UNIVERSITY OF CAPE COAST

TOWARDS SUSTAINABLE CITIES: IMPLEMENTING MASS RAPID TRANSIT IN THE GREATER ACCRA METROPOLITAN AREA

BY

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DECLARATION

Candidate's Declaration

I hear by declare that this thesis is the result of my original research and that no part of it has been presented for another degree in this university or elsewhere.

Candidate's Signature…………………….............Date……………………

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Supervisors' Declaration

We hereby declare that the preparation and presentation of the thesis were supervised in accordance with the guidelines on supervision of thesis laid down by the University of Cape Coast.

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ABSTRACT

Many cities face a myriad of accessibility challenges that could be linked to unsustainable mobility systems (UN-Habitat, 2013a). The Government of Ghana has been saddled with the challenge of solving urban mobility problems (Ministry of Transport, 2016). One cardinal area of interest in the urban transport policy reforms has been the introduction of Mass Rapid Transit (MRT) system. The study explored factors that would make the introduction of MRT systems work in Greater Accra Metropolitan Area (GAMA) and other urban areas in Ghana. It identified the infrastructure and institutional arrangements for MRT implementation in Accra, factors that would motivate small private motor vehicle owners to park and use Bus Rapid Transit (BRT) and the perception of users of the piloted Commuter Rail Transit (CRT) of its performance. Following a pragmatic approach, it dwelt on both the positivists and interpretivists' research approach. The study identified that small private motor vehicle users would be motivated to use BRT if buses are punctual and frequent, comfortable and neat, and safe while riding. The CRT also received good commendation from users for avoiding traffic, reducing travelling time, charging affordable fares and leaving on time. Challenges that with respect to the implementation of the two modes of MRT included the poor infrastructure base of the CRT and lack of the political will to implement a full-scale BRT in Accra. The study recommended among others, the development of Mass Rapid Transit (MRT) routes to ensure the integration of different transportation modes and infrastructure, proper stakeholder consultation in the designing of BRT systems and the implementation of a full-scale BRT in the Greater Accra Metropolitan Area.

KEY WORDS

Bus Rapid Transit (BRT)

Commuter Rail Transit (CRT)

Intermodal Transportation

Mass Rapid Transit (MRT)

Mobility

Sustainable Cities

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DEDICATION

To my mother Mrs Hannah Amoo-Agyemang

and

to the memory of my late father Mr Daniel Amoo-Agyemang

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AFP	-	Agence Francaise de Developpement
AdMA	-	Adentan Municipal Assembly
AFCS	-	Automatic Fare Collection System
ANOVA	-	One Way Analysis of Variance
ASEMA	-	Awutu Senya East Municipal Assembly
AshMA	-	Ashaiman Municipal Assembly
BRT	-	Bus Rapid Transit
CAS	-	Country Assistance Strategy
CBD	-	Central Business District
CRT	-	Commuter Rail Transit
CLG	-	Company Limited by Guarantee
CUT	-	Centre for Urban Transportation
DUR	-	Department of Urban Roads
DMU	-	Diesel Multiple Unit
DVLA	-	Driver and Vehicle Licensing Authority
FDI	-	Foreign Direct Investment
ECLAC	-	United Nations Economic Commission for Latin America and the Caribbean
ESCAP	-	United Nations Economic and Social Commission for Asia and the Pacific
GAMA	-	Greater Accra Metropolitan Area
GAPTE	-	Greater Accra Passenger Transport Executive
GCCA	-	Ghana Civil Aviation Authority
GCMA	-	Ga Central Municipal Assembly

GEF	-	Global Environmental Fund
GEMA	-	Ga East Municipal Assembly
GHA	-	Ghana Highways Authority
GIS	-	Geographic Information System
GPRTU	-	Ghana Private Road Transport Union
GRC	-	Ghana Railway Company
GRF	-	Ghana Road Fund
GRDA	-	Ghana Railway Development Authority
GSMA	-	Ga South Municipal Assembly
GWMA	-	Ga West Municipal Assembly
IBRD	-	The International Bank for Reconstruction and Development
IFC	-	International Finance Corporation
ILUTP	-	Integrated Land Use and Transportation Planning
ISUMP	-	Integrated Sustainable Urban Mobility Plans
ITDP	-	Institute for Transport and Development Policy
ITS	-	Intelligent Transportation System
KKDA	-	Kpone Katamanso District Assembly
LaDMA	-	La Dade Kotopon Municipal Assembly
LaNMMA	-	La Nkwantanang Madina Municipal Assembly
LeKMA	-	Ledzokuku-Krowor Municipal Assembly
LRMT	-	Light Rail Metro System
LRT	-	Light Rail Transit
MLGDR	-	Ministry of Local Government and Rural Development
MOF	-	Ministry of Finance

MOT	-	Ministry of Transport
MRT	-	Mass Rapid Transit
MRH	-	Ministry of Roads and Highways
MTTD	-	Motor Transport and Traffic Department
NDPC	-	National Development Planning Commission
NRSC	-	National Road Safety Commission
PAO	-	Project Advisory Office
PBIC	-	Pedestrian and Bicycle Information Centre
PPP	-	Public Private Partnership
RSC	-	Route Service Contract
SDG	-	Sustainable Development Goal
SCUTA	-	Steering Committee on Urban Transportation in Accra
STIP	-	Statewide Transportation Improvement Programme
SUMP	-	Sustainable Urban Mobility Planning
TCDP	-	Town & Country Planning Department
TMA	-	Tema Metropolitan Assembly
TOD	-	Transit Oriented Development
UCC	-	University of Cape Coast
UTP	-	Urban Transport Project

CHAPTER ONE

INTRODUCTION

Background to the Study

The world is becoming more urbanised and hence the need to broaden the scope of the discussion to look at urbanisation from a broader perspective than is currently the case. It has been projected that by 2030 about 60 percent of the global population will be inhabitants of urban areas with 95 percent of the total urban expansion expected to occur in the developing world (United Nations Human Settlements Programme [UN-Habitat], 2016a). Africa is also expected to go beyond the 50 percent urbanisation rate by 2035 (United Nations, 2012).

Urbanisation is associated with a number of challenges which is reflected in the Sustainable Development Goal (SDG) 11 "make cities and human settlements inclusive, safe, resilient and sustainable". With respect to the urban transportation challenge, the SDG target 11.2 advocates for making provision for access to safe, affordable, accessible and sustainable transport systems for all. There is also emphasise on improving road safety with a focus on expanding public transportation systems and taking care of the transport and mobility needs of the vulnerable and the excluded (United Nations, 2016).

There is now a deviation from solving urbanisation problems by examining urbanisation as a process to exploring innovative ways to make cities more liveable through reduction of congestion, provision of basic services, and ensuring sustainable urban governance in city management. This new paradigm shift has been re-emphasised by the original notion of cities as engines of economic growth for national development. International Bank for

Reconstruction and Development [IBRD]/ The World Bank (2000) argues that cities, if well managed, could serve as avenues for development and sustained economic growth with associated social welfare gains. The World Bank echoes this in its Urban and Local Government Strategy that the condition for realising the potential of cities for development will be a function of how city authorities manage growth and fulfil their mandate of extending good responsive governance and the provision of requisite services to households and enterprises (International Bank for Reconstruction and Development [IBRD]/ The World Bank, 2000). As cities grow, one issue of concern would be solving the challenges that are associated with urban mobility.

The United Nations Human Settlement Programme [UN-Habitat] (2013a) explains that moving around cities is associated with a number of negative externalities. Many cities, therefore, face a myriad of accessibility challenges that could be linked to unsustainable mobility systems. Excessive motorisation leads to pollution with its impacts on human health and the global environment. A number of pollutants have been identified in this direction such as lead, carbon monoxide, small suspended particulate matter and ozone in some cities. In the developing world, air pollution that could be associated with transportation leads to the premature death of over 500,000 people per annum (World Bank, 2015). Another problem identified is increase in traffic congestion which translates into loss of man-hours in traffic jam and hence loss of productivity (IBRD/ The World Bank, 2000). In the view of Porter and Abane (2008) and Abane (2011), in spite of the fact that transportation development was not explicitly stated in the Millennium Development Goals (MDGs), accessibility of transport with emphasis on its availability and quality would augur well for the attainment of Goals 1 and 6 that were related to poverty and environmental health respectively.

Solving the urban transportation challenges, therefore, becomes an arduous task for city managers and planners. Rethinking urbanisation requires solving traffic congestion and transportation at large from both the supply and demand sides. The supply side focuses on improving urban transportation infrastructure or capacity enhancement measures. The demand side includes measures such as widening the travelling mode choices, shifting travelling routes and departure times, and reducing the need to travel and the number of travel trips (The Association of Commuter Transportation, 2004). One popular demand-side measure has been how to reduce the use of personal small motor vehicles in favour of using Mass Rapid Transit (MRT) systems. Deutsche Gesselschaft fur Zusammernarbeit (GTZ) defines Mass Rapid Transit (MRT) as " a passenger transport service usually local in scope that is available to any person who pays a prescribed fare". It is further explained to include heavy rail transit, metro, commuter rail systems, light rail transit and bus rapid transit (GTZ, 2005, p.2).

The Government of Ghana has been saddled with the challenge of solving urban mobility problems (Ministry of Transport, 2016). One cardinal area of interest in the urban transport policy reforms has been the introduction of Mass Rapid Transit system. Commuter Rail Transit (CRT) has been introduced in the Greater Accra Metropolitan Area, operating in two corridors, being the Accra–Nsawam and the Accra-Tema CRT corridors. The Ghana Shared Growth and Development Agenda (GSGDA) highlights on the implementation of Ghana Urban Transport Project (GUTP) with emphasis on

Bus Rapid Transit. The policy also acknowledges the critical role of the Public Private Partnership (PPP) in transport infrastructure and services provision (Government of Ghana, 2010).

For this policy to succeed in reducing traffic congestion, vehicular pollution, productive man-hours that are lost in traffic jam and increased accessibility in Ghanaian cities, there is the need for favourable contribution by the private sector, co-operation of small vehicle owners and the requisite institutional framework for policy implementation. Implementation of MRT will require the necessary infrastructure based on the selected modes of transportation. Infrastructure development should focus on both construction and engineering work as well as software (Intelligent Transportation Systems) development.

Sustainable Cities

The concept of sustainable development gained much attention after the United Nations Commission of Environment and Development conference in 1987. With the publication of ‘Our Common Future’, by the Commission, nations became conscious of the need to incorporate sustainability into national development planning. Sustainable development was defined as “development that meets the needs of the present without compromising the ability of the future generations to meet their own needs” (United Nations, 1987, p.37).

The UN Conference on Environment and Development in Rio de Janeiro in 1992 further buttressed the need for sustainability in national and regional development in the Agenda 21 declaration. The conference highlighted the need to promote sustainable human settlements by ensuring improved environmental quality of settlements, improved livelihoods and working environments of people and ensuring partnerships, technical co-operation and participation of major stakeholders in decision making.

Agenda 21 recognised the environmental problems that are associated with cities. With regard to urban transportation, the document affirmed the need for cities to promote sustainable urban transport systems. Key areas of interest that would help address environmental problems that are associated with the urban transportation problems include: integration of urban land use and transportation planning by incorporating measures that would curtail demand for travelling; adoption of urban transport programmes that promote the development of high-occupancy transport systems; promotion of non-motorised transport modes; paying particular attention to prudent transport management; and efficient public transport systems and transport infrastructure (United Nations Division for Sustainable Development, 1992).

The focus on sustainable cities has become more important with the increasing rate of urbanisation globally and cities in the developing world becoming the epicentres of urban population explosion. It has been estimated that about 90 percent of global urban growth is now exhibited in cities in developing countries (IBRD/World Bank, 2010).

Whereas urbanisation has lately been associated with the convergence of innovation, productivity and economic growth, its negative impacts such as socio-economic challenges, slums development, and climate change and related challenges may offset the benefits if not well managed. Sustainability is in a way making cities more resilient and be able to adapt and recover from shocks and disaster. With the growing challenge of myriad environmental, social and economic difficulties, the success of cities would depend on how they maintain vital functions as well as adaptation to the prevailing external conditions for sustained development (Seeliger & Turok, 2013).

Throughout the world, there are attempts by international development agencies and countries to measure and assess urban sustainability. One of such practical examples is the urban sustainability index that has been introduced in China. The index measures the performance of cities according to five major aspects: accessibility to basic needs; resource efficiency, which highlights on water and energy use and effective waste recycling; environmental health; and commitment to sustainability, which concentrates on the institutional capacity to implement city sustainability policy and measures. The fifth dimension which is of interest to this study is the measure related to the built environment. It focuses on cities liveability and efficiency. Basic indicators to assess cities in this regard dwell on a commitment to densification, mass transit transport usage, public green space, and building efficiency. The results from the assessment of Chinese cities so far indicate that, with intense urbanisation and densities, Chinese cities may be able to avoid sprawl and continue to rely on public transportation (Xiao, Xue & Woetzel, 2010, pp. 10, 11).

With the current threat of climate change, attention has been drawn to mitigation and adaptation measures. This brings cities to the fore of climate change mitigation measures because of intense Green House Gas (GHG) emissions from cities. It has been estimated that cities as home to half of the world’s population have a total share of 60 to 80 percent of energy use and over 75 percent of carbon emissions. Potential sources of emission reduction from cities would, therefore, be from sectors such as transport, waste, energy generation and energy efficiency (United Nations Environment Programme [UNEP], 2012a).

Ensuring sustainable production and efficient mass rapid transport systems in cities will, therefore, assist in reducing greenhouse gas emissions into the atmosphere. Sustainable urban transport thus becomes a strategy worth considering. Making a case for sustainable urban transport, UNEP (2012b) advocates for concentration on reducing dependence on the energy sector, reduction in congestion, increasing productivity and reducing air pollution levels. UNEP (2012b) further explains that public transport systems can potentially assist in employment creation, increase accessibility and serve as a conduit to bridge the urban socio-economic divide.

The argument about bridging the urban socio-economic divide ushers in the equity dimension of sustainable development. The 2011 Human Development Report, highlights on sustainability and equity. Sustainable development should lead to a more equitable distribution of resources and accessibility of services (UNDP, 2011). It could, therefore, be explained that achieving sustainable cities would also imply making services work for the poor. With regard to transportation and greenhouse gas emissions, the predominant use of small motor vehicles will imply more vehicular pollution by the middle class and the rich at the expense of the poor. Mass Rapid Transit systems would lead to a reduction in the use of small motor vehicles and hence vehicular pollution. The equity dimension is that the poor will have cheaper accessible transportation systems.

The Urban Transportation Challenge

The world has been experiencing an increasing rate of urbanisation. About 54 percent of the world's population now resides in urban areas with urban areas accounting for 70 percent of global carbon dioxide emissions (UN-Habitat, 2016b). The urban growth rate for the regions of the world has not been even with the urban growth rate for Africa being almost 11 times higher than Europe (UN-Habitat, 2016b).

One major challenge that has been facing cities is the increasing rate of motorisation, especially in cities of the developing world. With rising income levels, many urban dwellers, particularly the middle-income class, are shifting from public and non-motorised forms of transportation to private automobiles. The higher income levels also enable some urban dwellers to own more spacious houses in suburban areas of cities and using their own small private vehicles to reach jobs and services centres. This trend leads to increasing urban sprawl and motorisation (The International Bank for Reconstruction and Development [IBRD], 2013).

Transport has a direct influence on other sectors of the economy. A positive change in demand for transport is also reflected in the demand for fuel and other oil-based resources, materials for vehicles manufacturing and land (Morchain & Fedrizzi, 2011). In countries where governments have to subsidise the cost of fuel for vehicles, this will translate into a heavy burden on the national economy. The heavy burden that fuel subsidies have imposed on the government of Ghana has generated a debate on the relevance of the policy. It has been estimated that the government of Ghana spent US$ 85 million during the second quarter of 2014 alone (Klutse, 2015). Similarly, the government of Zambia spent over US$ 200 million on fuel subsidies during 2016 (Xinhua/NewsGhana, 2016).

Resources that could have been used to develop other sectors of the economy would be channelled into fuel subsidies. In situations where fuel subsidies account for a significant proportion of government budget or national Gross Domestic Product (GDP), the impact could be fiscally stressful and economically detrimental. Fuel subsidies often tend not to be pro-poor as wealthier consumers gain most of the benefits at the expense of the poor. On the average, it would require $33.00 to yield $1.00 of fuel price relief to the poor (Acheampong & Ackah, 2015).

Some urban areas in the developing world face the problem of lack of co-ordination in urban land use and transportation planning. The 2012 Ghana National Urban Policy Framework document notes that there is weak transport and traffic management in the urban areas in Ghana. The situation has led to extreme cost by way of time spent in traffic, fuel, vehicular maintenance and the overall cost of doing business in the cities. The document observed that although the Department of Urban Roads has been widening and introducing new road links, little impact is achieved in the urban transportation and traffic management because of the absence of Integrated Land Use and Transportation Planning [ILUTP] (Ministry of Local Government and Rural Development [MLGRD], 2012a).

With respect to the African continent, the IBRD]/The World Bank (2011) observed that increasing urbanisation and lack of policies on land use and economic development fuel urban sprawl with its negative impacts on urban transportation. The urban poor who are often compelled to live in the urban fringes where there is relatively cheap accommodation and land have to cope with the burden of increasing transportation cost to the inner city. The use of private motor vehicles by the peri-urban dwellers increases traffic congestion, travelling time and automobile pollution for city dwellers. In his analysis of urban transportation problems in Nigeria, Aderamo (2012) notes that the problem of traffic congestion in Nigerian cities could be attributed to the structural nature of the roads and unplanned growth and haphazard land-use distribution.

UN-Habitat (2013b) explains that a city's performance is partly measured by the ability of the inhabitants to move from neighbourhoods to work places and services centres with ease. There is, therefore, a relationship between accessibility and income levels, housing location of individuals and business establishments. In improving accessibility, it will prudent for city authorities to focus on measures that facilitate the efficient movement of people and not cars. It has been observed that many cities that sought to solve traffic congestion by increasing roads construction could not achieve the desired results. In most cases, the increase in the construction of more urban roads was accompanied by an increase in the desire to travel and most especially with small vehicles (Banister & Banister, 1995).

Hook (2006) argues the urban transportation challenge from the perspective of its impact on the urban poor. The urban poor spend a lot of their disposable income on transportation. The working urban poor may not afford accessible accommodation to the work place and most of the times are forced to reside in distant locations and spend a sizeable proportion of their income on transportation. The unfriendly nature of the roads and motorists to the use of bicycles and the lack of capital to invest in motor cycles make such options not worthy of consideration by the urban working poor. They, therefore, spend a lot of money on fares on buses and mini-buses.

One other major urban transportation challenge is that the public transportation sector in some African countries has not been performing as expected. The World Bank (2008) notes that this could be partly attributed to the increasing rate of the introduction of mini buses and motor cycles to replace dysfunctional urban public transport systems. Public buses fail to operate after long periods of overload and lack of routine maintenance. The bad nature of roads and the low transport fare charges serve as a disincentive for public buses to operate on sound economic principles. Commuters are compelled to fall on the unregulated and informal sector of the transportation industry which is usually unsafe, dirty, irregular in time and service quality, and uncomfortable.

In solving the environmental problems that have been associated with the urban transportation challenge, there is also an emphasis on suitable friendly policies. The United Nations Environment Programme (UNEP) in 2011 proposed a three-way solution to the urban transportation challenge. The focus is on Avoid-Shift-Improve. 'Avoid' focuses on measures that would reduce vehicle kilometres with the introduction of efficient land use and transportation planning, transportation demand management, improvement in information technology and shorter supply chains. 'Shift' policy measures dwell on shifting from private vehicles to non-motorised and public transport, from aviation to rail and transfer of freight from road to rail and water. The third policy measure, 'Improve', focuses on ensuring more energy efficient vehicles, and carbon-neutral liquid fuels and designing innovations for traditional non-motorised transport ().

Concentration without Congestion

The 2009 World Development Report highlights on the impact of location on resources endowment and attraction of investment. Cities are favoured in the attraction of investment and development and hence concentration of population and businesses. City dwellers tend to have the added advantage of enjoying higher living standards. Estimates from several living standards surveys from developing countries such as Brazil, Indonesia, Bulgaria, Sri Lanka and Ghana indicate that well-endowed areas in these countries have an average consumption level that is 75 percent higher than households in less endowed areas in these countries. The prosperity that is associated with cities generates congestion but the spillover effects of this prosperity is felt in areas that are well connected and integrated to with the areas of concentration. The document notes that prosperity will not be evenly distributed. The concentration of resources and investment in the cities will create unbalanced development. What governments could do to offset the differences in standard of living and poverty between the cities and hinterlands, which is in favour of the cities, is to encourage the integration of the cities' economy with that of the hinterlands. Cities should as well pursue policies that would ensure concentration without congestion (IBRD/World Bank, 2009).

Cities have been variously pursuing policies and programmes to help reduce congestion. Lately, in the United States of America (USA), there has been an emphasis on the promotion of 'complete streets' as a measure to ensure safe streets, promote accessibility for all users of the road rather than the development of roads and streets for only automobile users. The promotion of complete streets ensures reduction of congestion as it provides avenues for other road users outside vehicle users. It is seen as "a transportation approach that ensures all future streets projects will take into account the needs of all travellers regardless of age, ability, or mode of transportation". In a way, complete streets' thinking of roadways takes into consideration the function of roads for intermodal transportation, integrated land use and urban development. Some streets diverge from proper urban transportation planning schemes and ensures that the design of roads and streets vary with respect to future and existing needs of the area in question (Manaugh, Badami, & El-Geneidy, 2015).

One important means of congestion reduction is reducing the need for motorised transport. This could be achieved by considering urban land use planning in conjunction with urban transportation planning and infrastructure development. Un-regulated urban development often results in urban sprawl with a number of people and businesses continually moving into the periphery areas of cities. To help check haphazard development and urban sprawl, one of the measures that have been proposed is transit-oriented development. It is based on the notion that people living close to well-serviced transit stops are more likely to use public transport on their way to work or shopping in the city centre. Transit-oriented development helps in reducing the demand to travel because well-serviced areas around transit stops provide a lot of services and commercial activities that would have been produced in the city centre. It, therefore, reduces the distances that residents have to travel for services and journeys to the city centre (European Commission, 2005).

Writing on congestion management, European Conference of Ministers of Transport [ECMT] (2007) explains that there is no specific prescription to traffic management. Congestion management should be tailored to the needs and specific urban characteristics of the city in question. Three strategic congestion management principles are however identified. The first measure prescribes a combination of urban land use and transportation planning, taking due consideration of the community's goals and objectives in urban planning and management. Lack of long-term co-ordination of land use and transportation planning does not augur well for prudent congestion management. The second measure focuses on delivering predictable travel times. It addresses measures that will enhance both average travel speed and travel time reliability with emphasis on the latter. Measures recommended include "planning and co-ordination of road works, speedy response to defective traffic signals and to the disruption caused by accident and debris". The third measure focuses on managing "highly trafficked roadways to preserve adequate system performance".

Abane (1993) identified the human element in traffic congestion in Accra such as reckless driving, hawking along major streets, indiscriminate parking on the sides of roads and general indiscipline on roads. To help deal with traffic congestion in Accra, an integrated approach is recommended which would attend to the popular road congestion measures such as roads expansion and improvement as well as addressing human-related issues such as influencing the behaviour of road users, and addressing competency challenges of drivers. These could be complemented by a land use policy that would decongest the Central Business District and encourage Mass Rapid Transit.

Attention has also been drawn towards measures that would maximise accessibility, the ability to complete a range of daily activities and access services with little travel, as against mobility (the ability to move freely). This reiterates the overarching need to integrate urban land use and transportation planning (Dredge, 2001). In some countries land use planning has been the prerogative of local governments and city authorities in contrast as observed by Deakin (1989) in the United States, transportation planning (as distinct from traffic engineering) has been less visible until very recently.

