheads. SA Crime Quarterly 10, 13-18. Available at: https://doi.org/10.17159/2413-3108/2004/v0i10a1026

Shittu, A.O., 2014. Towards quasi-formal management of paratransit in informal transport dependent cities of Nigeria. IOSR Journal of Humanities and Social Science (IOSR-JHSS) 19, 75–80.

Simone, A., 2004. People as infrastructure: Intersecting fragments in Johannesburg. Public Culture 16. Available at: https://doi.org/10.1215/08992363-16-3-407

Spooner, D., Manga, E., 2019. Nairobi Bus Rapid Transit labour impact assessment research report.

SSATP, 2000. Africa Transport Technical Note: Urban transport microenterprises in Abidjan. SSATP Note 27

Stokes, A., 2019. Governance and transportation in Nairobi, Kenya: Understanding how policy, planning, and levels of governance alter mobility through a multi-modal network analysis. PhD Thesis, Columbia University.

Sylla, F.K., Faye, A., Fall, M., Tal-Dia, A., 2017. Air pollution related to traffic and chronic respiratory diseases (Asthma and COPD) in Africa. Health 09, 1378–1389. Available at: https://doi.org/10.4236/health.2017.910101.

Teffo, M., Earl, A., Zuidgeest, M.H.P., 2019. Understanding public transport needs in Cape Town's informal settlements: a Best-Worst-Scaling approach. Journal of South African. Institute of Civil Engineers 61. https://doi.org/10.17159/2309-8775/2019/v61n2a4.

Techmoran, 2018. Uber Tuk Tuks launch in Dar Es Salaam, Mombassa as uberPOA. Available at: https://techmoran.com/2018/09/20/uber-tuk-tuks-launch-in-dar-es-salaam-mombasa-as-uberpoa/

Teffo, M., Earl, A., Zuidgeest, M.H.P., 2019. Understanding public transport needs in Cape Town's informal settlements: a Best-Worst-Scaling approach. Journal of South African. Institute of Civil Engineers 61. https://doi.org/10.17159/2309-8775/2019/v61n2a4.

Tembe, A., Nakamura, F., Tanaka, S., Ariyoshi, R., Miura, S., 2018. The demand for public buses in sub-Saharan African cities: Case studies from Maputo and Nairobi, IATSS Research, 43(2), July 2019, 122 – 130, Available at: https://doi.org/10.1016/j.iatssr.2018.10.003.

Tembe, A., Nakamura, F., Tanaka, S., Arioshi, R., Miura, S., 2020. Travel behavior of the urban poor: A comparative study between Maputo and Nairobi. Transportation Research Procedia 48, 1478–1492. Avaialble at: https://doi.org/10.1016/j.trpro.2020.08.193

Tembe, A., Matusse, A., 2020. Commuting Trips, Income and Gender in the Metropolitan Maputo, Mozambique.Available at: https://doi.org/10.4236/cus.2020.84031

Thambiran, T., Diab, R.D., 2011. Air pollution and climate change co-benefit opportunities in the road transportation sector in Durban, South Africa. Atmospheric Environment 45, 2683–2689. Available at: https://doi.org/10.1016/j.atmosenv.2011.02.059.

Thondhlana, B., 2020. Zimbabwe: One vast informal business. GGA. Available at: https://gga.org/zimbabwe-one-vast-informal-business.

Tichauer, C.R., Watters, M., 2008. N2 BMT lane - a first for South Africa. Presented at the 27th Annual Southern African Transport Conference, July 2008, Pretoria, South Africa.

Tongwane, M., Piketh, S., Stevens, L., Ramotubei, T., 2015. Greenhouse gas emissions from road transport in South Africa and Lesotho between 2000 and 2009. Transportation Research Part D: Transport and Environment 37, 1–13. Available at: https://doi.org/10.1016/j.trd.2015.02.017

Trans-Africa Consortium, 2008. Overview of public transport in Sub-Saharan Africa. UITP – International Association of Public Transport, Brussels

Turner, J. Kwakye, E. 1998. Transport and survival strategies in a developing economy: case evidence from Accra, Ghana. Journal of Transport Geography 4(3), pp. 161-168

UNEP, 2020. Used vehicles and the environment – a global overview of used light duty vehicles: flow, scale and regulation.

Van Biljon, B., Venter, C.J., 2013. The use of Monte Carlo simulation to determine the optimal configuration for minibus taxi loading areas. Presented at the 32nd Annual Southern African Transport Conference 8-11 July 2013, Pretoria, South Africa.

Van Schalwyk, D., 2011. A troubled journey: The South African government and the Taxi Recapitalisation Policy, 1998-2008 (No. 1). Ph.D Thesis, University of the Free State.