Statement of the Problem

In many cities of the world, attempts are being made to revive the mass public transportation system. This is because mass public transit has the tendency to reduce vehicular traffic congestion, air pollution and make transportation convenient. However, according to Abane (2011), public transportation in major Ghanaian cities could be described as uncomfortable, unsafe and generally inconvenient. This has led to a dominance of small vehicles with associated problems of congestion, time wasting in traffic, vehicular pollution and an increase in the number of trips that people make daily.

The Ghana National Urban Policy Framework of 2012, notes that little is achieved from the widening of roads and creation of new link routes because of the absence of Integrated Land Use and Transportation Planning [ILUPT]

(MLGRD, 2012). The widening and improvement in the road network have also not been able to solve traffic congestion in the major cities in Ghana partly because of the steady increase in the importation and use of small private motor vehicles. Data from the Ghana Driver and Vehicle Licensing Authority (DVLA) indicate that whereas the number of annual new registered buses and coaches reduced from 10,387 in 1995 to 5,585 in 2005 and increased marginally to 9506 in 2010 and 11, 240 in 2012, the registration of new small motor vehicles (both private and commercial) with up to 2000 cubic capacity increased from 20,189 in 1995 to 29,635 in 2005 and increased further to 30,765 and 53,475 in 2010 and 2012 respectively (DVLA, 2014).

The nature of urban development in the country could be associated with urban sprawl with the area covered by Accra expanding horizontally. The urbanised areas of Greater Accra covered 163,7097km^2 representing 4.43 percent of the total land cover in 1985. This figure increased to 534.2279 km^2 in 2014, representing 14 percent of the total land cover of the Region (Osei, Balogun & Afrifa, 2013).

Many people dwell in the fringing communities of Accra and neighbouring local authority areas and commute daily to work in Accra and back in vans, mini buses and small motor vehicles. The traffic congestion in Accra implies that commuters have to spend a long time to journey to the workplace in the morning and be in the traffic jam again in the evening for the long driving time back home. With the absence of the promotion of densification, mass rapid transit systems become imperative and a viable option for Accra and other metropolitan centres in Ghana (Ministry of Transport, 2008). MRT has been seen as cost-effective strategy in serving low-density settlement pattern communities and small and medium-sized cities due to the use of dedicated bus lanes or busways integrated with feeder routes (IURD, 2013).

The need for the MRT system for Accra, in particular, could also be explained from both land use and transportation linkage point of view. The relationship between land use and urban transportation has been well documented (IBRD/The World Bank, 2013; Transport and Infrastructure Council, 2016). Whereas one school of thought sees the need to allow transportation planning to influence land use planning, other researchers believe in MRT systems that are adapted to the existing urban land use planning system (GTZ, 2005). The proposed study focuses on the attempt to develop MRT systems in Accra in its current land use pattern. MRT systems that could be considered in the medium term and hence the focus of the research included 'Commuter Rail Transit' (CRT) system and 'Bus Rapid Transit' (BRT).

The ability of MRT systems such as CRT and BRT to reduce the number of vehicles on the roads of Accra, reduce traffic congestion and productive hours that are spent in traffic jam is contingent on the willingness of small private vehicle owners to use MRT systems, especially to work for relatively longer journeys. Little is however known by way of research on the willingness and what will motivate small private motor vehicle owners to park and use BRT systems if introduced. Available research on Accra BRT such as Feye, Evia and Benefoh (2014), Okoye, Sands, and Debrah (2010) and Agyemang (2015) focus on issues that are related to the general characteristic, mode of operation and challenges of the BRT system. A study of the willingness and motivational factors that would help owners of small motor vehicles in Accra to use BRT systems becomes relevant to assist in assessing the potential of BRT to reduce traffic congestion in the country.

Mass Rapid Transit implies the use of different modes of transportation and hence the need for multimodal and intermodal transportation forms. In discussing MRT in Accra, one mode of transportation that is already in place is the Commuter Rail Transit (CRT) system, specifically, the Nsawam- Accra and Tema-Accra rail corridors. However, very little is known about the mode of operation and the perception of passengers on the operations of the Commuter Rail Transit system, a research gap which deserves the needed attention.

Private sector participation is also very important in the operation of MRT systems. In Ghana, mass transportation is currently dominated by private sector operators. However, little is known about the interest and the preparedness of the private sector for the introduction of MRT systems in Ghana. Public Private Partnerships (PPPs) would, therefore, be very important and crucial for the success of MRT system in Accra, and potentially other urban areas and hence, the need to investigate the preparedness and readiness of the private sector to participate in an MRT system.

Given the issues raised thus far, therefore, the study would be guided by the following research questions:

- What are the institutional arrangements for effective Mass Rapid Transit in the Greater Accra Metropolitan Area (GAMA)?
- What is the available infrastructure for Mass Rapid Transit in the GAMA?

- How can small private vehicle owners be motivated to use BRT?
- How do the users of the piloted CRT perceive its performance?

Objectives of the Study

The main objective of the study was to explore factors that would make the introduction of Mass Rapid Transit systems work in Accra and other urban areas in Ghana.

The specific objectives of the study were to:

- Explore the institutional arrangements for effective Mass Rapid Transit in the Greater Accra Metropolitan Area;
- Document the level of development of proposed infrastructure for the Mass Rapid Transit in the GAMA.
- Determine the factors that would potentially motivate small private motor vehicle users to use Bus Rapid Transit system; and
- Assess the perception of users of the pilot Commuter Rail Transit system in Accra on its performance.

Significance of the Study

The study has become imperative because of the mounting urban transportation pressure that is exhibited in the city of Accra. The pattern of urban development in Accra could be described as urban sprawl with many people living in the peri-urban communities and commuting to work in Accra (Osei, Balogun & Afrifa, 2013). A vibrant Mass Rapid Transit system will reduce the number of vehicles on the roads and hence traffic congestion.

The study will provide transport policy and planning stakeholders with the important factors to consider in the implementation of Mass Rapid Transit (MRT). It fills a gap in BRT research in the country that focuses on its nature and mode of operation by identifying factors that will motivate small private motor vehicle users to park and use BRT.

The government of Ghana has in recent years introduced Commuter Rail Transit (CRT) system on two major corridors of the GAMA: the Nsawam to Accra and Tema to Accra corridors. It was therefore necessary for a study on the nature of operations of the CRT and the perception of users of the CRT system. Results of the study will assist in informing policymakers and stakeholders of future CRT operations in other corridors of Accra as well as other cities of the country on measures that will motivate and sustain ridership.

Solving urban transportation problems in the country has been a major challenge for urban transportation planners. A number of strategies have been debated upon, including strengthening private sector participation, improving non-motorised forms of transportation, and improving transport infrastructure and MRT (Ministry of Transport, 2008). The outcome of the study would help bring to the fore the potential of MRT systems in solving the urban transportation challenge in the country.

The contribution of the study to knowledge development in transportation planning in the country is also worth mentioning. The concept of liveable cities as explained by Laconte (2012) and reviewed in the study will assist in comprehensive transportation planning that will take due cognisance of both demand and supply side measures in solving the urban transportation challenge.

Scope of the Study

Accra has been selected as the study area of the research. Accra in the context of this study has been defined to include the selected District Assemblies in the Greater Accra Metropolitan Area for the Bus Rapid Transit project and the Commuter Rail Transit. Specifically, the study area for the research consists of the 13 Metropolitan, Municipal and District Assemblies that operate under the Greater Accra Passenger Transport Executive (12 in the Greater Accra Region and Ewutu Senya Municipality in the Central Region). Additionally, the Nsawam-Adoagyiri Municipal Assembly in the Eastern Region was also included because of the Nsawam-Accra commuter train corridor.

There are different categories of Mass Rapid Transit but MRT, as used here, was restricted to 'Bus Rapid Transit' (BRT) and 'Commuter Rail Transit' (CRT). This could be explained by the fact that the two categories have been selected for implementation in Ghana. The financial expenditure involved in some of the other MRT systems such as the subway and light rail systems makes the selected two a viable option.

Organisation of the Study

The study was organised into nine chapters. The first chapter gave a general introduction to the study and explained sustainable cites, the urban transportation challenge and concentration without congestion. The chapter further explained the statement of the problem, objectives, justification of the study and the scope of the study. Chapter two covered the theoretical and conceptual perspectives of urban transportation planning. Under this, types of cities (focusing on liveable and smart cities), transit ridership determination and transportation satisfaction determination are treated. The chapter ends with a write-up on stakeholder participation in transportation planning, urban transportation models and the conceptual framework.

Chapter three reviewed approaches to urban transportation planning with a focus on different levels of the process, Transit Oriented Development, intermodal and multimodal planning and eventually Mass Rapid Transit with a reflection on examples in some selected cities. The fourth chapter addressed methodological issues including the research philosophy and design, target population, data collection methods and analysis, field challenges and ethical considerations.

The field findings are presented in chapters five, six, seven and eight. Chapter five analysed the preparatory and institutional measures for the implementation of Bus Rapid Transit (BRT), whereas the sixth chapter focused on the infrastructure for the implementation of Mass Rapid Transit in the Greater Accra Metropolitan Area. Chapter seven assessed factors that would motivate small private motor vehicle owners to park and use BRT and chapter eight analysed the perception of users of the Commuter Rail Transit (CRT) on its performance. The final chapter (nine) dwelt on the summary, conclusions and recommendations of the study with suggestions on further areas of research and a highlight on contributions to knowledge.

Summary

The chapter gave a general introduction to the study, discussed sustainable cities, the urban transportation challenge (which touched on the myriad challenges facing urban transportation) and concentration without congestion. The chapter then addressed the statement of the problem, the research questions and objectives of the study, justification for the study and the scope of the study. Finally, the chapter outlines the contents of the various chapters of the study.

CHAPTER TWO

THEORETICAL AND CONCEPTUAL PERSPECTIVES OF URBAN TRANSPORTATION PLANNING

Introduction

The chapter covers theoretical and conceptual issues that are related to the study. It begins with an in-depth discussion of the New Urban Agenda in general and types of cities in particular. Under this, the concepts of liveable cities and smart cities are introduced with emphasis on how the concepts have been adopted to promote sustainable urban transportation. A number of theoretical issues are then introduced. One of the objectives of the study was to determine factors that will potentially motivate small private motor vehicle owners to use Bus Rapid Transit in the Greater Accra Metropolitan Area (GAMA) if fully implemented, hence the issue of transit ridership determination is discussed. The discussion on transport satisfaction determination is also motivated by the objective of assessing the perception of users of the pilot Commuter Rail Transit system in Accra of its performance.

There is also the recognition of the crucial role of stakeholder participation in transportation planning and this is reflected in the discussion on stakeholder participation in transportation planning. This is in consonance with the objective of exploring the institutional arrangements for effective Mass Rapid Transit in Accra. The Four-step transportation model is further introduced as a framework to help explain the demand for transportation in the urban environment. Finally, the conceptual framework for the study, the Input-Output Framework of Transport Interventions, is introduced as a framework that assists in explaining the input and output variables for transport interventions.

Types of Cities

In current urban development dispensation, the New Urban Agenda has become a fundamental global policy initiative for sustainable urban development. The New Urban Agenda is based on the conviction that by 2050, the global urban population is likely to double and hence making urbanisation a very important global development issue. It is envisaged that realigning the development, management, designing, planning and governance of cities would lead to a transformative change in solving urban poverty, improving sustainable economic growth, gender equality and building inclusive and resilient cities. With regard to urban mobility and transportation, there is an emphasis on integrating transport and mobility planning into the entire city development agenda and incorporating a myriad of transport and mobility options (United Nations, 2017). The discussion of types of cities is aligned towards current dispensation on city goals that help address the New Urban Agenda with emphasis on mobility and transportation.

Liveable Cities

The term liveable city has been among the vocabulary of urban planners for long, but it only attracted much public attention in recent years. The late adoption could be explained by the subjectivity that is involved in the definition of liveable cities (Koninklijke Philips Electronics, 2010). The former Prime Minister of Singapore, Lee Kuan Yew explained that a good city is one that is clean, creates a sense of safety and space, provides mobility and connectivity, and above all, "a sense of equity, that everybody owns a part of the city". As one of the ten options to obtain a livable city, Singapore highlights on prioritising green transport and building options. There is emphasis on greener building and transport systems. Greener transport focuses on energy efficient transport systems, especially for mixed-used neighbourhoods. Public transport has the potential to reduce pollution and help decongest city centers in the world.

The concept of liveable cities also focuses on eco-efficiency and principles of eco-efficiency while sustainable development centre on maximising the competitiveness of the city, quality of life and giving due attention to environmental sustainability. With regard to urban public transportation, there is an emphasis on building the city for people and not for vehicles. Hence premium is put on the development of walkable and bikeable cities and investment in public transport (United Nations Economic and Social Commission for Asia and the Pacific [ESCAP], 2014). Similarly, the European Union explains that from the perspective of transport, liveable cities also concentrate on making mobility sustainable, inclusive and healthy. This would imply sustainable energy efficient and affordable transport systems; an enabling environment for soft transport modes such as cycling and walking; and easy access to all neighbourhood by foot, bike and public transport. It also demands local transport connectivity with peri-urban areas, and regional networks (European Union, 2011a, p.45).

GTZ (2010) argues that liveable cities are mindful of parking policies and management to ensure a reduction in traffic congestion and promote the safety of pedestrians. It is argued that the on-street parking may cause safety and congestion problems by narrowing streets to single lanes and forcing pedestrians to use the road if no proper arrangement is made for the provision of walkways. It is further explained that congestion and pollution could be reduced if there is less parking in the city centres to encourage people to patronise other modes of transport. Liveable cities hence encourage Mass Rapid Transit systems.

Some authors believe that liveable cities should be in a position to address problems that are associated with urbanisation such as urban sprawl, addressing issues that are related to urban distressed areas, urban services and infrastructure provision. Writing on liveability in Nigerian cities, Taiwo and Olajide (2014) touched on the need for cities to address the increasing rate of urbanisation and its associated environmental deterioration and pressure on infrastructure.

It has been argued that liveable cities should also be conscious of urban spatial planning issues. Geertman (2010) addresses urban liveability from the perspective of the intricate relationship between urban land use and transportation planning. The author proposes a 3-D approach to making cities more liveable, being density (of jobs as well as residence); diversity (focusing on mixed-use areas with an emphasis on increasing accessibility rather than focusing on mobility); and design (relating to issues such as connectivity, safety and attractiveness). The prime objective is for cities to put people first but not vehicles for healthier, safer, prosperous and happier places for the inhabitants of the city. Laconte (2012) also stresses on the fact that liveable cities should ensure sustained mobility. This focuses on the integration of transport policy and urban planning, parking controls with an emphasis on public transport as the mode of transport for all but not only for the poor and the elderly.

The Western Australian Planning Commission (The WAPC), the institution that is responsible for co-ordinating state planning process in Western Australia, issues guidelines for liveability neighbourhoods to assist planning in the State. With regard to transportation, liveable neighbourhoods put emphasis on the promotion of walkable neighbourhoods based on wards of comparable mixed uses that reduce dependence on vehicles, walkable neighbourhoods and accessibility of services by all, including the physically challenged. It also ensures an interconnected network of streets that facilitate safe, efficient and pleasant, walkable, cycling and driving. Finally, there is the promotion of public transport systems that provide safe direct access to the systems by residents (State of Western Australia, 2007, pp.1-2).

The observation about the concept of liveable cities is that the discussion tends to focus on high-density cities. The infrastructure required and the requisite institutional capacity for effective urban planning and management may be lacking in some cities in the developing world and that may serve as a hindrance in the attainment of liveable cities as defined from the perspective of mainly western cities. It must, however, be emphasised that understanding and appreciation of the concept will enable cities in the developing world to gradually develop the needed institutional capacity and plan towards the attainment of liveable cities.

Smart Cities

The concept of smart cities has been explained and defined variously based on the context and interest of the individual or organisation in question. Definitions centre on efficient and effective managed cities in terms of governance, mobility, infrastructure development, information technology development and environmental management (Chourabi, 2012). The Climate Group, ARUP, Accenture & The University of Nottingham (2011) explain smart city to mean a city that uses data, information and communication technology for efficient and enhanced services, monitors government's progress for effective delivery of services on climate change mitigation and adaptation; effective infrastructure planning and management; remove organisational bottlenecks and promote cross-sector collaboration; and create the enabling environment for business models that would ensure public and private service provision.

Development of a smart city implies seeing the city as a system. This would require an integrated approach to both delivery and strategy. Hence in an interconnected urban system, trees and green spaces assist in cooling streets, urban waste serves as an input for energy generation, recycled water from houses serve as water for washing vehicles and greenhouse agriculture use and apartments use organic waste as manure (ARUP, 2010).

This is explained against the background that cities need to find new and innovative means of meeting the needs of the increasing urban population without exponentially increasing resource use. In line with this, city transportation managers are seeking more pragmatic ways of reducing road congestion by encouraging the use of public transportation and bicycles. Some smart transportation measures that have been proposed include the use of smart cards that link multiple forms of transport; the introduction of car clubs that would encourage easy sharing and hiring of vehicles; promotion of bicycles as against driving; buses and trains that run on more efficient renewable power; provision of transport information via mobile phone applications (APPs); and real-time transport displays that will ensure adequate and efficient visibility to public transport users. Some of these actions have been implemented in some cities (Climate Group et al, 2011).

The Global Commission on the Economy and Climate (2014) argues that building a connection on production-oriented cities can trigger economic prosperity and help combat climate change. Other measures proposed include densification, connected infrastructure and proper urban governance, cost-efficient investments and proper waste management and transit. With regard to urban transportation, the report highlighted that many cities are making progress with over 160 cities implementing Bus Rapid Transit Systems, widening the coverage of railway services in urban areas in China to 3000 km in length in 2015 and close to 700 cities implementing bus-sharing schemes. Car sharing is also being promoted in many cities. It could be appreciated that based on the argument of the Climate Group et al. (2011) smart cities should aim at developing climate risk-free cities.

Urban transportation is considered as a key area for consideration by cities pursuing smart cities agenda. It contributes to increasing the quality of life of city dwellers, enhances the competitiveness of the economy of cities and assists cities in the attainment of sustainable cities with improved resource efficiency and meeting emission reduction targets (Di Napoli, Di Nocera, &

Rossi, 2014). The new emerging concept of mobility on demand has also been lately associated with the attainment of smart cities. Mobility-on-demand systems provide stacks and racks of light electric vehicles and bicycles at closely spaced intervals throughout a city (Massachusetts Institute of Technology, 2008, p.1).

Users access the vehicles or bicycles with the use of electric cards. The users drive the vehicles to the nearest rack to their destination. It must be emphasised that mobility-on-demand vehicles and bikes are not a replacement for urban transit systems but rather compliments Mass Rapid Systems. It facilitates movement from mass transit terminals to the final destination of users of MRT (Massachusetts Institute of Technology, 2008).

Finland has unveiled an ambitious plan to better the lives of residents of Helsinki by making car ownership obsolete in the next decade. This objective is being pursued with the application of smart new technology and digitisation. The city of Helsinki introduced 'Mobility as a service' [MaaS] (Intelligent Mobility and the Long Walk to Freedom from Cars, 2015) The concept of Mobility-as-a-Service is defined as the ability for users to buy mobility services based on their needs, instead of just buying a means of mobility (Finland develops the Mobility-as-a-Service ecosystem, 2015).

Mobility as a Service introduces a one-stop shop for transportation services. With a single interface-mobile application or website- transport service users can plan their transportation needs and organise their travel plan and make payments for use of public transportation, city bikes, shared rides, rental cars and long-distance trains (Intelligent Mobility and the Long Walk to Freedom from Cars, 2015).

The European Union (2014) identified six characteristics of smart cities. These are *smart governance* which integrates across-city and within city governance. The focus is on public-private collaboration in achieving smart objectives including data management and the use of ICT in e-governance in participatory decision-making; *smart economy*, explained to mean ICT enabled manufacturing and services delivery, including local and international. *Smart environment* deals with smart energy being ICT enabled energy grids, green carbon planning, efficient resource use, pollution reduction measures and waste management, green urban planning; *smart people* is explained to mean proper knowledge management and e-skills, ICT, having access to education, human capacity development; and *smart living* means ICT enabled healthy living in a culturally vibrant city with good housing, high social cohesion and social capital.

Finally, *smart mobility* which is of interest to the researcher is explained as ICT supported integrated transport systems. This would include interconnected transport systems such as trams, buses, trains, metro, cars, and cycles with adequate provision for pedestrians. The public is able to access transport information with easy to enable in journey planning and reduction of time waste. In effect, smart mobility enables providers of transportation services to plan adequately for effective services delivery and ensures that users have adequate information on transport services provision.

The IT industry could, therefore, be seen as playing a key role in the transformation of the urban transport sector. Intelligent transport systems have made possible and easy, integrated fare management in the Mass Rapid Transit sector. Technology has also assisted road time traffic management, smart parking, road user charging, personal travel assistant and applications (APPs) (Fishman, 2012). Others like the University of Michigan Transport and Research Institute [UMTRI] and University of Michigan Taubman College of Architecture and Urban Planning [TCAUP] (2011) believe that "the next generation of urban transportation is about connecting transport modes, services, and technologies, bringing diverse innovations together in ways that favour accessibility (meeting needs) over mobility (moving for the sake of moving), and that work significantly better for people, economies and the planet". Smart transportation is viewed as having four quadrants that must be well connected to achieve sustainable mobility and accessibility. These quadrants are service, technology, product/mode, and design. From the point of view of the organisations, there is no single solution to mobility and accessibility in the cities (Figure 1).

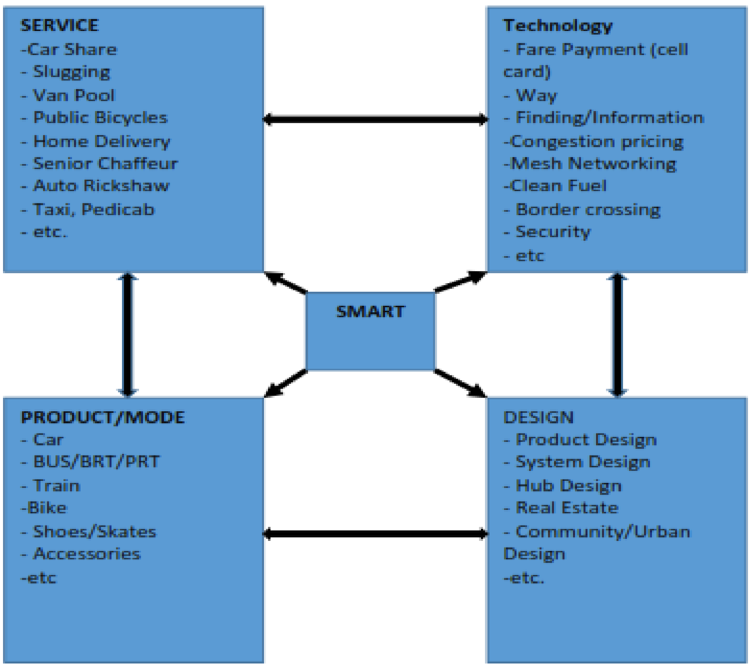

Figure 1: The Four Solitudes

Source: Adopted from UMTRI and TCAUP, 2011

It is explained that operators of different or individual quadrants tend to operate on their own without recognising the complementary role of operators in the other quadrants. Achieving smart and sustainable accessibility and mobility would require harmonisation of the effort of all operators of all the four quadrants (UMTRI & TCAUP, 2011). In some cities, pursuing smart cities agenda, transit stops and terminals are information-rich spaces that are equipped with real-time transit data and wayfinding routes, routes finding elements. Transit units such as trams and buses are furnished with free wifi to customers and report their location. This assists in generating rich data and information on public mobility (ARUP, 2010).

Transit Ridership Determination

The need for improvement and introduction of Mass Rapid Transit has gained public interest recently in Ghana. Public transportation planners and other stakeholders are also interested in justifying investment in public transit services hence the resultant interest in measures to increase ridership. Transport Research Board (2007) argue that increasing ridership is a measure to sustain public investment, justify public policy goals on air quality improvement, reduction of congestion, sustainable energy conservation and mobility for transport-disadvantaged groups. In addition, it is seen as an avenue for the creation of liveable cities, enhanced economic growth and attainment of efficiency in the overall transport system.

Chen, Varley and Chen (2011) explain that studies on transit demand ridership could be classified under micro and macro level studies. Micro-level studies dwell on interpreting individuals' transit use as a function of some independent variables such as family income and automobile ownership. Macro-level studies focus on transit demand as a region-wide phenomenon recorded in time. The object is to determine the impact of macro-level variables such as population and unemployment, fuel prices, and transit fares on transit.

Transit ridership sometimes depends upon the availability of other modes of transit. In situations where there is only one mode of transit, commuters are compelled to use only that mode of transit. Chen et al (2011) observe that a perfect transit network in New York City is a major factor that encourages transit ridership. Transit users in New York are not forced or compelled to use urban transit because of their inability to own an automobile but are rather choice users of transit.

A study to investigate reasons behind the increase in BRT ridership along two corridors in the Los Angeles County revealed that there was reduction in passenger travel times along the two corridors due to a number of measures adopted to improve bus service operating speed such as "bus signal priority level boarding/alighting with low-floor buses, headway rather than timetable-based schedules, fewer stops, far-side intersection location of stations, and joint active manage service". Riders also perceived a leap in service quality improvement in areas such as reliability of service, clean bus interiors, friendly client services, and easy bus identification (United States Department of Transport, 2005, p.17). A study to appreciate the differences in attitude of United States (US) population towards the use of public transit revealed that reduced travel time, closer distances to transit station/stops and reliability of service formed the most important determinants of ridership by all age groups (Transit Centre, 2014).

One other major factor that encourages ridership is the concentration of populations along the corridors of the transit systems. This is especially true of commuter rail systems. Cervero and Guerra (2011) claim that rail transit systems require high passenger volumes to be cost-effective and hence the need for high population concentration zones and jobs around stations.

The Puget Sound Regional Council (2015) addresses transit ridership and services determination from the perspective of the intricate relationship between land use and transportation planning. Their explanation of the relationship is akin to the concept of transit-oriented development that advocates for the creation of mixed-use, densities, employment zones, and residential facilities around transit nodes. The framework explains the relationship between land use and transit as suggested by Puget Sound Regional Council is shown in Figure 2. It is argued that factors such as employment centres, population and housing densities and urban form and design would assist in determining transit ridership.

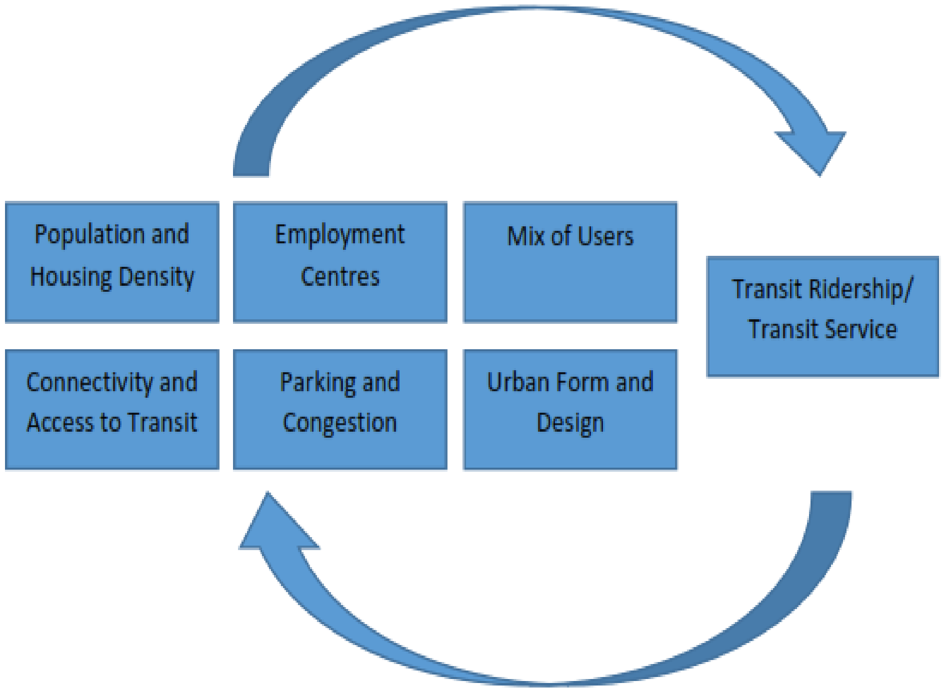

Figure 2: Interdependence of Transit and Land Use
Source: Puget Sound Regional Council: Interdependence of Transit and Land Use (2015)

Santa Clara Valley Transportation Authority (2016) identified the significance of geography in the determination of transit ridership in a study to determine ways to improve ridership in the Santa Clara Valley County. The study identified four geographical features as very important: density, walkability, linearity and proximity. Density (like the study by Puget Sound Regional Council, 2015) is about the concentration of population, workplaces and activity destinations near each transit stops. Walkability focuses on the ease at which people walk from their residents to the transit stops and to places. Linearity touches on how users see transit routes as straight to their destinations. Finally, proximity defines how users perceive transit distance as relatively short. Another factor that was mentioned in the study is the need for mixed land use pattern along the transit corridor.

A report on achieving ridership growth strategy for the city of Toronto noted that transit service that operates in mixed traffic would suffer from providing the needed quality service that would potentially attract large numbers of automobile users to pack their vehicles and join the transit service. Strategies to encourage ridership growth that were proposed included measures to reduce passenger waiting times, reduction of crowding, upgrading of surface routes and targeting some corridors for transit-oriented growth (Toronto Transit Commission, 2003).

There has been an argument in the literature that the density of residential development is an important condition for higher transit ridership. However, Barnes (2005) who worked on the importance of trip destinations in determining transit found out that the density of a residential area alone may not be sufficient to determine an increase in ridership. The characteristics of the areas where transit users work is also seen as very relevant. An increase in the number and density of work locations beyond some point would potentially trigger an increase in ridership to the work locations even without a change in the conditions of the residential area of the workers.

Transport Satisfaction Determination

Performance measurements are very important in transportation planning. They enable transport planners and operators to assess efficient use of resources, equity and assist in the determination of potential problems and to verify the outcomes of targeted performance improvement measures. Performance measurements, therefore, pave way for corrective measures to enhance the overall performance of the system (Deutsche Gesellchaft fur Internationale Zummernarbeit [GIZ], 2011).

Passengers' perception and satisfaction have been regarded as cardinal in the determination of transit service attractiveness. These factors depict passengers' own assessment of the quality of service provided by the transit mode and further, determinants of sustained high ridership (Diab & El-Geneidy, 2014; Mineta National Trust Research Consortium [MNTRC], 2013). Assessing passenger satisfaction with public transit hence becomes very important in determining the quality of service provided by the particular transit mode in question. Olivkova (2015) explains that the quality of transit service has a direct relationship with the use of automobile in cities. The presence of quality transit services has the potential to induce a reduction in the use of automobiles in cities. The use of private automobiles in cities is associated with a number of challenges such as increased number of traffic accidents and traffic congestion which have some negative impact on the flow of mass transit transportation.

Performance evaluation in transport planning could be addressed from different perspectives such as the operator efficiency and from a user-oriented perspective. Popular indicators that assist in operator efficiency measures include load factor and cost-per-vehicle-kilometre. User-oriented indicators assist in developing transit systems that respond and reflect the demands of users and hence have the potential to attract choice riders. These indicators include rider comfort, service reliability, affordability, satisfaction and travel speed (GIZ, 2011).

A study by Khurshid, Naeem, Ejaz, Mukhtar and Batool (2012) on service quality and customer satisfaction in the public transport sector of Pakistan revealed a positive relationship between service quality and passenger satisfaction. Passengers were not satisfied with service conditions such as uncleanliness of bus stops, reckless driving by public transport drivers, picking of passengers at wrong spots along the road, drivers transferring passengers to other vehicles in the course of the journey, and perceived lack of safety by female passengers. Customer satisfaction bridges the gap between what the company intends to offer by way of products and services and the reaction of customers (Fellesson & Friman, 2008).

Mineta National Trust Research Consortium [MNTRC] (2013) in a study on the reliability of bus transit in the District of Columbia, United States of America, identified the key drivers of the decision to use public transit to include access, cost, safety and reliability. It was further explained that riders would perceive transit service as unreliable if there is lack of respect for scheduled times. This would result in long waiting periods and intermittent crowding at stations. The resultant poor quality of service would reflect in the reduction of ridership, revenue and a build-up of running cost with time.

A study on user perception on transit stops and stations in Los Angeles (United States of America) identified out-of-vehicle conditions and services as other elements that influence transit ridership that are very often overlooked. Walkability, the station environment, waiting time, frequency and reliability of service, and perceived safety at the station become very important in determining user satisfaction and hence ridership (Iseki & Taylor, 2010).

Parasuraman Zeithaml, & Berry (1985) used the Gap Model (popularly referred to as the Servqual) to assist in the measurement of service quality. The scale that was developed focused on calculating the differences between expected and perceived services in relationship to five (5) service quality dimensions and twenty-two (22) items under the five broad categories. The five broad service quality dimensions are tangibles, reliability, responsiveness, assurance and empathy. Figure 3 illustrates the Servqual model, depicting the gaps that were identified as very important in the determination of service quality. In explaining the gaps, Parasuraman et al (1985) highlighted that a set of key discrepancies or gaps exists regarding executive perceptions of service quality and the tasks associated with the service delivery to customers (Table 1).

Table 1: Five Broad Dimensions of Service Quality

Dimension	Definition
Tangibles	Appearance of physical facilities, equipment, personnel and written materials
Reliability	Ability to perform the promised service dependably and accurately
Responsiveness	Willingness to help customers and provide prompt service
Assurance	Employees' knowledge and courtesy and their ability to inspire trust and confidence
Empathy	Caring, easy access, good/communication, customer understanding and individualized attention to customers

Source: Adapted from Zeithaml et al. (1990)

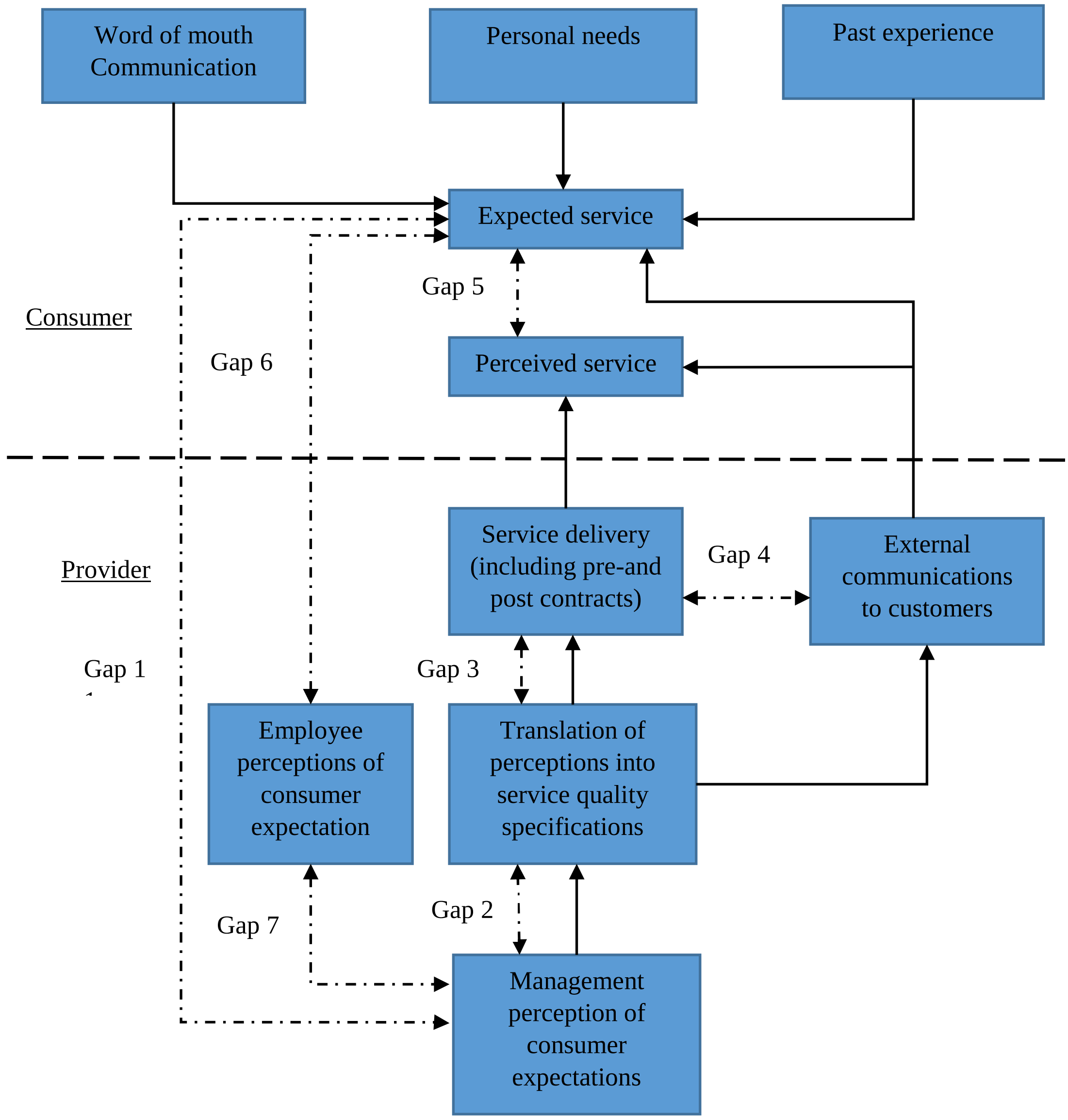

Figure 3: Model of Service Quality Gaps

Source: Parasuraman et al, 1985

The servqual model has been recognised as very important in the determination of consumer and supplier perception of service quality. This stems from the fact that user-oriented indicators of service quality in transport planning include rider comfort, service reliability, affordability, satisfaction and travel speed (GIZ, 2011) which could be seen as gaps from the perspective of the servqual model. Addressing these gaps will therefore translate into improved customer satisfaction and hence increase ridership.

Stakeholder Participation in Transportation Planning

Effective community and stakeholder participation is very important in ensuring the successful execution of projects. It ensures that local expectations are met and serves as an avenue to overcome obstructions that are locally generated. Factors that would assist in achieving this include: community members having a clear understanding of the purpose of the engagement; an accessible and inclusive process that ensures effective contribution by all; the removal of language and cultural barriers that would affect participation; and the effective communication of the processes and the results of the engagement (Sustrans, 2015). In the view of Michigan Department of Transportation (2009) reasons for engaging stakeholders in transportation planning include reducing the risk of late changes to the project, forging partnership, timely conflict resolution, better customer relations, ensuring multi-modal considerations in the planning process and improved community fit .

European Commission (2008) identifies three categories of stakeholders in transportation planning. Primary stakeholders are individuals and organisations likely to be affected by the implementation of the intended project whether positively or negatively. Examples may include establishments and individuals who live, work or spend substantial time near the area under consideration. They usually have a high stake in the project but with little influence on the process. Key stakeholders on the other hand wield great power and influence by virtue of the political responsibility, financial resources, authority or expertise they have. Finally, local champions are identified as stakeholders with greater influence in mobilising resources, forging partnerships due to their expertise and recognition in the society. Stakeholder participation in transportation planning should go along with citizen participation which enables citizens contribute in the debate on the process and project to ensure broader collective decision making (Challenge, 2013).

Engaging key actors in transportation planning has become important in ensuring the sustainability of transport development strategies. The United States Department of Transportation (2005) argue for the inclusion of both the public and the private sectors in transportation planning. It is explained that the public and private sectors have mutual interest in transport related challenges such as traffic congestion and capacity, socio-economic development in general, funding and financing transport infrastructure, public security and environmental issues. Public participation affords transportation officials the opportunity to factor in the contribution of citizens, through channelling pubic investment in transportation to meet the needs of the travelling public, and hence generates positive outcomes including prudent decision making and quality transportation for the movement of goods and people.

One noted example of the collaboration between the private and public sectors in the management of public transportation system is the operation of the Bus Rapid Transit system in Bogota in Columbia. The management of the overall system is under a public company, TransMilenio S.A (IBRD/The World Bank, 2002) which is funded from 3 percent of ticket proceeds. There is a separate company which is selected through competitive bidding for the development and distribution of smart cards, security validation systems, money handling and other intelligent transportation systems. The revenue generated is lodged in a trust fund which serves as a source of payment of operators engaged by TransMilenio SA as per their respective contracts.

In their quest to explain the need for proper public participation in transportation planning, Misra, Gooze, Watkins, Asad, and Le Dantec (2014) advocate for a crowd sourcing approach to public participation. It is argued that very often public participation is the preserve of small groups and this reduces the level of public ownership of the process. A crowd sourcing approach will ensure greater participation by the general public by using maximum input from the masses for enhanced participation in transportation planning. Misra et al. (2014) further explain that in recent times the decrease in citizens' participation could be attributed to the over reliance on community meetings which would definitely price out a number of potential contributors with time and location constrains. The use of modern technology is seen as an avenue to encourage crowd sourcing. Measures proposed include the development of project websites and web-based meetings and discussions.

International Finance Corporation [IFC] (2007) advocates for the commencement of stakeholder consultation at the beginning of project conception before implementation of project. Such proactive relationship building serves as capital for difficult times of project implementation. Furthermore, such consultations build more trust and is more sustainable than consultation of stakeholders during challenging times of project implementation. Potential stakeholders may not be willing to associate with a company in crises during such consultations in the midst of challenges.

The European Commission (2008) explains that stakeholder analysis should not be a one-time event in the planning and implementation of a project but should be carried out repeatedly with scenarios and policy options becoming clearer. In some situations, changing circumstances may call for re-assessment of the role of stakeholders.

Urban Transportation Models

Urban transportation modelling is seen as an integral part of the urban transportation planning process. "A transport model is a simplified representation of a complex transport system. A good transport model should be based on sound economic theory, and be able to capture elements considered important for particular applications" (Commonwealth of Australia, 1998, p.1).

Sivakumar (2007) explains that the need for travel demand models was recognised by urban planners and researchers as early as the mid-19th century with the introduction of mass economic analysis involving the spatial flow of commodities. Initially, urban planners and researchers focused on aggregate approaches in predicting spatial flows and movement such as the entropy and gravity-based models. A more systematic and sequential way to estimating travel demand based on aggregate approaches was introduced during the mid-twentieth century being the 4-step model. The period also saw the recognition by urban planners of the delicate relationship between transport network and the rest of the urban system. This fuelled the development of integrated land use-transport (LU-T) models in the 1950s and 60s. Transportation demand models are important in predicting "the travel needs of the population by mode, time of day, duration and location". Some models also take into consideration not only the travel needs of individuals but also of businesses and organisations (Sivakumar 2007, p1). The transport sector is very important and contributes to a substantial amount of urban energy consumption. To assist in taking stock of the energy used by the urban transport sectors, travel demand models assist in making the necessary predictions about the travel behaviour of individuals and organisations (Sivakumar, 2007).

The Four-Step Transport Model

The travel model that is comprehensive enough to address the variables in this study is the four-step transport modelling process. The four major steps are trip generation, trip distribution (travel demand), mode split, and trip assignment as shown in Figure 4.

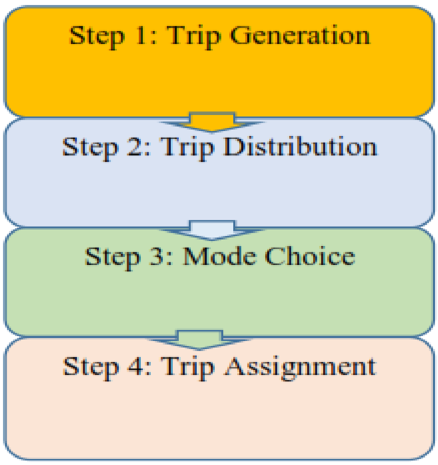

Figure 4: The Four-Step Transport Model

Source: McNally, 2000

Step 1: Trip Generation

As the first step in the 4-step transportation model, trip generation is concerned with the determination of the current trips in the planning area in question. The amount and type of travel in the planning region is explained by the land use of the area. The amount of travel in a region is a function of factors such as household size, income, ownership of automobile and density and category of development. One important element that influences trip generation is the quality and availability of public transportation (Transport Research Board, 2008).

It uses average trip rates to quantify trips made in the study area. The purposes for the trips may be classified under home-based work, shopping, education, recreation and other trips. Trip generation sometimes changes based on the transport network under consideration for both road and public transport networks (Transport and Infrastructure Council [Australia], 2015).

STEP 2: Trip distribution

The second step, trip distribution, deals with where trips that are generated at the first step (trip generation) end. Trip distribution relates trip productions to the attractions related to each zonal pair. The important factors in the analysis of trip distribution include trip length and travel orientation and the associated traffic density and passenger volumes (Transport Research Board, 2008).

In discussing trip distribution, the level of activity of the transport zone becomes very important. An individual is likely to travel to a transport zone with a high level of activity that is closer than to a distant place with low level of activity (activities may include employment, shopping or recreation). The most common measure for trip distribution is the gravity model. The model explains that the number of trips between zones is a function of the level of land use and activity within each zone and the ease of journeying between the zones (University of Minnesota Centre for Transportation Studies, 1999).

Step 3: Mode Choice

The third step distributes the origin-distribution trips that were generated from the trip distribution analysis (under step 2) to the various travel modes between the zones according to the purpose of the trip. The step analyses the selection of a particular mode of travelling by the trip maker based on some indicators such as income, car ownership and age of the trip maker; characteristics of the trip itself by way of trip purpose, origin and destination; and the general characteristics of the travel mode. This stage leads to an estimation of travel by all modes between all transport zones, and by different trip purposes (Commonwealth of Australia, 1998).

Step 4: Trip Assignment

The last stage determines the routes used by travellers to access their destination. This step however takes into consideration only motorised trips, being public transit and trips by automobile/car. Trips made with private vehicles and trucks are classified as "traffic assignment" and assigned to the highway network whereas public transit trips are classified as "transit assignment" and assigned to the transit network. (Metropolitan Washington Council of Governments, 2017). The results generated at this stage could serve as an avenue to assess certain deficiencies in a transport system; assist in performance assessment of the transport system; evaluate transport-based project proposals; evaluate transport and land use policies; and serve as the basis economic appraisal (Transport and Infrastructure Council [Australia], 2015, p.22).

Conceptual Framework for the Study

The study reviewed a number of frameworks on transportation planning to identify a framework that contains the necessary variables of urban transportation that the study reviewed. The study settled on the input-output framework for urban transport interventions (International Bank for Reconstruction and Development/The World Bank, 2010) as shown in Figure 5. The framework attests to the fact that transportation is not an end in itself but rather a means to an end or a combination of ends. It therefore becomes difficult to consider a single objective taking cognisance of the relevant constraints and trade-offs. Generally, an urban transportation system would require many inputs which generate outputs that could be classified as desirable or undesirable that in turn influence the inputs. The inputs could be classified as desired inputs that could be controlled to some level and independent inputs that are not subject to control. The desired inputs include policy, legislation and regulations; institutions; physical systems, technology, and spatial planning; stakeholders; and economic and financial aspects. The independent inputs that are not subject to control include geographic constraints; demographic and economic conditions; climatic and atmospheric conditions; and social norms and historical practices.