Vanderschuren, M., Cameron, R., Newlands, A., Schalekamp, H., 2021. Geographical Modelling of Transit Deserts in Cape Town. Sustainability 13, 997. Available at: https://doi.org/10.3390/su13020997

Venter, C., 2013. The lurch towards formalisation: Lessons from the implementation of BRT in Johannesburg, South Africa. Research in Transportation Economics 39, 114–120. Available at: https://doi.org/10.1016/j.retrec.2012.06.003

Venter, C.J., 2020. Measuring the quality of the first/last mile connection to public transport. Research in Transportation Economics, 100949. Available at: https://doi.org/10.1016/j.retrec.2020.100949

Venter, C., Barrett, I., Zuidgeest, M., Cheure, N., 2020. Public transport system design and modal integration in Sub-Saharan African cities. The Volvo Research and Educational Foundations, VREF Position paper: The state of knowledge and research.

Verster, B., 2010. Five years down the line: did anything change for public transport interchange users?. Presented at the 29th Annual Southern African Transport Conference, 16 - 19 August 2010, Pretoria, South Africa.

Vieira, K., Dadá, Y., Martins, M., 2014. “Transportes Públicos Rodoviários na Cidade de Maputo: Entre Os TPM e os My Love”. OMR e Universidade Politécnica de Maputo.0

WHO (World Health Organization), 2018: Global status report on road safety 2018, Available at: https://www.who.int/publications/i/item/9789241565684

Wilkinson, P., 2008. “Formalising” paratransit operations in African cities: constructing a research agenda. Presented at the 27th Annual Southern African Transport Conference, 7 - 11 July 2008, Pretoria, South Africa.

Wilkinson, P., 2010. The regulatory cycle stalled? An assessment of current institutional obstacles to regulatory reform in the provision of road-based public transport in Cape Town, South Africa. Research in Transportation Economics 29, 387–394. Available at: https://doi.org/10.1016/j.retrec.2010.07.049

Williams, S., White, A., Waiganjo, P., Orwa, D., Klopp, J., 2015. The digital matatu project: Using cell phones to create an open source data for Nairobi's semi-formal bus system. Journal of Transport Geography 49, 39–51. Available at: https://doi.org/10.1016/j.jtrangeo.2015.10.005.

Woolf, S.E., Joubert, J.W., 2013. A people-centred view on paratransit in South Africa. Cities 35, 284–293. https://doi.org/10.1016/j.cities.2013.04.005

World Bank. 2003. Urban Transport Services in Sub-Saharan Africa: Improving Vehicle Operations. Sub-Saharan Africa Transport Policy Program working paper; SSATP 75. Washington, DC.

World Bank Group., 2019. Sierra Leone - Integrated and Resilient Urban Mobility Project (No. PAD2711). Sierra Leone.

Wright, L., 2004. Planning guide: Bus rapid transit, division 44 environment and infrastructure. Sector project "transport policy advice." Deutsche Gesellschaft für Technische Zusammenarbeit (GTZ), Eschborn.

Wright, L., Hook, W., 2007. Bus rapid transit planning guide. Institute for Transportation and Development Policy, New York.

Xiao, A.H., Adebayo, K.O., 2020. Cohabiting commerce in a transport hub: Peoples as infrastructure in Lagos, Nigeria. Urban Studies 57, 2510–2526. Available at: https://doi.org/10.1177/0042098019879810