The desired outputs could be seen as project development outputs or indicators for monitoring and evaluation of transportation interventions. In other words, these are objectives to be maximised being: mobility, accessibility, quality, efficiency, safety and affordability. These desired outputs are the product of transport interventions that focus on land uses and travel demand management, infrastructure and services delivery and management of vehicle fleet and fuel supply. There are however, undesired outputs or externalities that should be minimised to ensure sustainable transportation interventions. These undesired outputs include, costs that are associated with implementation and life-cycle of projects, accidents and related issues, global and local emissions, and the impact on land, water, and energy consumption.

Desired Inputs

One important element of desired inputs, which could be controlled to some extent, is the policy, legislative and regulatory framework. The national policy, national development framework documents, legislation and some local legislation and regulations, both at the meso and micro levels, assist in shaping urban transportation. To achieve sustainability, such policies, legislature and regulations would require institutions, processes and financial mechanism that would promote public transportation, non-motorised forms of transportation and de-emphasise the use of individual private vehicles. At the sub-national level, measures that would assist in the effective implementation of policies, legislation and regulations include integrated transport and land use plans, public transport services regulations, zoning, taxation and financial mechanisms.

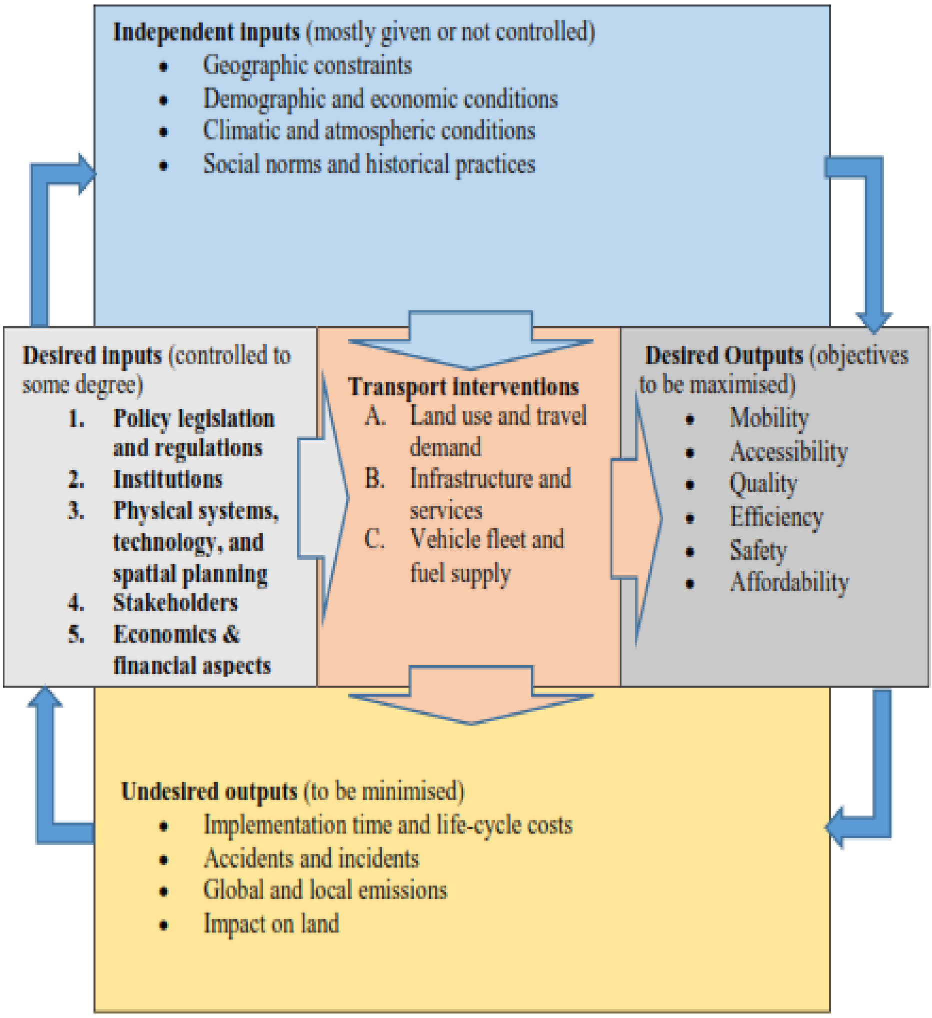

Figure 5: The Input-Output Framework of Transport Interventions

Source: International Bank for Reconstruction and Development/The World Bank, 2010

Strong and efficient institutions are required for effective planning, implementation of transportation plans and strategies and for management and regulation. The scope of the institution in question will depend on whether it is planning for a city, major corridor or a comprehensive regional plan. Planning and financing functions of the institutions include public transportation network planning, pedestrian and bicycle accessibility and facilities planning, roadway investment and maintenance plans, budgeting, financing and decision on standards. At the implementation and service provision level, there is emphasis on physical integration, integrated transport strategy and private sector participation. Management and regulatory functions of institutions include traffic, parking, road access, freight management; regulation of public transportation and taxis; and planning for intermodal and multimodal optimisation.

One other desired input that is worth mentioning in the framework is physical systems, technology and spatial planning. Transportation planning should be continuous, multi-stakeholder, and inclusive process. Spatial planning should take into consideration the current travel and freight demands and future land use.

Transport Interventions

Land use planning could be seen from two perspectives being: macro level master planning which involves a relatively larger area and long term planning, spanning over ten (10) years and micro level planning which involves a smaller area and short to medium term planning. Transportation planning should consider the impact of transportation interventions on future land development and on travel demand. Spatial planning could be seen as a tool to induce changes in demand, the choice of transport mode and financing of urban transportation investment. Micro level planning tools such as transit-oriented development and densification have the tendency to influence travel demand. Density and mixed-use areas have the capacity to reduce the number of travel distance for services. Such developments also encourage the use of bicycles and walking. Conversely, low density urban areas encourage the use of automoblies and serve as a disincentive to multimodal sectoral plans. It must also be explained that unplanned high-density areas also affect the quality of life of inhabitants negatively.

Prudent spatial planning takes into consideration the location of infrastructure and services. Transportation infrastructure development is sometimes used as tool for mobility management. The aim is to enhance the supply of infrastructure and to induce modal shift. The most popular mobility intervention is road development. This would however work effectively when complemented with other investment in measures such as public transportation, traffic management, road safety, non-motorised forms of transportation and intelligent transportation systems. One other important transport intervention is investment in measures that would enhance efficient fuel usage and reduction in fuel consumption

The conceptual framework was operationalised in the study by the identification of the desired inputs and outputs for efficient Mass Rapid Transit (MRT) implementation in the Greater Accra Metropolitan Area (GAMA). It assisted in the identification of the regulatory framework and stakeholder institutions for MRT in the GAMA. The analysis of the framework further assisted in giving the necessary recommendations and policy options.

Summary

The chapter commenced with a discussion on two concepts that underpin the New Urban Agenda with emphasis on urban mobility and transportation planning being Liveable Cities and Smart Cities. Transit ridership determination was discussed to serve as the theoretical basis for analysing factors that would encourage ridership of MRT systems in GAMA. The discussion on transit satisfaction determination necessitated the introduction of the service quality model to serve as the basis for later analysis on customer perception on the services of the Commuter Rail Transit (CRT).

The chapter further discussed stakeholder participation in transportation planning which dwelt on the importance of participatory urban transportation planning. The write-up on urban transportation models gave a brief explanation of the Four-Step Transport Model. The chapter ends with a detailed clarification of the conceptual framework of the research, the input-output framework of transport interventions. It touched on both the desired and undesired inputs and outputs as well as the requisite transport interventions.

CHAPTER THREE

APPROACHES TO URBAN TRANSPORTATION

Introduction

The chapter deals with empirical issues in urban transportation planning. It addresses approaches to urban transportation planning as used in different countries. The intricate relationship between land use planning and urban transportation is explained showing its importance in encouraging densification, non-motorised forms of transportation and reduction of congestion. Transit Oriented Development is presented as a perfect example of the relationship between land use and transportation planning.

The importance of modal choices and modal interconnectivity for enhanced mobility and efficient use of transportation systems is explained under intermodal and multimodal transportation planning. The chapter further gives a detailed explanation of Mass Rapid Transit (MRT), touching on empirical cases of the implementation of MRT in selected cities around the world.

Urban Transportation Planning Process

The United States Department of Transport [USDT] (2005) explains that transportation planning is about "identifying opportunities to improve mobility for the people and businesses who use transport systems; it is about providing accessibility to everyone in your community". It is also about analysing the current transportation problem and how to develop options to solve future transportation problems. Transportation plans are usually of the long term because transportation systems are very often designed to last for many years, usually 20 years or more.

Explaining the transportation planning process, the US Department of Transportation used the performance-based planning approach (usually used in strategic planning or organisations). The process begins by asking the critical question of where and how far one wants to go: a particular approach that incorporates public decision in the derivation of broad strategic vision for the metropolis or region. How to get there assists planners in identifying trends and targets, analyse alternative scenarios based on reliable data and information and comparative analysis of similar past projects. What will it take to get there helps identify plans, programmes and critical investment required to achieve the set goals and objectives. Finally, how did we do will assist in evaluating how options identified help in meeting project goals (USDT, 2005).

There have been attempts to distinguish between mobility and accessibility-based transport planning. Mobility based transport planning considers evaluating transport systems using indicators such as traffic speed and vehicles operating costs while ignoring delicate accessibility factors. Accessibility based transport planning however takes a broader perspective, considering factors such as alternative modes, accessibility land use patterns and improvement in mobility.

Another form of transportation planning is Sustainable Urban Mobility Planning (SUMP). It is about urban mobility planning for the future of the city with people as the focus. Its ultimate goal is sustainable urban transportation development. Sustainable Urban Mobility Planning is therefore defined as “a strategic plan designed to satisfy the mobility needs of people and businesses in cities and their surroundings for a better quality of life. It builds on existing planning practices and takes due consideration of integration, participation, and evaluation principles" (European Union, 2011b, p.6). There is emphasis on the creation of sustainable urban transportation system by ensuring accessibility by transport systems, ensuring safety and security; conscious effort to reduce pollution and emissions of greenhouse gases and promoting energy efficiency; improving cost effectiveness of transportation goals and services; and should also aim at contributing towards the quality of urban environment and design and attractiveness of the metropolis.

The positive outcomes of SUMP include more attractive public spaces, improved city air quality, reduction of noise and air pollution, safe roads and a better opportunity to tackle climate change. Other positive outcomes include an improved city image, an opportunity for planners to reach more people to attend to their mobility needs and improved city's competitiveness to attract investment (European Union, 2011b).

In the United States, regions or states develop long-range statewide transportation plans for the entire state and rural areas. Metropolitan Planning Organisations (MPOs) develop short term transportation plans based on the vision of Long-Range Statewide Transportation Plans called Transportation Improvement Programme (TIP) which is usually updated every four years. Each state also develops a Statewide Transportation Improvement Programme (STIP) which is consistent with the Long-Range Statewide Transportation Plan. After the transportation plan has been completed, the project development process starts. Projects are subjected to environmental assessment as demanded by the National Environmental Policy Act [NEPA].

One major challenge to urban transportation planning in cities is how to integrate urban mobility planning and urban development. In Mexico, the federal government promotes urban mobility planning through the preparation of Integrated Sustainable Urban Mobility Plans (ISUMP) to help finance infrastructure. These plans focus on designing and attaining the desired finances for the introduction of Bus Rapid Transit corridors. These plans are however, at variance with taking a comprehensive consideration of mobility of the entire city and its complimentary relationship with urban development. There is hence a dichotomy between urban development and mobility.

Integrated Transport and Land use Planning (ITLUP)

There are a lot of competitive needs for urban spaces. The need of urban space for housing, commercial activities, green spaces and roads often leads to sub-urbanisation and its negative impacts on agriculture land. Land use planning is able to influence spatial distribution of structures in the urban neighbourhood and hence assist in reducing vehicle kilometres travelled and increase high transit share. Densification and mixed-use that are associated with integrated land and transportation planning assists in promoting non-motorised modes of transport (GTZ, 2004). Integration of urban land use planning and transport policies enables local authorities to effectively reduce the need to travel, improve transport modes with affordable and efficient public transit systems and manage traffic to curb congestion which is a major challenge of city dwellers (IBRD/ The World Bank, 2013).

Conventional planning focuses on mobility rather than on accessibility. In such situations, solutions to urban transport problems tend to focus on highway expansion with little attention to non-motorised forms of transportation. Highway expansion often leads to sprawl with its resultant effects on the reduction of land accessibility and an increase in the length of distance people need to travel to reach their destinations (Litman, 2013a). European Commission (2006) argues that the one major characteristic of land use policy that is designed to support transport policy is the focus on higher density development, mixed land use development, and the promotion of public transportation with limited on-site parking provision.

Integrated land use and transportation planning assist in the traffic management in cities and the reduction of congestion. The National Urban Policy framework document recognises that “the urban transport and traffic congestion issue is due mainly to the absence of Integrated Land-Use and Transportation Planning (ILUTP), including (i) a continuous survey of the origin and distribution of traffic entering the city and large towns; and (ii) parking needs studies” (Ministry of Local Government and Rural Development [MLGRD], 2012a). It is further explained that the Department of Urban Roads has been engaged with the introduction of new link routes and the redevelopment of roads but little achievement is made in the reduction of traffic congestion and general improvement in urban transportation because of the absence of Integrated Land use and Transportation Planning (Ministry of Local Government and Rural Development [MLGRD], 2012a).

The delicate relationship between land use and transportation planning could be well appreciated by evaluating the outcome of land use and transportation planning. If the outcome is sprawl development, it leads to dispersed, low density and a land use pattern that is automobile-dependent.

Conversely, smart growth leads to more compact, mixed use and a land use pattern that encourages multi-modal transport use (Litman, 2013a). High density zones with mixed land use around public transport nodes improve ridership of public transport systems and hence make them more viable. In Hong Kong areas with high density attracts 85 percent of trips to be made with public transit whereas areas with low density could attract as low as 35 percent and below trips made with public transit (UN-Habitat, 2013a).

The outcome of transport-land linkage is sometimes contingent on the type of infrastructure that is involved and the zoning status of the area under consideration. The construction of a new road to the outskirts of a metropolis may generate low density residential neighbourhood and industrial development whereas the construction of a rail link to an inner-city low-density neighbourhood may spark the development of a medium density zone (Government of South Australia, 2013). Transit systems that are radial in nature and oriented towards the central business district of cities help keep downtowns economically vibrant (IBRD/The World Bank, 2013). The Transport and Infrastructure Council (2016) explains that a city's approach to infrastructure development can help change the pattern and growth of the city. This would invariably influence location decisions of individuals for residence and of businesses. This will alter the value of estate and of land in different segments of the city. The market forces would thus determine where intensification of urban development that is required, creating a new urban form and structure. This consequently implies that major transport initiatives in the city should be looked at from the perspective of a preferred urban structure as against the traditional approach of transport infrastructure responding to evidenced demand.

The incorporation of Mass Rapid Transit (MRT) into the city system has implication for planning. It would require the creation and protection or right-of-way and space for depots and terminals development. It may also call for redefinition of zoning and the level of densification in some parts of the city. In cities with urban subway (metro) systems, the growth of the central business districts is sustained by the presence of the metros. The high capacity of the metro assists in carrying passengers regularly to the central business district to sustain growth and economic activities (International Bank for Reconstruction and Development/The World Bank, 2002).

Transit Oriented Development

The need to account for non-work travel in transportation planning is partly attributed to its importance in relation to transport and land use policy. Transit Oriented Development (TOD) has been seen as a policy response to the myriad challenges of urban land use and transportation such as traffic congestion, environmental pollution and growth (Nelson, Niles & Hibshoosh, 2000). The California Department of Transportation (2002) defines transit oriented development (TOD) as "moderate to higher density development located within an easy walk of a major transit stop, generally with a mix residential, employment and shopping opportunities designed for pedestrians without excluding auto". Centre for Community Innovation [CCI], (2009) similarly defines Transit Oriented Development as "a planning and design trend that seeks to create compact, mixed-use, pedestrain-oriented communities located around new or existing public transit stations".

Transit oriented development aims at achieving sustainable land use planning and transportation planning. It aims at creating "walkable and sustainable land use communities for people of all ages and incomes and providing more transportation and housing choices (including downtowns, apartments, live-work spaces, and lofts). It opens avenue for a lifestyle that is affordable to all income groups, creates a social environment for children to play and comfortable abode for the aged. TOD creates a friendly neighbourhood for non-motorised modes of transport such as biking and walking, boosts the use of Mass Rapid Transit, increases densification and mixed use of land and urban space (Reconnecting America, 2010). Transit Oriented Development (TOD) could be seen as an avenue to achieve liveable communities. The mixed development that is associated with TOD enables walking without the use of automobiles and increases the sense of community among residents.

Transit Oriented Development has achieved successes in a number of cities in the world such as Copenhagen, Curitiba, Denver and Hong Kong (ITDP, 2013). One element that is important for a successful TOD is equity. A conscious effort to make housing affordable to middle income and low-income groups along the transit corridor will assist in TOD meeting the desired objectives. In Curitiba, the government subsidised the construction of homes designed to incorporate low income housing schemes into TOD. The government assisted in the provision of housing schemes for 17,000 families. The Bus Rapid Transit (BRT) network covers 90 percent of the city, with inhabitants not walking more than 500 metres to access mass rapid transit services. It has been estimated that about 28 percent of houses are along the transit corridor (Institute for Transportation Development Policy Mexico [ITDP Mexico], 2013).

One other interesting TOD best practice case is found in Portland, Oregon's Pearl District. Transit Oriented Development implementation assisted in changing the outlook of the area from a warehouse district to a liveable, mixed-use, walkable community with affordable housing and mass transit options (Carlton & Fleissig, 2014). Portland also feature a success story of Public Private Partnership (PPP) in transit and land use planning. The Pearl District neighbourhood was developed along a streetcar transit line. The owner of a 40-acre land signed an agreement with city authorities to upgrade the density of housing units from 15 dwelling units per acre to 125. The area attracted many residents and jobs leading to further development of a second vacant land (Reconnecting America, 2010).

The City of Calgary's TOD implementation forms part of the broader agenda of Advancing Smart Growth. The city has a vibrant Light Rail Transit (LRT) system, which is comprised of 32.7 km operational tracks on three lines with 33 stations and 11 downtown platforms. To assist in the development of TOD, the city made amendments to land use zoning and provided the necessary infrastructure. There was also emphasis on maximising the efficiency of land use by having new housing schemes close to transit stations with mixed-use to encourage varied transit pedestrian mobility choices. The TOD policy also favoured the integration of employment, residential and commercial facilities of both public and private nature make the stations more vibrant (The City of Calgary, 2004, p.5).

In order to combat urban sprawl in the Western Australian State capital of Perth (with a population of 1.4 million dispersed along an area of 130 km along the coast) the State government pursued a policy that would integrate urban land use and transportation planning. Transit Oriented Development zones have been planned and implemented along new railway lines and bus stations in the city with both public and private participation. These 'Network Cities' have three main elements. Activity corridors are developed along arterial roads or railway corridors, using land area of 400m on each side of the transport nerve. Activity centres are noted for employment, commercial and services centres with medium to higher density residential facilities within walking distances to public transport nodes. Transport corridors on the other hand serve one or more activity centres and provide inter-urban transit services (Curtis, 2009).

Transit oriented development transportation planning sometimes face opposition from community members who express fears about their perception on the project. Such negative perceptions are borne out of fears such as lowering of property values, overcrowding, pressure on public facilities and the fear of unwelcomed groups into neighbourhoods. This calls for an inclusive planning process that is very participatory enough to build the confidence of community members in order to marshal the necessary support for a successful TOD (Centre for Community Innovation [CCI], 2009). Similarly, the need for community participation in TOD planning and development. Major stakeholders outlined for consultation in TOD planning include local residents, neighbourhood organisations, businesses, transit agencies and local government.

Centre for Transit-Oriented Development (2012) argues that the success of TOD planning will depend on how it is made attractive to different categories of users. It should be attractive to families, singles and all age groups. To help achieve this, planning for TOD corridors should aim at creating complete communities. Such communities put premium on complete streets where children can run bike in streets and with improved pedestrian lanes. There is also emphasis on transit-accessible schools which are well incorporated into community planning and accessible and high-quality transit to employment zones. Finally, there is emphasis on accessible and transit to commercial zones and libraries.

Intermodal and Multimodal Transportation Planning

With the emergence of new transportation options and priorities, attention has been drawn to the need to focus on modal choices and connectivity for enhanced mobility of goods and people and for maximising the efficient use of existing transportation facilities. This is where multimodal and intermodal transportation systems become issues of importance. The American Association of State Highway and Transportation Officials (AASHTO) define intermodalism as “the systematic merging of different modes of transportation into a single functional system for movement of freight or passengers”. Examples of intermodal systems include airline passenger who continue their journey from the airport of disembarkation with bus or rail transit, and commuters who park their private vehicles at transit terminals and continue their trip via bus or rail transit (Southwest Region University Transportation Centre, 1995, p.2).

Intermodal transportation enables various modes of transportation to operate in an interdependent manner; it incorporates various modes and transportation services to achieve efficiency in the entire transportation value chain (Bektas, Crainic & CIRRELT, 2007). For a perfect intermodal system, some key issues that should be given the deserved attention are connectivity, co-ordination and co-operation. There is also the need for efficient transfer terminals to ensure quick and easy transfer of passengers from one transportation mode to another. To assist in achieving this objective, intermodal transfer terminal planning would require the coordination and maximum co-operation of all the unimodal transportation authorities that would be operating at the terminal (Southwest Region University Transportation Centre, 1995, p.2). The Ghana Integrated Transport Plan document advocates for a collaboration of agencies for different modes of transport to ensure co-ordination of actions and projects to ensure modal compatibility and for passengers to make effective use of intermodal transportation facilities (Ministry of Finance and Economic Planning, 2010).

The city of Tucson, Arizona, has implemented a strategy to ensure a well-coordinated intermodal transportation system. The introduction of bicycle racks on buses encourage bicycle users to patronise the buses. Bicycle users ride to the bus station, pick the bus to a specific destination and continue with the bicycle. Provision has also been made for easy accessibility of buses by wheel chair users. All new buses have low-floors with wheelchair ramps and mechanisms to reduce slopes to make buses accessible to the disabled. The city has park-and- ride facilities to encourage the use of public transit. The facilities have parking lots for vehicles and bicycles racks. To encourage walking from communities to transit stations and bus stops, tens of miles of sidewalks have been constructed in the city (Pedestrian and Bicycle Information Centre [PBIC], 2000).

Multimodal transportation refers to the presence of several modes of transportation. In general, multimodal transportation can be categorised as either passenger- or freight-oriented (University Transportation Centre for Alabama [UTCA] (2003, p.1). Litman (2013b) sees the growing interest in multimodal transportation system as being in line with the shift in focus from the reductionist approach to transportation planning, that is devoid of a holistic approach to addressing transportation problems, to a win-win approach that takes a comprehensive look at all the modes of transportation and all other transportation-related issues.

Multimodal transportation planning is combined with sustainable land use planning to achieve results that would ensure accessibility to all modes of transportation. The city of Bellingham's (Washington, USA) Multimodal Transportation Concurrency regulations ensure the integration of urban transportation and land use planning to guarantee adequate infrastructure for the use of pedestrians, bicycle users, transit riders and other vehicle users. The long-term objective is to facilitate a modal shift to reduce the number of trips made by single occupant vehicles, and promote pedestrian walking, bicycling, and the use of mass rapid transit (Comeau, 2009).

One important element in multimodal transportation planning is giving users or travellers the desired and necessary information to assist them in their personal trips planning and usage of different modes of transport. The use of information technology has in recent times been very helpful to the dissemination of transit information to transit users. The multimodal journey planner (JP), an Information Technology (IT) system that enables users to have access to information about which transport modes are available for specific travel routes and times in some countries in Europe, has enabled users to have options about transport modes and to plan journeys systematically (European Commission, 2011a).

Mass Rapid Transit

Deutsche Gesellschaft fur Technische [GTZ] (2005) defines Mass Rapid Transit (MRT) as “a passenger transport service, usually local in scope that is available to any person who pays a prescribed fare” . One major characteristic of MRT is that it usually operates along specific tracks or exclusive right to use some potential common track. This is usually based on some assigned schedules, specific routes and stops. It must be explained that the Bus Rapid Transit (BRT) sometimes operate under mixed traffic with other road users. Mass Rapid Transit is explained to include Heavy Rail Transit (using electrically powered rail cars with exclusive right of way, usually without grade crossing, with high platform stations (GTZ, 2005). Commuter Rail systems are suburban railway operation for passengers within assigned areas of an urban area and suburbs. The difference between the commuter rail and the other rail system such as the light rail transit and metros is that passenger cars are generally heavy with lengthy trips. The commuter rails also use the tracks that are used by the general railway system (GTZ, 2005).

Another MRT system, the Light Rail Transit (LRT) is an electric railway system noted for its ability to use short trains or single cars and has "exclusive right-of-way at ground level, aerial structures, in subways, or occasionally in streets, and to board passengers at track or car floor level" (GTZ, 2005, p.2).

One MRT service that is of interest to this study is the Bus Rapid Transit (BRT) which "typically involves busway corridors on segregated lanes –either at-grade or grade separated-and modernised technology". A number of common characteristics of BRT include rapid boarding and alighting, efficient fare collection, clean buses and comfortable shelters and stations. Others are sophisticated marketing industry, excellent customer services and modal integration (GTZ, 2005, p.2). Bus Rapid Transit is most often associated with segregated lanes. The Institute for Transportation and Development Policy [ITDP], (2007) defines BRT as "a high-quality bus-based transit system that delivers fast, comfortable, and cost-effective urban mobility through the provision of segregated right-of-way infrastructure, rapid and frequent operations, and excellence in marketing and customer service" . The difference in cost between the BRT and metro construction is estimated at 10 to 100 times less for BRT.

A full BRT system also has characteristics such as busways in the median of the roadway rather than in the curb lane; integrated network routes or corridors; enhanced stations that are secure, and weather-protected; stations that provide level access between the platforms and vehicle floor (see Figure 6). Other conditions include pre-boarding fare collection and fare verification; entry to the system to prescribed operators under a reformed business and administrative system; fare-and-physical integration between routes, corridors and feeder services and distinctive marketing identity for systems (ITDP, 2007).

Figure 6: A full BRT System in Bogota, Columbia
Source: GTZ, 2007

There are some Bus Rapid Transit systems and other bus services that may not have all the qualities of BRT but assist in the provision of improved bus services and improved travel time to users such as busways and enhanced bus services (ITDP, 2007). Some cities have busway services that predates the BRT services. In the United States, busways have been used in some cities to provide express services to the cities centres along freeway corridors.

There is also the need to acknowledge the role of enhanced bus services in the provision of efficient bus transport services in some cities. These services otherwise referred to as ‘BRT Lite’ use the same lanes or run amongst mixed traffic. These services are popular in Europe and North America. There are bus services in cities such as Hong Kong, Boston (USA), Las Vegas (USA), London, Vancouver (Canada) and York (Canada). The enhanced measures include pre-board fare collection, enhanced driver training, priority lanes measures, real-time information displays at stations and quality incentive contracts with concessioned operators. Other measures are high standard customer service, signal priority at intercessions, fare machines at stations, colour coding and camera enforcement (ITDP, 2007). There are BRT Lite systems in some African cities including Lagos, Johannesburg, and Cape Town (Cervero, 2013). In their observation on the importance of priority intersections/signals, Agarwal Sharma and Singh et al (2010) noted that giving preferred treatment to buses at designated intersections enhances bus travel time reduction.

Bieger (2011) examined a number of the successful conditions for the implementation of BRT in Colorado and Gianesville in the USA. Using the conditions for the success of BRT in Curitiba, Brazil, Bogota in Columbia and Eugene in Oregon, the writer developed a Pre-Implementation Evaluation Criterion (PIEC) for BRT. The conditions developed included an already existing public bus system, concentrated employment densities, incorporation of inter-modalism, federal funding sources and other methods of funding (excluding federal grants). Other factors included strong BRT sensitisation campaign, a stable and/or growing population and adaptable road infrastructure. The author concluded that the conditions enumerated above were necessary for the implementation of a BRT system.

Another MRT system that is of interest to this study is Commuter or Suburban rail services “mostly provided by general railroad companies who share track with freight and long-distance transport” (GTZ, 2005, p.15). Commuter trains should be distinguished from Light Rail Metro System (LRMT) which are urban rail transport solutions that use electrically powered coaches (known as rolling stock) to transport customers between fixed stations” (IBRD/World Bank, 2010, p.11). While in theory, the number of passengers should relate to the number of seats, in some developing countries, the trains take more than the assigned number of passengers. The railway lines usually follow the radial system and are oriented towards the city centre. Well noted cities with commuter trains are Mumbai, Bueno Aires and Johannesburg. In Mumbai, about 6 million passengers are carried by commuter trains each day (GTZ, 2005).

Rehabilitation and improvement in the urban railways show positive cost-benefit ratios and could be classified as a pro-poor transport measure due to its ability to serve the poor who live in the suburban areas of the city. The most significant challenge of the commuter railway is institutional and it pertains to commuter railway systems that are run by government institutions. Such publicly run commuter railway systems tend to suffer from neglect, given low priority and face powerful road lobby. They are also poorly co-ordinated with other modes of public transport (GTZ, 2005).

Some Empirical Case Studies of MRTs

The TransMilenio of Bogota, Columbia

Established in 2000, the TransMilenio of Bogota in Columbia, aimed at addressing the inefficiency of the public bus system, public safety, reduction of pollution, and sustainability of public bus transport (IDS, 2007). It is characterised by buses using dedicated lanes, large capacity buses, raised stations and rapid boarding and pre-boarding ticketing. The project was implemented with a combined component of reducing the network of private bus companies (IDS, 2007).

The TransMilenio is under the management of a public transit authority Transmilenio SA. The Company is responsible for the award of contracts to private operators. The government is responsible for the construction of busways and station infrastructure. The bus companies (operators) are responsible for the purchasing of modern buses to operate and the provision of drivers (Centre for Clean Air Policy, 2012). The operations fleet centre manager manages and monitors bus movements, updates passengers on bus schedules and keeps data and information on buses. The buses are linked to the operation rooms by Global Positioning System (GPS). Stations are 500 metres apart and passengers have access to stations through overpasses, tunnels or intersections traffic lights (Energy Sector Management Programme [ESMP], 2009).

Initially, the reaction of the traditional bus operators to the introduction of the BRT bus operation was not encouraging. There was the fear of loss of business, the huge financial investment they have to make to acquire modern buses, lack of confidence in government completing the project and the fear of retiring of old operators. These problems were resolved through dialogue with the existing operators being allowed to own shares and bid for the operation of the bus routes (Centre for Clean Air Policy, 2012).

The TransMilenio assisted in reducing travel time significantly by 25 percent and the value of property along the routes soared by 15 to 20 percent, increasing tax revenue, creating jobs and with enhanced health and safety for the community (Centre for Clean Air Policy, 2012). The TransMilenio (BRT) has assisted in replacing over 9000 old inefficient buses with 200 high capacity centrally co-ordinated buses. The BRT system has dedicated lanes and feeder networks that have been integrated into the main system. There is an integrated fare system that enables free transfers. In spite of its implementation challenges, passenger ridership increased from 94 million persons in 2006 to 134 million in 2009 (UNFCCC, 2010).

The BRT in Bogota was complemented by an urban environmental improvement programme. Informal vendors were relocated from the public streets. An urban greening project was embarked upon with renovation of city parks, avenues and restriction of parking along sidewalks by raising the sidewalks and installing bollards (Centre for Clean Air Policy, 2012).

In a critical evaluation of the TransMilenio Bus Rapid Transit in Bogota, Moller (2010) observed that many cities have BRT systems that are based on the TransMilenio model. An attempt was made to compare the high floor buses used by the TransMillenio as against the low floor buses of Cali in the south-east of Columbia to include the high cost of maintenance of exclusive lanes, the challenge of financing new busways, protests from users against the high level of dissatisfaction. Moller (2010) also posited that the high cost of user fees leads to social exclusion and hence not a pro-poor policy. The low-floor buses of Cali (usually for 60, 100 or articulated buses for 160 passengers) have the advantage of using every street with street pavement without necessarily construction of resistant bus lanes to accommodate them.

The BRT System in Lagos, Nigeria

The need for BRT in Lagos was based on the fact that the transport infrastructure that was meant for a population of 6 million served an increasing Lagos population for some two decades. Transport cost formed a sizeable proportion of expenditure and congestion further increased the plight of residents of the city (Amiegbebhor & Dickson, 2014). The Lagos 'BRT-Lite' scheme began operation on 17th March 2008. It is a form of BRT that cannot measure up to the standard of the TransMilenio of Bogota. The construction cost of the Bogota system is estimated at $6 million per kilometre whereas the Lagos BRT Lite cost an average of $1.7 million. The Lagos BRT Lite carries almost 200,000 passengers a day. It consists of a 22 km route with 65 percent physically segregated and 20 percent detached from the main road system by road markings (Integrated Transport Planning Limited [ITP], 2009).

After the completion of the Lagos BRT-Lite in 2000, an evaluation revealed that users were saving time, reduced the number of transfers and made savings in the cost of travelling and felt more secured with the introduction of BRT. A number of businesses along the corridor recorded improvement with workers getting to their workplaces on time and experiencing a reduction in the travel time to do business. Negative sentiments recorded revolved around the need to expand the system and increase the fleet.

The conclusion of the evaluation report was that the scheme had been successful (IBRD/World Bank, 2009).

Factors that contributed to the success of the scheme included the attainment of the desired political will to implement the project, the presence of a well-established transport authority (Lagos Metropolitan Area Transport Authority [LAMATA]) and the concentration of the scheme on the needs of users, due recognition of the role of major stakeholders, ensuring efficiency in the use of budgetary allocation and a conscious effort at community engagement (IBRD/World Bank, 2009). Integrated Transport Planning Ltd [ITP] (2009) explained that the success of the Lagos BRT-Lite could not be associated with the use of separate lanes alone but also to other complementary activities such as organisational restructuring of the bus industry, bus purchasing financing, creation of the requisite institutional regulatory framework to support it, human resource development including training of drivers and management training (ITP, 2009).

The MRT System of Johannesburg, South Africa

The Johannesburg BRT system was initiated in 2006 and the first BRT system started operation in Rea Vaya in 2009. With a population of 4.4 million, population growth rate 3.4 percent, an apartheid legacy of rich and poor neighbourhoods, the introduction of the BRT was seen as an avenue to obtain social harmony and good integration between economically vibrant areas of the city and other adjoining neighbourhoods. The first phase of the project carried 43, 000 passengers per day(City of Johannesburg, 2013).

The Rea Vaya is the first fully implemented BRT system in Africa. Its implementation was partly necessitated by the need to ferry football fans around the city during the 2010 (19^{th}) FIFA World Cup in South Africa. One of the initial challenges was the resistance from the local taxi minibus operators. The resistance was due to the fear of losing their source of livelihoods although their services were quite unregulated. The first phase (Phase A) involved a 25.5 km service from Soweto to the Central Business District of Johannesburg. It has five (5) feeder services and two complementary routes. It is operated by 143 buses (with 43 articulated buses operating on dedicated routes and 10-13m long buses operating on complementary and feeder routes. The fare structure that is in place is slightly lower than that of the normal minibuses. Passengers are assisted at each station by three staff with information about the operation of the buses. There is a central control system to monitor the movement of buses (Heather, 2013).

Writing on the socio effects of the Rea Vaya, Rahim (2014) observed that commuters of the BRT who were previously using the city taxis were satisfied with the customer care that was exhibited by the drivers and other workers of the Rea Vaya. Passengers witnessed an improved attitude of drivers of the BRT. They, however, emphasised the need for further training of drivers in customer care and relations. Generally, commuters found the Rea Vaya tend to be punctual and reliable. They explained that in spite of the fact that the buses stop operations after 18.00 hours during weekends, buses do not break down and hence reliable.

One important feature of Mass Rapid Transit in South Africa is the construction of the Guatrain. A public-private-partnership (PPP) of 80km rapid rail system initiative between the government of South Africa and private entities: Bombela consortium and local firms, Murray and Roberts. The project is expected to significantly reduce the travel cost and time between the Pretoria and Johannesburg transport corridor and reduce motorised transport (Global Mass Transit Report, 2009). Commuter rail in Johannesburg is operated by Metrorail. The rail network connects major suburbs of the city with the city centre. The current network does not adequately fit the current residential and economic nodes of the city. However, some major destinations that were not served by the commuter train network are currently serviced by the Guatrain (Johannesburg Transport Department, 2013).

Mass Rapid Transit in Guangzhou, China

One important mode of Mass Rapid Transit in Guangzhou is the Guangzhou Bus Rapid Transit. The project was designed through a collaboration between ITDP-China and the Guangzhou Municipal Engineering Design and Research Institute (GMEDRI). This constituted planning, engineering designs and implementation from the project conception in 2005. The Guangzhou BRT commenced operation in 2010 with an average ridership of 28,000 passengers per hour and a daily ridership of 850,000 passengers (Guangzhou BRT, 2016). The BRT covers a 22.5-kilometre corridor, one of the busiest avenues of the city, Zhongshan Avenue.

The primary aim of implementation of the BRT is to reduce congestion along the corridor and to improve upon the viability of bus transportation in the city. Institute for Transportation and Development Policy (ITDP) estimates the gains in reduction of travel time for passengers and bus drivers to be 29 percent and 20 percent respectively (IBRD/The World Bank, 2013).

The Guangzhou BRT has been designed to encourage intermodal transportation. A bike sharing system enables passengers to use a bicycle for the last stretch of their route (see Figure 7). There are 113 stations for a total of 5, 000 bikes. It is estimated that about 20,000 people use bikes daily (ITDP, 2011). The BRT is also integrated with the metro transport system of the city. Some BRT stations have direct tunnel connection to the metro subway stations (ITDP, 2011).

One peculiar feature of the Guangzhou BRT system is the operation of an open system where buses operate both along the main BRT corridor and outside the corridor. This enables passengers to reduce the number of transfers and it also assists in offsetting the problem of construction of interchange stations (IBRD/The World Bank, 2013; Zeng, Lu, Guo, & Ma, 2013).

The operation of the bus involves a number of companies who have a contractual agreement for service provision. The operating companies are paid based on a percentage of the passenger revenue which is related to the number of bus-kilometres driven and adjustments made for service quality and performance calculated monthly (IBRD/The World Bank, 2013 &, ITDP, 2011).

Figure 7: Bicycle Sharing Station in Guangzhou

Source: The Institute for Transport and Development Policy [ITDP], (2011).

With a total capital cost of US $ 103 million or US 4.5 million per kilometre, the Guangzhou BRT enjoys a lower cost of construction that is about one-tenth to one-twentieth of the recent capital cost of metro construction in some Asian cities (ITDP, 2011).

The BRT is expected to contribute towards sustainable urban development by linking some well-developed areas of the city to areas of expected future growth. The BRT busway of 22.5 kilometres is fully segregated with 26 stations and 31 bus routes. All the BRT stations have been designed to have overtaking lanes and this encourages the operation of express routes and multiple sub-stops. Passengers pay for bus fares at station-entry turnstiles and not aboard the bus. Stations and buses have been designed with intelligent transportation systems to provide information on bus arrival schedules and for enhanced monitoring of buses within a centralised control system (ITDP, 2011).

Istanbul Mass Rapid Transit, Turkey

Istanbul Bus Rapid Transit (Metrobus) is the most vibrant BRT system in Europe. The BRT currently operates a busway of 52 km with a daily passenger rate of 800, 000 (Istanbul's Metrobüs, 2015). Bus Rapid Transit in Istanbul was constructed under four (4) phases. The first phase which commenced operations in 2007 was an 18.2 km route length. The first phase was evaluated as being very successful in the reduction of the use of small private motor vehicles, increased ridership and reduction of CO_2 emissions via the introduction of high-tech buses and the reduction of low-tech buses. Subsequently, Phase II started operation in 2008 along an 11.8 km route. Phase III which straddled the Asian and European sections of the city was commissioned in 2009 and had a length of 11.5 km route. The last phase (Phase IV) started operation in 2012 along a 9.7 km route. This brings the total length of the BRT route in Istanbul to 52 km with 44 stations (Cengiz, 2017).

Metrobus operated a 24/7 bus schedule with an operating speed of 35km/hour, Metrobus assists in an average time reduction of 52 minutes per day for the user when compared with other modes of transport. In an evaluation of the services of Metrobus, the BRT scored 70 out of a total of 100 points using internationally accepted BRT standards. Indicators used in the evaluation included "the quality of the bus lane design, the number and length of routes, the information services offered, and the integration with other modes of transport like metro, light rail, conventional buses, and minibuses" Istanbul's Metrobüs, 2015)

The Metrobus operates under a fully segregated route system in the middle of the highway except along the Bosporus bridge section of the corridor. The average number of passengers by weekday is estimated at 872,527. The BRT has a commercial speed of 35 km/h. There is a pre-boarding fare collection system with the use of smart cards by passengers before accessing the platforms (Cengiz, 2017).

The Metrobus is operated by Istanbul Elektrik Tramvay ve Tünel (IETT). The choice of a BRT system was based on the ease of construction and the need to reduce the disruption of the current traffic system. The success of the Metrobus BRT system has led to the consideration of operating a BRT system in the tunnels alongside the light rail system (Transport Cooperation Research Programme [TCRP], 2011). The travel time along the total length of the busway is estimated as 63 minutes. Riders pay a pre-boarding one-way fare of 1.65 Turkish lira ($ 1.04). The busway has 33 stops (TCRP, 2011).

One major objective of BRT along the main D-100 highway that links the Asian and European sections of Istanbul was to ensure a fast, reliable and comfortable bus service for small private vehicle owners to help reduce the use of private motor vehicles along the corridor. This would help achieve another important objective of reducing greenhouse gas emissions in the city. BRT account for 6 percent of road transportation by mode in Istanbul (Cengiz, 2017).

MRT and Implications for the Study

The empirical review of MRT systems under operation unearthed a number of issues that are important for consideration in the planning and implementation of MRT. In the main, BRT systems lead to an appreciable reduction in the commuting time of workers to work. Businesses along BRT corridors have experienced some level of improvement. This is evident in the Bogota, Johannesburg and Lagos BRT corridors. The introduction of BRT in Johannesburg also led to commuters witnessing improvement in passenger satisfaction.

One objective of BRT implementation is the reduction of traffic congestion and greenhouse gas emissions. The implementation of the TransMilenio led to the replacement of 9000 old buses with 200 high capacity and efficient ones with reduced greenhouse gas emissions (UNFCCC, 2010). The important role of Public Private Partnership in the implementation of MRT also surfaced. The need to make MRT implementation pro-poor also came to the fore. Moller (2010) pointed out that the high user fees charged by the TransMilenio reduce the ability of the BRT to be pro-poor and hence the project is not a good ambassador of social inclusion. There is, therefore, the need for MRT projects to have pro-poor and social inclusion objectives.

Dialoguing plays a very important role in overcoming fear and misconceptions about MRT projects from the perspective of the transport operators. The review also highlights the need to engage stakeholders from the early stages of project inception. This will enable them to have a clear view of the project objectives and intended outputs and outcomes. It also affords them of the opportunity to be well versed in their expected roles, commitment and responsibilities. It is also an avenue to assure transport operators of the intended partnership the project is proposing and their expected corporate responsibilities.

Organisational restructuring and capacity building are vital ingredient in the BRT implementation. Building the capacity of local transport operators for efficient operation and financing helped the BRT systems in Bogota, Guangzhou and Lagos. The social element in transportation planning and implementation such as punctuality, the attitude of drivers and customer care is seen as requisite for a successful MRT. Furthermore, the necessary political will and leadership are important for MRT implementation. This is confirmed by BRT implementation in Lagos and Bogota where strong leadership and political will provided the desired catalyst for project implementation. The intermodal approach by the Guangzhou MRT system attests to the fact that planning MRT would require a holistic approach that takes multimodal and intermodal systems into consideration.

Summary

The chapter covered some empirical issues in urban transportation planning. It explained the urban transportation process with a focus on its different dimensions. There is a discussion on the intricate relationship between urban land use and transportation planning which centred on Integrated Transport and Land use Planning (ITLUP) and Transit-Oriented Development. Further, the chapter addresses intermodal and multimodal transportation planning. Finally, the chapter reviews Mass Rapid Transit (MRT), explaining the basic characteristics and providing empirical examples of the implementation of MRT in some selected cities.

CHAPTER FOUR

RESEARCH METHODS

Introduction

The chapter focuses on the research philosophy and the methodology of the research. It explains the research design and justifies the reasons for the adoption of the descriptive approach. The study area and the characteristics of the study area with regard to transportation, the focus of the research, are introduced. This is followed by an explanation of the target population, sampling procedures and data collection procedures. The chapter ends with data processing and analysis procedures and challenges encountered during the fieldwork.

Philosophy of Research

The study employs the pragmatic approach in that it dwelt on both the positivists and interpretivists' research approach. Positivism is related to foundationalism which is the belief in the real world that is quite independent of our knowledge. The real world is also seen as the foundation of our knowledge. This position of ontology is prominent in research in the social sciences. The positivist view advocates that it is possible to acquire knowledge about the world unmediated. This makes room for objectivity in research (Poetschke, 2003). The foundationalists are linked to quantitative methods of research (Marsh & Furlong, 2002). Two of the objectives of the research: 'determining the factors that would potentially motivate small private motor vehicle users to use Bus Rapid Transit system' and 'assessing the perception of users of the pilot Commuter Rail Transit system in Accra on its performance' required a survey and quantitative analysis. It involved the conversion of data to a numerical form and subjecting it to statistical analyses (Babbie, 2008, p.443).

The interpretivists do not accept the position that the world exists independently of our knowledge. They uphold the notion that the world is socially or discursively constructed, taking an anti-foundationalist ontological stance (Marsh & Furlong, 2002, p.26). The interpretive research paradigm involved qualitative research with the use of methods such as in-depth interview, observation and more qualitative data. Two of the objectives of the study: 'exploring the institutional arrangements for effective Mass Rapid Transit in Accra' and 'investigating the available infrastructure for the Mass Rapid Transit in Accra' required a qualitative research approach which involved the "examination of social research data without converting them to a numerical format" (Babbie, 2008, p.415).

Research Design

The study adopts a cross-sectional and descriptive research design. Kothari (2004) explains descriptive research to include "surveys and fact-finding enquiries of different kinds" and utilising methods such as comparative and correlation methods. The study was a cross-sectional study because it involved a sample of the actual population that was measured at a particular point in time (Bhattacherjee, 2012). The descriptive study became a preferred research design due to the large sample sizes that were involved in different aspects of the research. The objectives that were related to 'determining the factors that would potentially motivate small private motor vehicle users to use

Bus Rapid Transit system' and 'assessing the perception of users of the pilot Commuter Rail Transit system in Accra of its performance' demanded the collection of large sample sizes and quantitative analysis. The study employs both quantitative as well as qualitative methods which are allowed in descriptive research (Tavakoli, 2012).

Study Area

The study area for the research consists of the 13 Metropolitan, Municipal and District Assemblies that operate under the Greater Accra Passenger Transport Executive (12 in the Greater Accra Region and Awutu Senya East Municipality in the Central Region). Additionally, the Nsawam-Adoagyiri Municipal Assembly in the Eastern Region was also included because of the Nsawam-Accra commuter train corridor (Figure 8).