A. TRANSITIONS RESEARCH AND ROUTEMAP FRAMEWORK

A. TRANSITIONS Research and Routemap Tool Framework

CONTEXT and **PROBLEM FRAMING**						**ORGANISATION** and **ENGAGEMENT** approaches						**CAPACITY** and **CAPABILITIES** of public authorities						**ACTIONS** for low carbon, affordable and safe transport					
What is the attitude and policy position towards informal transport and is this informed by good evidence?						**What is the organisational make-up of the sector/s and with which actors can we best engage?**						**Are government and transport adequately equipped to replace or improve/reform informal transport?**						**What are the most promising strategic 'routes' and actions for low carbon mobility?**					
• What is the current attitude? • Is there information on the transport network and benefits of the informal sector/s? • Is there evidence of the negative externalities of the informal sector/s?		Known/understood	Lit. review	Interviews	Survey	• What organisations and engagement structures are in place currently? • What is the organisational/financial make-up of the informal transport sector? • What changes/trends are occurring in the sector?		Known/understood	Lit. review	Interviews	Survey	• What is the status of public transport services? • What is the status "stage in the cycle" of informal transport regulation and enforceability? • What level of support is currently available for informal transport?		Known/understood	Lit. review	Interviews	Survey	• What are the comparative advantages of working with the informal sector/s? • Which actions have been deployed and how successful were they? • What package of integrated/interdependent actions have the best potential in the future?		Experience/status	Lit. review	Interviews	Survey
Attitudes & policy	How does government view informal transport? How is the sector defined and attitudes embedded in policy cycles and regulations.					**Organisational and financial models**	What are the dominant organisational models (collective organisation) in the sector? Is the industry highly fragmented?					**Public Transport status & integration**	How have Public Transport (PT) services developed since independence? What is the current service level?					**Infrastructure & operations**	Rank/terminus provision				
	Is the informal transport industry inclined to work with government?						To what extent and by what means is the informal transport sector 'self-regulating'?						Does PT integrate OR co-exist with informal transport? Have/are there projects to replace informal transport with PT/Bus Rapid Transit?						Bus/informal transport priority lanes				
Informal transport network	**Network characteristics** – Are the geographic coverage, route density mapped and understood?						What are the dominant financial/business models and the economic efficiency of the sector?						Have there been attempts from government to involve the informal transport industry in public transport projects?						Integration of PT & informal transport hubs				
	Service characteristics – Are service frequencies and operational characteristics recorded?						What are the fuel supply channels and quality controls?					**Informal transport regulation**	Are planning, regulation, contracting and operational functions clearly defined and attributed?						Access (safety) and public space for walkers & cyclists at hubs				
	Modal share – What are the typologies & modal share of informal transport? Is the modal share increasing or declining?						Which actor has ownership of the vehicle? Where are these sourced? Is there a typical funding cycle for vehicle procurement, maintenance and disposal?						To what type of regulation is informal transport currently subject (route/area licence, general permit, vehicle/driver licence, city tax/VAT/sticker fee etc.)?						Road network management/ITS				
	Employment – What are the numbers of jobs created and local economic value?																		Informal transport operations management				
Informal transport benefits and negative externalities	**Gender (employment)** – How many women are employed in the industry?						What are the labour conditions and remuneration approaches?						Does the government set fare-levels for informal public transport services?					**UAR & network transformation**	Informal transport route assignment				
	Affordability – What is the cost of using informal transport versus the alternatives?						What driver behaviour and preferences are observed?						How effectively are the regulations enforced? And are they considered to have been beneficial?						PT and informal transport integration (e.g. informal transport as 'feeder' service)				
	User profiles – Which segments of the population use informal transport?					**Engagement context**	How is the industry changing – are their 'disruptive' aspects such as emergence of ride-hailing?						Which phase of the regulatory cycle are we in?						Vehicle size restrictions (i.e. larger vehicles with more passengers)				
	User perspective – What are the main pros and cons for passengers (e.g. flexibility). And with regard to moving goods/cargo						Are there official channels of communication/representative bodies to facilitate engagement, negotiation and decision-making?						Are public institutions adequately staffed (number and qualification) and resources (CAPEX and OPEX)?						City centre access bans				
	Road safety – What is the safety record associated with informal transport?						Is there a history of constructive engagement? Are there recent cases of betrayal or manipulation?					**Industry support**	Does government support informal transport vehicle purchase and/or maintenance?					**Fleet & fuel**	Emissions/quality regulations				
	Safety from theft and harassment – What is the safety level of passengers of informal transport?						Are there segments of the informal transport sector with which engagement is better?						Does government currently provide supporting infrastructure for the informal transport industry?						Discounts for new fleets				
	Air quality and GHG emissions – What are the profiles and emissions levels of typical vehicles?																		Scrappage schemes				
																			Cooperative loans				
																			Vehicle maintenance support				
																		Business development	Business skills training				
																			Business consolidation / remuneration				
																			Business diversification / logistics				
																			Labour conditions / remuneration				
																			Safe driver training and tracking				
																			Driver incentives/awards				
																		Passenger services	Driver ranking/reviews				
																			Network mapping and information				
																			Digital journey planners				
																			Cashless (and integrated) ticketing				
																			Ride hailing and ride pooling				

B. LITERATURE REVIEW PAPERS

This Compendium Report is based on the production of a series of topic and city-based literature review papers as presented in the table below:

Topic	Author	Organisation
Informal transport businesses	Roger Behrens	University of Cape Town (UCT)
Regulatory frameworks	Roger Behrens, Laurie Pickup	UCT, Vectos
Operating practices	Simon Saddier	Transitec
Vehicles, fuels and acquisition	Herrie Schalekamp	Transitec
Environmental externalities	Marion Hoyez	Transitec
Digital platforms	Tim Durant	Vectos
Methods and techniques of informal transport analysis	Mark Zuidgeest	UCT
Informality	Jeffrey Turner	J Turner Transport & Social Development Consultancy
Gender and inclusion	Jeffrey Turner	J Turner Transport & Social Development Consultancy
City	**Author**	**Organisation**
Accra (Ghana)	Marion Hoyez	Transitec
Cape Town (South Africa)	Herrie Schalekamp	Transitec
Freetown (Sierra Leone)	Joseph Macarthy and Braima Koroma	Sierra Leone Urban Research Centre (SLURC)
Harare (Zimbabwe)	Tatenda Mbara	Freelance consultant
Kumasi (Ghana)	Charles Adams	Kwame Nkrumah University of Science & Technology (KNUST)
Maputo (Mozambique)	Joaquín Romero de Tejada and Géssica Macamo	Goteomoz Observatório da Mobilidade e Transporte de Moçambique