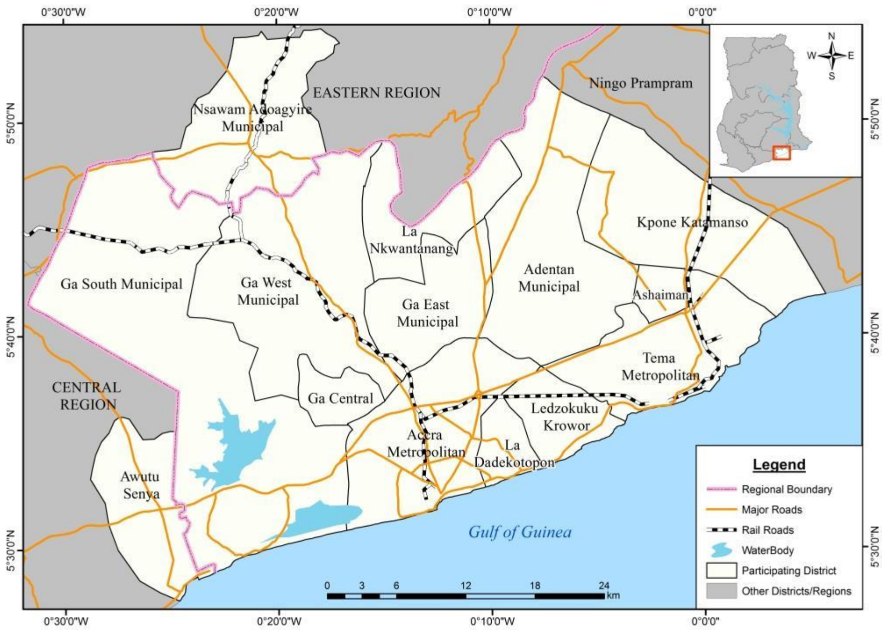

Figure 8: Map Showing Study Area
Source: GIS and Cartography Unit, Department of Geography and Regional Planning, UCC, 2016.

Socio-Economic Characteristics of the Study Area

The study harbours the area referred to as the Accra city-region in the National Spatial Development Framework. The area accounts for 25 percent of Ghana's Gross Domestic Product and leads or is second in total non-primary sector economic activities. It is situated at the heart of West Africa's economic corridor and is interconnected by sea, air and highways from Abidjan to Lagos (Government of Ghana, 2015a).

The Greater Accra Metropolitan Area (GAMA) is very important in the share of economic activities in the country. The area has the only vibrant international airport in the country, boasts of the most developed infrastructure and benefits from the advantages that accrue from the agglomeration of businesses and services and large labour market. The area also attracts 84 percent of Foreign Direct Investment (FDI) (Government of Ghana, 2015b).

The study area has eight (8) of the twelve (12) most economically viable MMDAs with regard to contribution to the national output. These MMDAs contribute nearly a fifth (19%) of the national GDP with the Accra Metropolitan Area (AMA) alone accounting for nine percent of total national GDP (Government of Ghana, 2015c). Accra could be classified as a primate city with regard to its population, political and socio-economic characteristics (Yankson & Bertrand, 2012).

Doan and Oduro (2011) explain that the peri-urban zones in Accra have lately experienced an increased rate of housing development by residents of the city, expatriate Ghanaians, and other migrants to the city to solve their accommodation problems. Another feature is that development in the peri-urban areas of GAMA has been beyond the control of planning authorities leading to haphazard development. It has been observed that Accra has been experiencing urban sprawl with the development of new urban areas in the peri-urban zones of the city. These new urban areas have large residential houses with insufficient urban infrastructure (Akubia, 2016).

Demography

The GAMA area is noted for being an attractive destination for internal migration. The region has a net migration of 32 percent (Government of Ghana, 2015c). This makes a study on Mass Rapid Transit important to assist in transportation research and planning for the area. The total population as per information from the 2012 Ghana Population and Housing Census is 3,950,845 with 1,911,758 (48.4%) males and 2,039,087 (51.6%) females as shown in Table 2. Accra Metropolitan Assembly has the highest population of 1,665,086. This is followed by Ga South Municipal Assembly with 411,377 and the district with the lowest population being Adenta Municipal Assembly with 78,215.

Table 2: Population of MMDAs in the Study Area

MMDA	Total Population	Male Population	Female Population
Accra Metropolitan	1,665,086	800,935	864,151
Adenta Municipal	78,215	39,366	38,849
Ashiaman Municipal	190,972	93,727	97,245
Ga Central	117,220	57,321	59,899
Ga East Municipal	147,742	72,987	74,755
Ga South Municipal	411,377	201,222	210,155
Ga West Municipal	219,788	107,742	112,046
Kpone-Katamanso District	109,864	53,376	56,488
La Dade-Kotopon	183,528	86,738	96,790
La-Nkwantanan-Madina	111,926	54,271	57,655
Ledzokuku-Krowor	227,932	109,185	118,747
Tema Metropolitan	292,773	139,958	152,81
Awutu-Senya East*	108,422	52,197	56,225
Nsawan-Adoagyiri*	86,000	42,733	43,267
Total	3,950,845	1,911,758	2,039,087
		(48.4%)	(51.6%)

Source: Ghana Statistical Service (2010)

Transportation Systems of the Study Area

Some decades ago the state was the prime operator of public transport services in the city of Accra. The economic crises that the country experienced in the early 1980s contributed to the collapse of public transport operations in the country. The Ghana Private Road Transport Union and Taxi Drivers

Association assumed the role of providing a private transportation system for the country. These associations use mini-buses, shared taxis and private cars in their operations. They are, however, not able to meet the demand for transport services during the peak hours of the day (Adanu, 2004, p.5).

The metropolitan area accounts for about 25 percent of the urban population in the country, 50 percent of the national vehicle fleet and a density of approximately 1150 persons per square-kilometre (Norwosoo, 2006, p. 39). The transport environment in the study area is "characterised by heavy congestion particularly during the peak periods, low vehicle utilisation, weak implementation of traffic management measures, inadequate facilities for pedestrians and bicyclists, poor road safety arrangements and high accident rates" (Norwosoo, 2006, p.2). About 70 percent of person trips in the area rely on bus related vehicles that utilize less than 15 percent of the road space whereas individual private vehicles and taxis, which account for less than 30 percent of the person trips, utilize 70 percent of the road space (The World Bank, 2006).

Accra city is associated with vehicular traffic congestion which manifests itself especially during the peak hours of the day. The city relies heavily on the services of informal private buses and is saddled with poor traffic management, inadequate planning for non-motorised forms of transportation and poor road safety measures with its associated high accident rates (Global Environmental Facility, 2013; Abane, 1993).

Norwosoo (2006) observes that public transportation in Accra is similar to what pertains in the rest of the country. About half of journeys to work is completed with one of the different types of buses that operate in the city. These buses are characterised by having no fixed bus stops and schedule times although some may have specific routes that they operate. Shared taxis account for about 15 percent of work trips and 10 percent by small private vehicles. The number of persons who make work trips by walking constitute 25 percent. One area of concern is the small percentage (less than 3 %) who use bicycles or motorcycles. This could be attributed to the climate and concern for safety along the city's road corridors.

The Choice of the Study Area

The choice of the Greater Accra Metropolitan Area (GAMA) as the study area has been motivated by a number of factors. The study addresses the implementation of Mass Rapid Transit (MRT) and hence there was the need for a city with a multimodal MRT system. The operation of the Commuter Rail Transit and lite Bus Rapid Transit (BRT) system projected the city as the obvious choice for the study. National development policy also favour Accra as a city for the implementation of Mass Rapid Transit in the country (Ministry of Finance and Economic Planning, 2010; Ministry of Local Government and Rural Development [MLGRD], 2012a); Ministry of Local Government and Rural Development [MLGRD], 2012b; Ministry of Transportation, 2008).

The myriad of transportation challenges that the GAMA area is facing such as traffic congestion, vehicular pollution, unregulated informal transport operators, and lack of proper provision for non-motorised forms of transportation presented the Accra as a city in search of a viable transportation solution and MRT as an alternative to the current system. It should also be noted that the addition of Awutu-Senya-East Municipal has been motivated by the inclusion of the Municipal area to the BRT project and the being one of the MMDAs under Greater Accra Passenger Transport Executive (GAPTE). The Nsawam-Adoagyire Municipal has also been added because of the Nsawam-Accra Commuter Rail Transit.

Target Population

The target population for the study involved two categories of commuters in the Greater Accra Metropolitan Area. The target population is explained to mean ‘a group of individuals (or a group of organisations) with some defining characteristic that the researcher can identify and study’ (Creswell, 2012). The first involved commuters who use personal small private vehicles to work in Accra. This assisted in meeting the objective of ‘determining the factors that would potentially motivate small private motor vehicle users to use Bus Rapid Transit system’.

The second category involved commuters who use Commuter Rail Transit in the Greater Accra Metropolitan Area. These commuters use the two commuter train corridors being the Nsawam-Accra and Tema-Accra corridors. This assisted in meeting the objective of ‘assessing the perception of users of the pilot Commuter Rail Transit system in Accra of its performance’.

A number of stakeholder institutions were also consulted to assist in meeting the objectives of ‘exploring the institutional arrangements for effective Mass Rapid Transit in Accra’ and; ‘to investigate the available infrastructure for the Mass Rapid Transit in Accra. The categories of stakeholder institutions that were consulted are explained in Table 3.

Table 3: Stakeholder Institutions Consulted

Name of Institution	Forms of Stakeholder Involvement
Ghana Private Roads Transport Union (GPRTU)	Major private transport operator in Ghana
Amalgamated Bus Rapid Transit Company Ltd.	-do-
Co-op Transport Association	-do-
Ministry of Transport (MOT)	Transport management and policy
Ministry of Roads and Highways (MRH)	Roads and highways planning and management
Department of Urban Roads (DUR)	Urban roads planning and management
Town & Country Planning Department (TCPD)	Urban land use and spatial planning
Greater Accra Passenger Transport Executive (GAPTE)	Management and co-ordination of Accra Pilot Bus Rapid Transit
Ghana Railway Company (GRC)	Railway operation and management
National Development Planning Commission (NDPC)	National development policy planning

Source: Agyemang (2016)

Sample Size

A sample survey was adopted because of its cost-effectiveness and the greater speed with which data is gathered as it deals with only a subset of the population rather than the entire population (Levy & Lemeshow, 2008). Sample size determination involved two stages: first was the determination of sample size to meet the objective of 'determining the factors that would potentially motivate small private motor vehicle users to use Bus Rapid Transit system' of which a sample size of 400 was projected. This figure was arrived at with the use of Yamane (1967) sample size determination formula.

The target population for the objective involved commuters who use personal private small motor vehicles to work in the Accra Metropolis. There was the need to get the total number of small private motor vehicles that were roadworthy or in use in Accra from the office of the Driver, Vehicle and Licensing Authority (DVLA). The registered number of roadworthy small private vehicles in the Accra offices of the DVLA is provided in Table 4. Small private motor vehicle is explained to mean private motor vehicle with up to 2000 cubic capacity.

Table 4: Road Worthy Small Private Motor Vehicles in Accra, 2014

Sub- Station	Number of Small Private Vehicles
Accra	12268
Tema	13587
Weija	79807
Total	105662

Source: Driver, Vehicle and Licensing Authority [DVLA] (2015)

A total number of 400 was therefore arrived at as the sample to meet the objective as stated above (see Appendix A). To enable greater power for effective analysis additional 50 was added to arrive at a sample size of 450 for that specific objective (the response rate was, however, 430).

The second stage involved sample size determination to meet the objective of ‘assessing the perception of users of the pilot Commuter Rail Transit system in Accra of its performance’. Two Commuter Rail Transit (CRT) corridors were involved: the Tema-Accra and Nsawam-Accra corridors. These corridors were treated separately because their respective commuters have different socio-economic characteristics and the coaches and rail lines in the two corridors similarly, exhibited different characteristics. Sample size determination was carried out separately for the two corridors.

To assist in the calculation of the sample size for the Tema corridor, the average number of train passengers for a week was obtained from the Ghana Railway Company. This figure was given as 3138, Using Yamane (1967) sample size calculation formula, the sample size for the corridor was calculated to be 354 (Appendix A). To enable greater power for effective analysis additional 50 was added to arrive at a sample size of 404 for that specific objective (the response was, however, 400).

Similarly, Yamane (1967) sample size determination formula was used to determine the sample size for commuters using the Nsawam-Accra corridor CRT. The average number of train passengers for a week was given by the Ghana Railway Company as 8664. The sample size was found to be 382. Additional 50 was added to enable greater power for effective analysis. This generated a sample size of 432 with a response of 430. The total sample size was therefore 1286 (for the BRT survey and for Tema and Nsawam CRT surveys) with the actual response being 1266, generating a response rate of 98.44 percent.

Sampling Procedures

The sampling procedure was categorised according to the different objectives of the research. The first involved 'determining the factors that would potentially motivate small private motor vehicle users to use Bus Rapid Transit system'. To assist in getting a wider coverage of the city, cluster sampling was used in dividing 'inner Accra' into five (5) main cluster zones, based on the five (5) main transit terminals and centres of the city. The five main cluster zones were (i) Achimota terminal and its environs (Achimota, University of Ghana, Tesano area); (ii) Tema Station, Accra central, and its environs (Ministries, Okaishie, Tudu); (iii) 37 Military Hospital terminal and its environs (Cantonments, Airport, Airport residential); (iv) Kwame Nkrumah transport terminal and its environs (Circle, Adabraka, Kokomlemle,); and (v) Kaneshie terminal and its environs (Kaneshie, North Kaneshie, Abosse Okai).

Quota sampling was used at the next stage for dividing the sample size of 450 by five (5) to get the actual sample size for each of the five zones. This generated a sample size of 90 for each of the five (5) selected cluster zones. In each of the five (5) zones, snowball and accidental sampling techniques were employed in getting small private motor vehicle users to respond to the questionnaires.

With regard to the objective: ‘assessing the perception of users of the pilot Commuter Rail Transit system in Accra of its performance’, commuters from the two Commuter Rail Transit corridors in Accra (the Nsawam-Accra and Tema-Accra) were purposively selected for the survey. The on-board survey was used and passengers who were regular CRT commuters were accidentally selected for the survey.

Stakeholder organisations that were needed for the other two objectives of exploring the institutional arrangements for effective Mass Rapid Transit in Accra; and investigating the available infrastructure for the Mass Rapid Transit in Accra were purposively selected. The institutions were selected based on their functions, level of influence and legitimacy, implementing and co-ordinating roles. They included government ministries in charge of transportation policy formulation, planning and implementation; implementing and oversight agencies; transport operating companies; and local government and regulatory agencies (as explained in Table 3).

Data Collection Instruments

The study used a mixed method approach hence data collection instruments employed reflected the methodology employed. The questionnaire was used to gather data for the quantitative analysis. The questionnaires had both closed and open-ended questions. The first set of questionnaires was for the objective of 'determining the factors that would potentially motivate small private motor vehicle users to use Bus Rapid Transit system'.

The first section consisted of 13 questions and centred on the background characteristics of respondents, including the location of their residence and workplace. The next section dealt with issues that were related to the make, characteristics, operation and vehicle maintenance (eight [8] structured questions in all). Section three (3) consisted of a set of 25 Likert scale questions to assist in determining factors that would potentially motivate small private motor vehicle users to pack and join BRT. The questions were subdivided into three (3) sections: 'condition of buses and bus lanes', 'terminal development', and 'customer care'. Finally, two open-ended questions gave an opportunity for respondents to list in order of importance, five (5) factors that would motivate them to use BRT or MRT in general, and five (5) factors that would hinder them from using BRT or MRT in general (see Appendix B).

The next set of questionnaire was to help address the objective of assessing the perception of the current users of the Commuter Rail Transit

(CRT) of its performance. The questionnaire consisted of two (2) main sections. The first section dealt with the background information of respondents and this comprised of 20 questions. The next section consisted of 35 Likert scale questions. The questions were classified into sub-sections being 'train operation', 'train services', 'condition of coaches', 'terminal development' and 'customer care'. Finally, two open-ended questions offered the opportunity for respondents to express their impression of the challenges of the CRT operations and to suggest recommendation to address the challenges identified (see Appendix C).

Qualitative data collection involved the use of an interview guide. The first interview guide was for transport operating organisations. It involved 15 open-ended questions and a table to help the respondents to explain the 'horizontal' relationship between different transport operating organisations and the 'vertical' relationship between transport operating organisations and other transport related organisations (see Appendix D).

Another interview guide was used to access information from urban transportation planning institutions. This comprised of 12 open-ended questions and a table to help explain the horizontal relationship between different transport organisations and the vertical relationship between urban transportation planning institutions and other transport related institutions (see Appendix E).

Data Collection/Fieldwork

Data collection commenced with a pre-testing of the questionnaire to assess its validity. Two stages were involved in the pre-testing exercise. First, was the pre-testing exercise aimed to assist in assessing the questionnaire for the objective of 'determining the factors that would potentially motivate small private motor vehicle users to use Bus Rapid Transit system'. The pre-testing exercise was carried out in the Central Business District (CBD) of Kumasi, Adum, during the month of November, 2015. One week was devoted to the pre-testing exercise and it involved the administration of 55 questionnaires. Alpha Cronhbach test (r = 0.93) showed that the questionnaire was reliable. The pre-test showed that respondents were not selecting the neutral option on the 5-point Likert scale. The Likert scale was therefore collapsed into to a 4-point scale Likert scale (i.e. Strongly Disagree, Disagree, Agree, and Strongly Agree).

The second pre-testing exercise involved assessing of the questionnaire for the objective on 'assessing the perception of users of the pilot Commuter Rail Transit system in Accra of its performance'. This was carried out in the month of December, 2015. The pre-test involved the administration of 30 questionnaires each from the Nsawam-Accra and the Tema-Accra corridors. The alpha Cronhbach test (r = 0.82) showed that the questionnaire was reliable. One outcome of the pre-test was the need to treat the two corridors differently because of differences in the railway infrastructure and the socio-demographic characteristics of passengers from the respective corridors. There was also the preliminary survey of institutions to identify relevant institutions for stakeholder consultations and in-depth interviews.

The actual survey took place in the first quarter of 2016. First was the survey to assist in meeting the objective of ‘determining the factors that would potentially motivate small private motor vehicle users to use Bus Rapid Transit system’. The researcher and four (4) research assistants were involved in the survey. Inner Accra was purposively divided into five (5) cluster zones based on the main transit terminals being areas in and around Tema station in Accra, Kwame Nkrumah Circle, Achimota terminal, 37 Military Hospital terminal, and Kaneshie terminal. Two (2) working days were used to gather data through accidental and snowball data gathering techniques in each of the clusters, giving a total of 10 working days.

The second survey was to meet the objective on ‘assessing the perception of users of the pilot Commuter Rail Transit system in Accra on its performance’. The researcher and four (4) research assistants were involved in this survey. An on-board survey approach was used in this exercise. In order to ensure completion of the questionnaire before respondents alight from the train, each respondent was provided with a questionnaire, envelope and a pen for the exercise. This enabled many commuters, who were willing to fill out the questionnaire, to complete the process before alighting at their destination. Others who were not able to complete the process later gave the completed questionnaire to the train conductors or the research team, the next time of boarding the train in the sealed envelope. The survey team also assisted respondents who could not read or understand the questionnaire to complete the exercise. The team spent five (5) working days each collecting data from the two Commuter Train Corridors hence a total of 10 days was used for the survey.

Qualitative data gathering from stakeholder institutions took a number of weeks because of the need to meet administrative bureaucracy requirements and the difficulty in meeting some key officers because of their heavy schedule. This involved in-depth interviews. The respondents were mainly officers in charge of planning, monitoring and evaluation from the transportation-related government Ministries, the National Development Planning Commission, and the Town and Country Planning Department. For information related to the Bus Rapid Transit, the Department of Urban Roads, the Greater Accra Passenger Transport Executive (GAPTE) and the three (3) transport companies that have signed an agreement with GAPTE for the operation of the pilot Lite BRT system in Accra became relevant. The in-depth interview also involved the Ghana Railway Company.

An interview guide was used which enabled the researcher to ask relevant questions and to probe further by asking other leading questions. Permission was sought from the interviewees for the use of tape recorders. This enabled the researcher to get a lot of information from the interaction. The researcher also recorded relevant issues into a reporter’s note pad to serve as a back-up of the recorded information.

Non-participant observation was also employed by the study. This enabled the researcher to observe at first hand, the location, nature, state and condition of the infrastructure of the BRT/CRT. The observation involved site visits to BRT/CRT stations, transect walk by the research team to sections of the railway and bus routes, and recording actual GPS location of stations to assist in the generation of bus and train route maps.

Participant observation also involved on-board train observation to experience the nature, mode of operation as well as witness the state of facilities of the train. Observation checklist (Appendices F & G) and field notes were employed in recording the observation information. Photographs were also taken to assist in the description of facilities where necessary.

Data Processing and Analysis

Due to the nature and the research instruments employed in this study, different analytical techniques were employed in analysing the data. Content analysis was used for analysing the qualitative data whereas descriptive statistics such as frequencies, percentages, means and standard deviations were calculated for all the nominal data and other characteristics of the respondents. A Spearman's rank-order correlation was used to analyse the association between the variables. These relationships were tested at the significant level of 0.05 (95% confidential level).

With regard to specific objectives on exploring the institutional arrangements for effective Mass Rapid Transit in Accra; and investigating the available infrastructure for the Mass Rapid Transit in Accra, content analysis was employed in discussing the issues and relating them to other policy issues and working examples in the world.

The other two objectives demanded quantitative analysis. These objectives dealt with determining the factors that would potentially motivate small private motor vehicle users to use Bus Rapid Transit system and assessing the perception of users of the pilot Commuter Rail Transit system in Accra of its performance. The approach involved ranking the factors to assist in selecting the factors that ranked high among the listed factors with the aid of means and standard deviations in each sub-division.

A Spearman's rank-order correlation was used to analyse the relationship between ordinal variables with three or more levels such as average monthly income and cost of maintenance and the key ranked factors selected.

Challenges Encountered on the Field

A number of challenges were encountered during the fieldwork that demanded measures to overcome them to ensure the success of the study. During the on-board CRT survey, some passengers were not able to complete the questionnaire before getting to their respective destinations. The distribution of envelopes and pens enabled respondents to complete the questionnaires on time. Respondents who were not able to complete the questionnaire were asked to complete and give them to the train conductors or the research team the next time of boarding the train. Some respondents who could not read or write were assisted by the research team.

During the survey on the BRT that covered small private motor vehicle owners, some potential respondents complained of not having enough time but upon explaining the nature and potential benefits of the research, some were willing to answer the questionnaire. In some organisations, management was not willing to allow workers to fill out the questionnaire during office hours. An arrangement was made for respondents to fill them during their break period for collection at a convenient period. Generally, there were some potential respondents who expressed research fatigue but some were willing to assist after knowing the objectives of the study.

Ethical Considerations

Ethical considerations were given due attention during the study. Participants were given information about the nature of the research and they were given the option to voluntarily participate in the research. Respondents were also assured of confidentiality and anonymity. The researcher also obtained a letter of introduction from the Department of Geography and Regional Planning (see Appendix H) to formally request information and data from institutions. Authorisation was obtained from relevant institutional heads before consultation of schedule officers on issues related to the study. Institutions were given information about that nature of the research and permission sought for the use of data and other important information from their relevant outfits. With respect to the on-board survey, special permission was given by the Ghana Railway Company (see Appendix I) for the use of their coaches for the survey.

Summary

The chapter dealt with the research methodology which commenced with a discussion on the philosophy of the research. The philosophy was based on the pragmatic approach and combined both the positivists and interpretivists research approach. It subsequently explained the research design (descriptive design) and introduced the study area, Greater Accra Metropolitan Area (GAMA). The chapter further discussed the study population, explained the sample size calculation for the different segments of the study, data collection procedures, and data processing and analysis. The total sample size for the quantitative work was 1286 with a response of 1266 (98.44% response rate). Additionally, ten (10) stakeholder institutions in transportation and MRT were also engaged for the qualitative aspect of the study. The chapter concluded with field challenges and ethical considerations.

CHAPTER FIVE

IMPLEMENTING BUS RAPID TRANSIT: PREPARATORY AND INSTITUTIONAL ARRANGEMENTS

Introduction

Transportation planning and interventions development require some desired inputs as identified in the 'Input-Output Framework for Transport Interventions', the conceptual framework for the study, Figure 5 (IBRD/The World Bank, 2010). The framework identified the desired inputs to include policy, legislation and regulations; institutions, physical systems and technology; and spatial planning, stakeholders, economic and financial aspects. The chapter addresses how inputs that are subject to control have been factored into the planning and implementation of Mass Rapid Transit in the country.

The chapter specifically delves into the legal and regulatory framework that was required for effective implementation of MRT in Accra. Attention is also paid to the planning documents and arrangements for effective project implementation. This involved content analysis and stakeholder consultations. Stakeholder participation is seen as a key institutional element to ensure the success of policy, programmes and projects implementation. The chapter further investigates the preparedness and willingness of the local private transport operators to cooperate with the public sector for effective Bus Rapid Transit (BRT) implementation in Accra.

Preparatory Arrangements for Bus Rapid Transit

Bus Rapid Transit in Accra is a product of the Urban Transport Project (UTP). The UTP started in 2008 under the funding of the Government of Ghana, World Bank (IDA), Agence Francaise de Developpement (AFP) and Global Environmental Fund (GEF) (GAPTE, 2016). The project fell under the World Bank's Country Assistance Strategy (CAS) for Ghana in 2004. The main objective of the project was to attain improvement in mobility and ensure affordable bus services within the MMDAs that have collectively been classified as Greater Accra Metropolitan Area (GAMA). This was to be achieved through improved traffic engineering and management measures, proper regulation of the public transport industry and the implementation of Bus Rapid Transit (BRT) system (Department of Urban Roads [DUR], 2015, p.2).

The Ghana Urban Transport Project had five components: Institutional Development; Traffic Engineering, Management and Safety; Development of Bus Rapid Transit System; Integration of Urban Development Planning; and Project Outcome Monitoring (World Bank, 2015, p.6). A substantial increase in the project cost from US $28 million to 57 million resulted in the pruning down of some of the components of the project. This affected some road infrastructure. One other issue was the political will to implement the project against the background of opposition to the project by transport operators. With regard to BRT, there was a shift in the implementation from the Accra-Mallam-Kasoa corridor to Accra-Amasaman corridor. This was based on the advice of the Urban Transport Advisory Council that comprised schedule ministers for Roads and Highways, Local Government and Rural

Development, and Transport, respectively, and the Greater Accra Co-ordinating Council (Department of Urban Roads [DUR], 2015).

With a total budget of US$ 82.0 million (revised) the project was scheduled for implementation between 2007-2012 but had to be rescheduled for completion in 2015 for reasons mainly due to implementation challenges and lack of understanding of the BRT concept from the perspective of the private transport operators (Department of Urban Roads, 2015). The Rea Vaya, the first fully implemented BRT system in Africa, Johannesburg, faced similar initial challenges, being resistance from the local taxi minibus operator which centred on the fear of losing their source of livelihoods although their services were quite unregulated (Heather, 2013).

The Urban Transportation Project produced a number of documents and logistics, including Guidelines on Transport Impact Assessment for MMDAs, urban safety standards, and the installation of GIS application for transportation planning and management (Department of Urban Roads, 2015). As a sub-component of the Urban Transport Project, a Project Advisory Office (PAO) was established with the mandate to provide advisory services to implementing institutions and operators as well as provide assistance in the planning, management and regulation of urban passenger transportation. Under the terms of the agreement with the World Bank, the Project Advisory Office was dissolved after some time and its mandate transferred to the Centre for Urban Transportation (CUT). The CUT was not able to operate after the World Bank withdrew funding and transferred the funding obligation to the government of Ghana. Funding of CUT could not be guaranteed under the Government of Ghana (Department of Urban Roads, 2015, p.16).

Some of the challenges of the Urban Transport Project included a delay in the implementation of the institutional component and limited funding to implement the institutional components. Another major challenge was the resistance from transport operators due to the fear of competition. The cost of some components was highly underestimated leading to dropping of some projects due to lack of funding.

Formation of Greater Accra Passenger Transport Executive (GAPTE) and Impact on Project Implementation

A mid-term evaluation after the first 5 years of project implementation (2007 to 2015) called for a restructuring of certain components of the project to help meet emerging challenges that surfaced during the initial project implementation. It was realised that the requisite institutional reforms that should accompany the civil works lagged behind in terms of expenditure and focus. To offset the resultant institutional challenges, Greater Accra Passenger Transport Executive (GAPTE) was formed and charged with the responsibility of planning and managing urban passenger transport component of the project and to help restore the balance between the civil works and institutional components of the project (Department of Urban Roads [DUR], 2015).

The GAPTE, an inter-district body, was tasked with planning, co-ordinating, regulating and monitoring of the BRT operations and urban transport services on specific routes. The implementation of the proposed BRT was initially faced with the problem of lack of trust by the existing private transport companies. The private transport companies have been the dominant force in public transport provision in the country as a result of the collapse of the government-run public transport services in the early decades of the country's independence. In the words of an officer from the Monitoring and Evaluation section of the Ministry of Roads and Highways:

> *"the absence of the involvement of the government in the planning and regulation of public transportation over the years has led to the dominance of the private sector in the provision of public transport. The private sector has great influence in public transport provision but the sector requires effective planning and policy direction from the government".*

Pre-GAPTE was set up in 2012 under the auspices of Ministry of Local Government and Rural Development (MLGRD). The Pre-GAPTE paved the way for the establishment of the Greater Accra Passenger Transport Executive (GAPTE) that was legally mandated to plan, regulate and co-ordinate urban passenger transport services in Greater Accra Metropolitan Area (GAMA). GAPTE was incorporated on the 4th April 2014 as a Company Limited by Guarantee (CLG) under the ownership of the 13 participating Assemblies in the Greater Accra and the Awutu Senya East Municipal Assembly (ASEMA) in the Central Region (GAPTE, 2016).

The functions of GAPTE included data collection and analysis, modelling for transportation planning; development of operation standards and monitoring and implementation for urban transport services; procurement of transport infrastructure and services for GAMA; and advocacy of the integration of urban development policy and urban transportation services through the use of Geographic Information System (GIS). Other functions are the provision of guidelines for the development of urban transport infrastructure and the mechanism to ensure equity and use of transport infrastructure and services by vulnerable groups (GAPTE, 2016).

GAPTE assisted in bringing the various MMDAs and transport organisations together for dialogue and negotiations on the implementation of the BRT. One major achievement of GAPTE was creating the assurance and confidence in the private transport companies that the operation of the BRT was not a ploy by the government to take over the running of urban public transport provision but rather a partnership to help revamp the operation of urban transport services in partnership with the private sector. This was given further impetus by GAPTE providing assistance in the formation of legally registered companies made up of already existing transport companies to operate along the selected corridors. The Chief Executive Director of GAPTE explained that:

> *"The establishment of GAPTE really improved the confidence of the local transport operators in the BRT implementation. The transport companies initially harboured the fear that the government had intentions to take over the running of mass transport away from the existing transport companies"*

The project covers 13 MMDAs with each Assembly having the mandate to regulate public transportation in its area of jurisdiction (Table 5 & Figure 9). GAPTE, therefore, acted as a co-ordinating body for all the 13 MMDAs. It also acted as a company with the 13 Assemblies being the shareholders. The chief executives of the respective Assemblies act as Directors of GAPTE. GAPTE is to assist in transportation and network planning and hence, operate transport services on the identified corridors which have proven to have mass commuting population. GAPTE was initially proposed to be financed by the MMDAs involved in the BRT project but is currently being financed by the Ministry of Local Government and Rural Development which is the oversight ministry.

Table 5: Participating MMDAs Under GAPTE

	Name of Participating District	
1	Accra Metropolitan Assembly	AMA
2	Tema Metropolitan Assembly	TMA
3	Ledzokuku-Krowor Municipal Assembly	LeKMA
4	Ga West Municipal Assembly	GWMA
5	Ga East Municipal Assembly	GEMA
6	Ga South Municipal Assembly	GSMA
7	Ga Central Municipal Assembly	GCMA
8	Ashaiman Municipal Assembly	AshMA
9	Adentan Municipal Assembly	AdMA
10	La Nkwantanang Madina Municipal Assembly	LaNMMA
11	La Dade Kotopon Municipal Assembly	LaDMA
12	Kpone Katamanso District Assembly	KKDA
13	Awutu Senya East Municipal Assembly*	ASEMA

* Located in the Central Region

Source: Agyemang (2016).

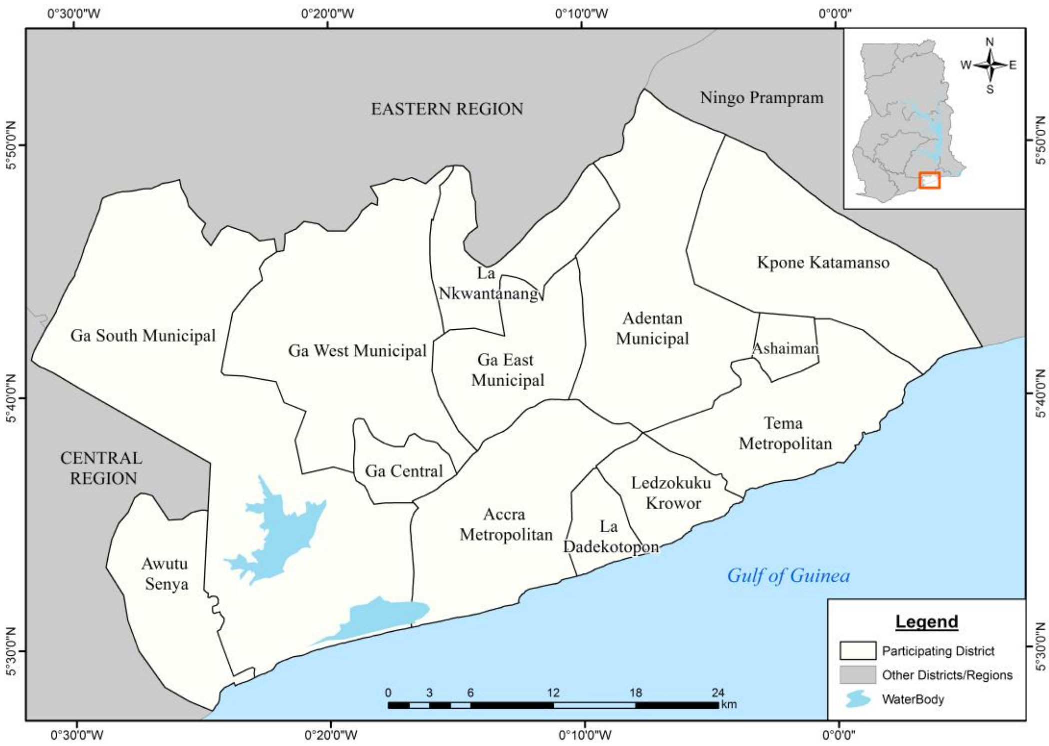

Figure 9: Map of BRT Participating Districts in GAMA

Source: GIS and Cartography Unit, Department of Geography and Regional Planning, UCC (2017).

Implementing Bus Rapid Transit

A review of the implementation of the Urban Transportation Project led to the donors of the project recommending a type B BRT as a pilot project in Accra. The donor partners saw the type B as an important step towards meeting the objectives of the reforms in the urban transportation sub-sector. The reforms included a review of the existing public arrangements that existed on the urban transportation system, review of the industry’s practices, institutional arrangements and capacity for regulating public transport. The donors were of the conviction that the pilot type B BRT would assist in identifying operational challenges as well as test how to effectively deal with the informal sector and relevant stakeholder institutions to help strategies for the implementation of a full BRT system.

After a careful consideration of the budget for the implementation of a full BRT, which would cost an average of US$ 3.5 million per kilometre, the government accepted the implementation of the type B BRT, a convenient fit for the budget of the donors. The type B BRT reduces infrastructural interventions to only sections of the corridor that are regarded as critical. The interventions concentrate on congested sections of the corridor.

Measures include employing engineering technology to discriminate in favour of public transport vehicles at selected junctions and intersections. For instance, the use of the 'queue jumper' strategy enables public transportation vehicles to bypass all other vehicles at traffic lights signal points. Being in the bus lane enables the green light to be switched on for the priority bus service even when the red lights are on for all other vehicles.

The chief executive officer of GAPTE explained in an interview that:

> *the type B BRT is not for only dedicated lanes but a combination of dedicated lanes and non-dedicated lanes using the queue jumper principle to give bus priority passage at intersections and signal points. This is what has been planned for the Amasaman to Tudu corridor and for the Adenta through 37 Military Hospital to National Theatre to the CBD.*

The chief executive officer of GAPTE further explained that:

> *What is to be implemented could be referred to as Quality Bus services. Bus services with improved infrastructure that is not experienced by trotro services under operation currently. The*

buses will be very durable with routine maintenance schedules, dedicated bus stops, depots, terminals and fleet management system.

The BRT under implementation in the GAMA area has been named the Aayalolo Bus System. There is a steering committee (Steering Committee on Urban Transportation in Accra [SCUTA]) that is made up of the MMDAs of GAPTE, under the co-ordination of GAPTE for the operation of the Aayalolo Bus System. The objective of the Aayalolo Bus System is to promote mass rapid transit along the corridors with very high demand for passenger mobility with a focus on ensuring high service quality, security, affordability, time reduction, and reliability (GAPTE, 2016). GAPTE has been mandated to develop, regulate, control and manage the BRT. This includes co-ordination of the activities of the operating transport service providers with respect to Aayalolo Bus Services operations, defining and monitoring service routes, fare collection systems and collaboration with other passenger services providers (GAPTE, 2016).

One observation about the design and implementation of the BRT is that no consideration was given to the development of a system that would address multimodal and intermodal transportation planning in the near future. During the field visit by the research team, it was observed that the siting of BRT stations did not consider the location of commuter railway stations. There is also no co-ordination or little co-operation between GAPTE and the Ghana Railway Company (see Table 6). Litman (2013b) sees lack of focus on multimodal transportation planning as a reductionist approach to transportation planning, that is devoid of a holistic approach to addressing transportation problems. Similarly, Bektas, Crainic and CIRRELT (2007) observed that intermodal transportation planning incorporates various modes and transportation services to achieve efficiency in the entire transportation value chain.

Legal and Regulatory Requirement for MRT

The Urban Transport Project supported the Ministry of Local Government and Rural Development (MLGRD) with the development of common by-laws to help regulate urban passenger transportation in the participating MMDAs. This was complemented by the development of a monitoring and evaluation framework for implementation (Department of Urban Roads, 2015).

The dialogue between the major stakeholders also led to a change in the by-laws of the MMDAs on the operation of the BRT. In the words of the Secretary of the Ghana Private Road Transport Union (GPRTU) of Accra Metropolitan Assembly (AMA):

> *initially, no trotro was to operate where the BRT was to pass. With the establishment of GAPTE and involvement of all major stakeholders about 13 by-laws that were not in favour of the private transport operators have either been changed or modified.*

The current BRT has been structured as a Public Private Partnership with four main entities involved being the Government of Ghana, represented by the Ministry of Transport (MOT) and Ministry of Finance (MOF); MMADAs, represented by GAPTE; Mass Transit Operators, represented by the three companies; and a leasing company. A local representative of the supplier of the initial buses for the operation of the Bus Rapid Transit, SCANIA GH Ltd. will have a maintenance agreement with GAPTE on behalf of the operating companies and ensure routine maintenance of buses (Ministry of Transport [MOT] & Ministry of Finance [MOF], 2014).

A route service agreement has been signed between GAPTE and the three (3) Operator Bus Companies. GAPTE in effect has been mandated to operate the pilot Type B system. The Route Service Contract (RSC) between GAPTE and the transport operators adopts a 10-year lease system for the operation of buses that remain the property of GAPTE (GAPTE, 2016).

One important component of Mass Rapid Transit is the development of commuter rail transit. To help in the achievement of the objective of reviving the railway sub-sector, the Ghana Railway Act, 2008, Act 779 established the Ghana Railway Development Authority (GRDA) as the regulatory body for railway operations in the country. The Act separated the commercial activities of the Ghana Railway Company Limited (GRCL) from the activities of the regulatory authority, GRDA (Ministry of Finance and Economic Planning, 2010).

Planning for MRT

Urban transportation planning was given a boost during the development of the National Urban Policy. As a shift from earlier approaches to urban development that focused on the project-based framework, the present one is holistic and designed to give policy guidelines to comprehensive urban development in the country (Ministry of Local Government and Rural Development [MLGRD], 2012a).

The policy initiative under transportation in the National Urban Policy Action Plan advocates for "spatially integrate regional and district capitals by transportation and communications facilities and other relevant services" (MLGRD, 2012b, p.14). As part of the key activities to meet this policy initiative, the plan proposed the development of needed suburban transport systems including BRT, railway services and other transport modes in metropolitan areas (Ministry of Local Government and Rural Development, 2012b).

The National Transport Policy further highlights the quest of government to focus on integrated multi-and inter-modal transport systems to assist in the attainment of affordable transportation for users. The policy also touched on the promotion of Public Private Partnership in transport sector investment and other related issues. Ghana Transport Policy identified mass transportation as a priority in solving the transportation challenges in the urban areas. In line with this, strategies outlined in the policy document included Bus Raid Transit (BRT); commuter rail transit systems in Accra-Tema, Kumasi-Ejisu, Accra-Nsawam, and Takoradi-Kojokrom; and extension of rail services to high population zones that would be cost-effective (Ministry of Transportation, 2008).

The Ghana Railway Master Plan envisages a shift from the predominantly goods-based rail transportation system to a combination of passenger and freight/goods system. The plan recognises the importance of an intermodal system between rail transportation and road transportation to ensure a convenient and swift shift from one mode to another at terminals and interchange stations.

The Railway Masterplan of 2013 (Urban Issues) identify five potential railway routes for the development of suburban railway routes in the Greater Accra Metropolitan Area as shown in Figure 10:

Route I: Kasoa-Darkuman-Accra centre (with branch route Darkuman-Awoshie-Sowutuom);

Route II: Adenta to Accra Centre;

Route III: Amasaman to Accra centre;

Route IV: Ashaiman to Tema;

Route V: Suburban Circular Railway linking routes I, II, III and IV (The Ghana Railway Development Authority, 2013).

Figure 10: Proposed Commuter Railway Routes for GAMA

Source: The Ghana Railway Development Authority (2013)

Transport Stakeholder Institutions

This section explains the role of the major stakeholders in transportation planning as well as the linkages between the various stakeholders (see Table 6). Two major ministries play important roles in transportation policy formulation, planning and implementation. The Ministry of Roads and Highways (MRH) is charged with policy development and co-ordination as well as having oversight responsibility of “Department of Urban Roads (DUR), Department of Feeder Roads (DRF), The Ghana Road Fund (GRF) and Ghana Highways Authority (GHA)”. The second ministry of importance to transportation planning and development is the Ministry of Transport, charged with policy formulation, co-ordination and oversight responsibility for “aviation, inland water and maritime, railway and road transport sub-sectors”. There is however a cordial collaboration between the two ministries as exhibited in the formulation of the National Transport Policy, Transport Sector Development Programme and in the preparation of sector Medium Term Development Plans of the respective ministries (Ministry of Finance and Economic Planning, 2010, p.32).

A number of regulatory agencies also come under the jurisdiction of the Ministry of Transport being: Driver and Vehicle Licensing Authority (DVLA), Ghana Civil Aviation Authority (GCAA), Ghana Maritime Authority (GMA), Ghana Railway Development Authority (GRDA) and the Motor Transport and Traffic Department of the Ghana Police (MTTD). The Ministry also has oversight responsibility for the National Road Safety Commission (NRSC), which although not a regulatory body, plays a critical role in ensuring road safety and the co-ordination of stakeholders involved in ensuring road safety (Ministry of Finance and Economic Planning, 2010, p.32).

The implementing agency for planning, managing and maintaining urban roads is the Department of Urban Roads with the oversight ministry being the Ministry of Roads and Highways. Metropolitan, Municipal and District Assemblies are however charged with the responsibility of planning, regulating and managing transport infrastructure in their areas of jurisdiction (Ministry of Finance and Economic Planning, 2010).

The implementation of Mass Rapid Transit (MRT) calls for effective collaboration among transportation organisations. This necessitated the identification of transport organisations in the country. Stakeholder analysis to determine the relevant organisations considered issues such as legitimacy and roles, mandate and strategic objectives, the field of action, and scope of influence (GTZ, 2007). The inclusion of public and private stakeholders was informed by the implementation of BRT, the TransMilenio, in Bolgota (IBRD/World Bank, 2002) and advocate by The International Finance Corporation [IFC] (2007) for the commencement of stakeholder consultation at the beginning of project conception before implementation of the project.

Stakeholder analysis identified the three private transport operators that have route service contracts with GAPTE for the operation of BRT in Accra (GPRTU, Amalgamated Bus Rapid Transit Company Ltd., and Co-operative Transport Association). The two transport ministries (Ministry of Transport and Ministry of Roads and Highways) and Department of Urban Roads are identified as the government organisations for urban transport policy implementation. Town and Country Planning Department is identified for its role in urban land use planning, and for the purpose of Bus Rapid Transit (BRT) implementation, GAPTE as a management organisation becomes very relevant. The Ghana Railway Company was included for its role in urban commuter rail management. Finally, the National Development Planning Commission (NDPC) is recognised for its role in the development of National Development Policy Framework.

Representatives of the organisations in high management positions were asked to assess their relationship and collaboration with other organisations in the planning and implementation of Mass Rapid Transit in Accra (see Table 6). They assessed and rated their relationship on a scale of 'VS: Very Strong' to the weakest 'VW: Very Weak' as shown in Table 6.

Table 6: Relationship Among Major Transport Organisations

	MOT	MRH	DUR	TCPD	GAPTE	GRC	NDPC	Private Transport Operating	Pseudo Private Transport
GPRTU	F	F	S	F	S	N	N	VS	S
Amalgamated Bus Rapid Transit Company Ltd.	N	W	W	W	VS	VW	F	VS	F
Co-op Transport Association	VS	S	S	F	VS	VW	VW	VS	F
Ministry of Transport (MOT)		VS	VS	F	VS	VS	VS	VS	VS
Ministry of Roads and Highways (MRH)	S		VS	W	S	VW	S	W	F
Department of Urban Roads (DUR)	F	VS		F	S	F	N	F	F
Town & Country Planning Department (TCPD)	N	N	VS		F	N	S	S	W
Greater Accra Passenger Transport Executive (GAPTE)	VS	VS	VS	F		VW	W	VS	S
Ghana Railway Company (GRC)	VS	VW	N	N	VW		F	VW	VW
National Development Planning Commission (NDPC)	S	S	S	S	N	F		F	F

VS: Very Strong; S: Strong; N: Neutral; F: Fair; W: Weak; VW: Very Weak

Source: Agyemang (2016)

There was a very strong horizontal relationship among organisations. For instance, there was a very strong relationship among the private transport operating organisations. Similarly, there was a very strong relationship among the Ministry of Transport (MOT) and the Ministry of Roads and Highways (MRH).

The vertical relationship among organisations of different nature becomes a challenge in some situations. The Ghana Railway Company (GRC) had a peculiar challenge of having a very weak relationship with all other organisations with the exception of the Ministry of Transport, the parent Ministry. The weak relationship between the GRC and the other organisations does not augur well for intermodal transportation planning. It has the tendency to affect Mass Rapid Transport planning with regard to the intermodal transfer of passengers. For an excellent intermodal system, some key issues that should be given the deserved attention are connectivity, co-ordination and co-operation. There is also the need for efficient transfer terminals to ensure quick and easy transfer of passengers from one transportation mode to another.

The National Development Planning Commission (NDPC), the organisation for government development policy formulation and national development framework policy document preparation had just a fair relationship with the key private sector operators. This development could affect effective cooperation and consultation for participatory policy formulation on urban transportation planning. GAPTE had a very strong relationship with the ministries and transport operators. GAPTE, therefore, played a co-ordinating role by bridging the communication gap between policy level operators (the ministries), transport operators and the MMDAs. GAPTE, like most of the other organisations, however, had a very poor relationship with the Ghana Railway Company.

Private Sector Co-operation in BRT Implementation

The initial idea to implement a Bus Rapid Transit System in Accra was not accepted readily by the transport operating companies. It was seen as a strategy by the government to totally take control of urban passenger transportation in the country. There was a misunderstanding about the nature of the project and the terms and conditions regarding the operations of the BRT system. This created some resistance from the local trotro and taxi operating organisations in the city. The Greater Accra Secretary of the Secretary of Amalgamated Bus Rapid Transit Company Limited commented that:

> *There was little consultation with private transport companies about the intentions of government and the impact of the BRT project on the private operator. We felt our source of livelihood was in danger. No one was certain about the role of the private sector.*

The initial project implementation did not lay strong emphasis on the needed institutional issues and on measures to achieve maximum participation from relevant stakeholders such as the local transport operators. Sustrans (2015) identified the clear understanding of the purpose of engagement and accessibility and inclusiveness of all as important in achieving community participation.

The challenge faced in Accra during the preparation for the implementation of the BRT was similar to what happened during the development of the TransMilenio BRT project in Bogota. There was the fear of loss of business, huge financial investment to acquire modern buses and lack of confidence in government completing the assignment. An agreement that was achieved through effective dialoguing that saw the operators bidding for bus routes to operate (Centre for Clean Air Policy, 2012).

The three private organisations that have formed limited liability companies to participate in the BRT project implementation in Accra were consulted to ascertain the preparedness of private transport operators to assist in the operation of the BRT system. The companies are Ghana Co-operative Bus Rapid Transport Association Ltd., Accra GPRTU Rapid Bus Services Ltd., and Amalgamated Bus Rapid Transit Company Ltd.

The chairman for Co-operative Transport Association, the main organisation that formed the Ghana Co-operative Bus Rapid Transport Association Ltd, expressed the desire of the company to co-operate fully with the implementation of the project. The organisation had been playing an active role in the preparatory work towards the implementation of the BRT through the co-operation with GAPTE and the other private operators of the BRT. The other two companies also expressed a similar desire to co-operate fully in the implementation of the pilot BRT.

The organisations enumerated the benefits of the BRT to the nation to include the provision of safe, reliable, comfortable and disability friendly service to the general public; monetary benefits to the transport union and guaranteed monthly income for drivers; and improvement and decongestion of the central business district of the city. The chairman of Greater Accra branch of Ghana Co-operative Transport Association in an interview commented that:

> *Private vehicles and taxis occupy a lot of space on our roads hence the use of buses will help reduce the number of vehicles at the central business district of the city.*

The acquisition of buses to operate with the support of government was seen as an important step in the use of Public Private Partnership in solving urban transportation problems in the major cities of Ghana. The transport companies explained that with the replication of the BRT project in other corridors of the city or in other major cities of the country, bidding for similar Route Service Contract would be easy. There was also the long-term vision of the companies that the operation of BRT would assist in transforming the organisation from a vehicle owner-based organisation to a fully developed limited liability company for all members of the organisation. The Secretary of the Greater Accra branch of GPRTU explained that:

> *We will be operating with new buses under the support of the government but our worry is how to sustain the procurement of buses without the support of government. We believe that we are in a better position to operate in other BRT corridors in the future if given the requisite support.*

On preparations that the companies were making towards a swift take-off of the BRT service, it was explained that a selected number of drivers from the organisations were to benefit from a special training programme for drivers of the BRT with the first training session already completed. The training was under the auspices of the suppliers of the buses, Scania Ghana Ltd and the National Drivers Academy.

The major concerns of the organisation included how the BRT would operate without affecting the business of other private operator and effective education of the public on the operations of the BRT. The high cost of brand-new buses for the operation of the BRT was also seen as a major challenge as it would be difficult for the companies to procure buses without the support of the government and this was seen as a sustainability challenge. The use of non-segregated routes was also seen an issue that deserved attention. It was suggested by the organisation that a gradual increase of sections of the road with segregated lanes will help improve the services of the BRT and the confidence that the general public would have in the system.

It was also suggested that in the designing of such projects, initial consultations with operators on the ground would help deal with elementary challenges. Enforcement of the bye-laws of the Accra Metropolitan Assembly and road regulations were seen as vital for the smooth operation of the BRT. In the words of the Secretary of Amalgamated Bus Rapid Transit Company Limited:

> *enforcement of AMA bye-laws and road traffic regulations will ensure proper adherence to traffic rules to enable the buses to operate as planned. Without that motorists will not respect the right of way of the BRT buses.*

Other suggestions included effective collaboration among stakeholder institutions in the transportation industry and revamping of the urban train system to complement the effort of the BRT to help solve urban transportation problems in Accra.

The discussion on preparatory and institutional arrangements for MRT in the GAMA has brought to the fore a number of issues that require highlighting: The input-output framework for urban transportation interventions (IBRD/World Bank, 2010), the conceptual framework, highlights on some desired inputs that could be controlled up to some extent. The desired inputs include policy, legislation and institutions, stakeholders, and economic and financial aspects. Effective institutions, legislation, policy, regulations, effective stakeholder consultations are essential for effective Mass Rapid Transit (MRT) implementation.

This will assist in the attainment of the desired outputs which the conceptual framework enumerates to include mobility, accessibility, quality, efficiency, safety and affordability. These desired outputs would require prudent transportation interventions with a focus on transport demand management, infrastructure and services delivery, and vehicular fleet management to achieve. Effective collaboration between relevant transportation stakeholders consequently becomes very important.

The need for effective collaboration of transportation planning and implementation stakeholders is further supported by the literature and concepts reviewed. The four solitudes, illustrated in Figure 1, (UMTRI & TCAUP, 2011) explains that achieving smart and sustainable accessibility and mobility would require harmonisation of the effort of all operators of all the four quadrants. The four quadrants represent stakeholders involved in technology, service, product/modes and design.

International Finance Corporation [IFC] (2007) advocates for the commencement of stakeholder consultation at the beginning of project conception before implementation of the project. It is argued that such proactive relationship building serves as the capital for difficult times of project implementation.

Public Private Partnership (PPP) has also emerged as an important ingredient in urban transportation development. One such example of PPP is exhibited in the design and implementation of Bus Rapid Transit System in Bogota, Columbia. The management of the overall system is under a public company, TransMilenio S.A, which is funded from three (3) percent of ticket proceeds. There is a separate company which is selected through competitive bidding for the development and distribution of smart cards, security validation systems, money handling and other intelligent transportation systems (IBRD/The World Bank, 2002).

With insight from the Servqual Model, the study identified institutional and operational gaps in the implementation of BRT. At the initial stages of the development of the BRT system, one institutional gap that was identified was the absence of a co-ordination body between the private sector and government sector institutions for effective collaboration and programme implementation. However, this was achieved by the establishment of GAPTE.

One other institutional gap was the financing of GAPTE. It was initially proposed to be funded by the implementing MMDA but currently under the funding of the Ministry of Local Government and Rural Development. This may be appreciated in the short term but there is the need to make funding of GAPTE more sustainable. TransMilenio S.A., the public company that is in charge of managing the TransMilenio BRT in Bogota, Columbia is funded from three (3) percent of ticket proceeds. There is also a separate company that is selected through competitive bidding for the development and distribution of smart cards, security validation systems, money handling and other intelligent transportation systems. The revenue generated is lodged in a trust fund which serves as a source of payment of operators engaged by TransMilenio SA as per their respective contracts (IBRD/The World Bank, 2002).

A careful examination of the implementation of the type ‘B’ BRT revealed that government considered the average cost of US $ 3.5 million per construction of a kilometre as costly. The benefit of a full BRT system would include reduction of productive hours spent in traffic, reduction of traffic congestion generally and reduction of vehicular pollution. With the requisite political will, the corridor for BRT could be divided into segments and a full BRT system implemented in phases. Tanzania has completed the first phase of Dar es Salam BRT which covered 21 km. The BRT corridor serves an average of 160,000 passengers daily, operating a fleet of 140 buses with the projected number of buses to increase to 300 when the first phase is fully operational (Sustainable Transit Award, 2017).

Summary

The chapter discussed the preparatory and institutional arrangements for the implementation of BRT in the GAMA. It gave a general background to the Urban Transportation Programme that recognised the need for a BRT system in the GAMA. The Greater Accra Passenger Transport Executive

(GAPTE) was introduced as an organisation to assist in the management of the BRT. This was followed by a description of the nature of the BRT Lite that is under implementation in the GAMA. The BRT under implementation is a type B (BRT Lite), with a combination of dedicated and non-dedicated lanes, using the queue jumper principle to give bus priority passage at intersections and signal points.

Subsequently, the chapter addressed the planning, legal and regulatory requirements for MRT, stakeholder institutions for transportation, and the willingness of the private sector to co-operate with BRT implementation.

CHAPTER SIX

INFRASTRUCTURE FOR MASS RAPID TRANSIT IN ACCRA

Introduction

This chapter addresses the major infrastructure in place for Mass Rapid Transit in Accra. Infrastructure is discussed to include Intelligent Transportation Systems. It outlines the initially proposed infrastructure for BRT in Ghana under the Ghana Urban Transport Project and infrastructure under the revised BRT plan as being implemented. There is also a review of infrastructure for the commuter train service along the Accra to Nsawam and Accra to Tema corridors. This involved stakeholder consultations, field and train on-board observations.

Proposed Projects under the Urban Transport Project

Discussion on infrastructure for Mass Rapid Transit in Ghana cannot be completed without reference to proposed projects under the Urban Transport Project. The landmark project proposed the introduction of BRT in Ghana. A number of BRT corridors were proposed for implementation (Table 7).

The Government of Ghana initially proposed the implementation of a full BRT system with median routes in Accra. However, after the completion of the infrastructure design, the total cost for a full BRT system exceeded the budget allocated for the project. The World Bank discussed with the Government of Ghana on the need to revisit the project cost and look for an alternative proposal.

Table 7: Components of Urban Transport Project

LOT	COMPOSITION	REMARKS
Lot 1	Construction of road over Railway Bridge and expansion of the Odaw river bridge on the Graphic road.	Construction completed
Lot 2	Construction of BRT way from Accra Central Business District (CBD) to First Light on Winneba road and stations up to Mallam junction.	Could not be completed due to financial construction
Lot 3	Construction of terminals, depots and tributaries and four (4) routes. Routes 1 (Amasaman Route- CBD); Route 2 (Adentan Route-CBD); Route 3 (Kasoa – Mallam)	Construction completed
Lot 4	CBD –Otumfour Osei Tutu II Boulevard to Ejisu Road in Kumasi	At various stages of implementation for high-quality BRT service

Source: GAPTE (2016)

GTZ (2005) and ITDP (2007) explain a full BRT system to have characteristics such as segregated right-of-way infrastructure; busways in the median of the roadway rather than in the curb lane; integrated network routes or corridors; enhanced stations that are secure, and weather-protected; pre-boarding fare collection and fare verification; and stations that provide level access between the platforms and vehicle floor.

The high-quality BRT system would require an average of US$ 3.5 million per kilometre to construct and this becomes quite burdensome for countries in sub-Saharan Africa to meet such an investment cost. Alternatively, an enhanced BRT system that does not meet the standard of the quality BRT but maintaining most of the basic characteristics of BRT becomes a viable option in sub-Saharan Africa. Such a system has characteristics as segregated busways, usually with kerbside operations, and stations on some major corridors integrated with tributary services; buses with standard capacity and appropriate emissions levels; on-board fare system or verification; and graduated fare structures with defined charges for feeder services and zones (Aayalolo Bus Rapid Transit, 2017).

This called for a thorough investigation and ranking of the routes identified in the original design by the government. The Kaneshie corridor qualified for a full BRT based on certain attributes and the other two corridors recommended for the type 2 BRT. It was further recommended that the type 2 system be piloted to test how the informal sector and other stakeholders would fit into the operation of the BRT. The Amasaman, Achimota, Tudu corridor was selected for a pilot type 2 BRT or 'BRT Lite'.

The ITDP (2007) noted that enhanced BRT or 'BRT Lite' that uses the same lanes or run amongst mixed traffic with enhanced measures such as pre-board fare collection, enhanced driver training, priority lanes measures, real-time information displays, high standard customer service, signal priority at intercessions, and camera enforcement are popular in Europe and North America. The Institute for Transport and Development Policy [ITDP] and IBIS (Cervero, 2013) also observed the presence of BRT Lite systems in some African cities including Lagos, Johannesburg, and Cape Town. The implication of their findings gives credence to the implementation of BRT lite in Accra. It however, means that for effective BRT lite system, measures introduced in the cities mentioned should be given the deserved attention.

Accra BRT Lite (Enhanced BRT System)

The enhanced BRT system in the Greater Accra Metropolitan Area has the following characteristics with regard to infrastructure:

Bus Priority Lanes

The type B BRT reduces infrastructural interventions to only sections of the corridor that are regarded as critical. The route has both dedicated bus lanes (see Figure 11) and non-dedicated lanes. This deviates from infrastructure for a full BRT with respect to bus lanes. The Institute for Transportation and Development Policy [ITDP], (2007) explains BRT to have segregated right-of-way infrastructure, busways in the median of the roadway rather than in the curb lane, and integrated network routes or corridors.

Figure 11: A Section of GAMA BRT Dedicated Lane

Source: Agyemang (2016)

The interventions for the Accra BRT Lite system concentrate at congested sections of the corridor. Measures include employing engineering systems to discriminate in favour of public transport vehicles at selected junctions and intersections. For instance, the use of the 'queue jumper' strategy enables public transportation vehicles to bypass all other vehicles at traffic lights signal points. Being in the bus lane enables the green light to be switched on for the priority bus service even when the red lights are on for all other vehicles. These measures are noted by Agarwal, et al (2010) to enhance bus travel time reduction. Bus priority lanes at some sections of the busway are guaranteed by the Road Traffic Regulations, LI 2180. The Chief Executive Officer of GAPTE explains that:

> *"the type B BRT is not for only dedicated lanes but a combination of dedicated lanes and non-dedicated lanes but using the queue jumper principle to give bus priority passage at intersections and signal points. This is what has been planned for the Amasaman to Tudu corridor and for the Adenta through 37 Military Hospital to National Theatre to the CBD".*

There are BRT Lite systems in some African cities including Lagos, Johannesburg, and Cape Town (Cervero, 2013).

Bus Routes

Information gathered from GAPTE and field observation and data gathering assisted in the generation of the bus routes (Figure 12) to be operated by different companies under the RSC as explained in Table 8. The total number of buses to be operated under the pilot scheme is 85. There are three routes for the type 2 BRT service in the GAMA. Route 1 is operated by the Ghana Co-operative Bus Rapid Transport Association Ltd. This is a semi-express route as shown in Table 8. It is depicted by the yellow line in Figure 12. The route starts from the Amasaman Terminal and has bus stops at Fiase, Festus, Pokuase, ACP Junction and John Teye along the route. The next major stop is the Achimota terminal after which there are other 5 stops before the final stop at the Tudu terminal. The company operates with 20 buses on the 26.65 km route.

Bus Rapid Transit (BRT) route 2 is the Ofankor-Tudu (stopping service) corridor which is operated by the Accra GPRTU Rapid Bus Services Ltd (Table 8). The route is depicted with blue in Figure 12. The route starts from the Ofankor terminal and has bus stop points at Taifa, Tantra Hills, St Johns, Mile 7 and ABC Junction before Achimota Old Station. There are other stops at Tesano, Abeka Junction, Circle, Adabraka, Roxy and finally the Tudu terminal, the final destination. The company operates with 44 buses on the 13.94 km stretch of the route.

The third route is the Achimota-Tudu stopping services corridor as shown in Table 8 and depicted by red in Figure 12. The route starts from the Achimota terminal with a number of stops at Achimota Old Station, Tesano, Abeka Junction, Circle, Adabraka, Roxy and finally the Tudu terminal. The route is operated by the Amalgamated Bus Rapid Transit Company Ltd. The company operates with are 17 buses on the 7.64 stretch of the route.

Table 8: Service Routes for Pilot BRT in Accra

Route No.	Route Name	Operating Company	No. of Stops	No. of Buses	KM
AT1	Amasaman-Tudu (Semi-Express Route)	Ghana Co-operative Bus Rapid Transport Association Ltd.	13	24	20.65
AT2	Ofankor-Tudu (stopping services corridor)	Accra GPRTU Rapid Bus Services Ltd.	19	44	13.94
AT3	Achimota-Tudu (stopping services corridor)	Amalgamated Bus Rapid Transit Company Ltd.	9	17	7.64
Total				85	

Source: GAPTE (2016)

Terminals and Bus Stops for BRT

Aayalolo bus system has 4 terminals, 15 Type B specific stations and 27 simple stops along the bus route for the pilot project (see Figure 12). Three depots have been constructed at Achimota, Amasaman and Ofankor for parking, corrective and routine maintenance of the buses. The depots have been equipped with the necessary technical equipment and infrastructure to ensure efficient operation (GAPTE, 2016).

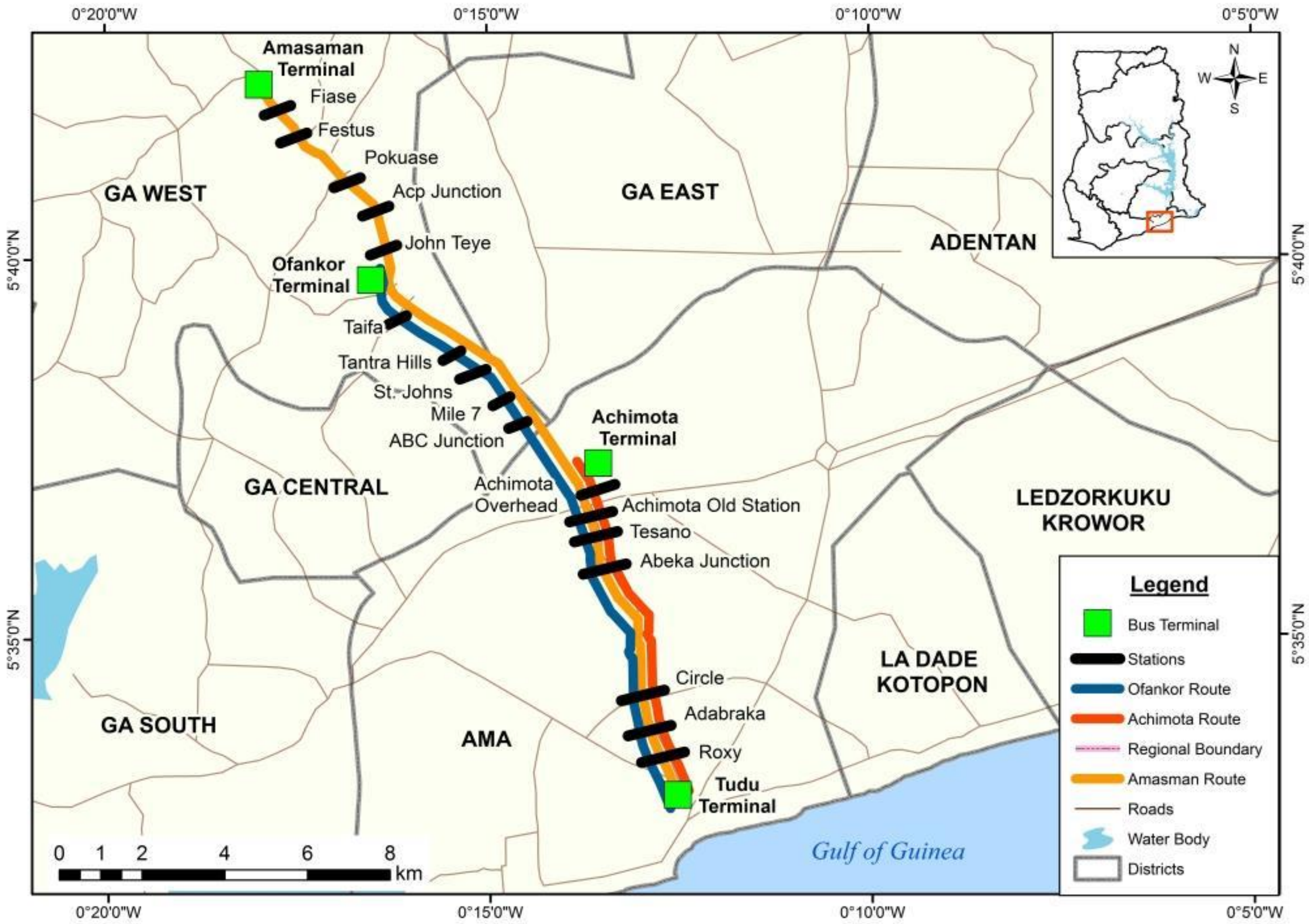

Figure 12: Bus Routes for BRT in the GAMA
Source: Agyemang (2016)

The buses have been made disability friendly with the provision of ramps that are lowered down at stations when necessary for passengers in wheelchairs to have access to the bus or alight. This is in line with the argument that liveable cities should promote public transportation systems that provide safe direct access to the system by all residents. It is also similar to buses operated in the city of Tucson, Arizona in the United States. BRT that have low-floors with wheelchair ramps and mechanisms to reduce slopes to make buses accessible to the disabled.

Intelligent Transportation System for Accra BRT

One important element of the Aayalolo BRT in Accra is the emphasis on Intelligent Transportation System (ITS) infrastructure as the backbone for the operation. Intelligent Transportation System is explained to mean "leading-edge information and communication technologies used in transportation and traffic management systems to improve the safety, efficiency, and sustainability of transportation networks, to reduce traffic congestion and to enhance drivers' experiences" ("Intelligent Transportation System," 2019). The buses have been equipped with on-board computers that work with the biodata on the bus for the automatic fare collection. Each bus has five (5) CCTV cameras for security reasons. The buses are equipped with screens to announce the next station and other passenger information. The IT equipment at various stations and points are linked to the central Control Centre at the Achimota terminal.

Centralised Control System

The Control Centre enables GAPTE to effectively monitor and control the schedule of each bus. This is achieved by the use of Intelligence Transportation Systems aboard the buses that transmit location information, CCTV cameras positioned at the terminals and in the buses, and GPS information and radio. The Control Centre would also enable efficient communication with drivers to check speed limits and manage emergency situations (GAPTE, 2016). The GAPTE central operating room ensures monitoring of the buses that have been equipped with GPS receptor devices that guarantees effective communication with the control room (Aayalolo Bus Rapid Transit, 2017).

Fare Collection System

The sale of fare payment cards is before boarding with on-board verification. A contractor shall be engaged by GAPTE for fare collection services. The contractor shall have the following responsibilities among others: procurement, installation and maintenance of Automatic Fare Collection System (AFSC) equipment at terminals and stations; ensuring constant supply of top-up facilities for bus electronic cards for enhanced ridership; providing other avenues for fare collection such as online services; and ensuring regular accounting and responsibility for insurance cover of daily sales before it is delivered to the fund manager.

Passengers need to get their Aayalolo bus cards before boarding. The cards could be assessed at six (6) locations being the four terminals (i.e. Amasaman, Ofankor, Achimota and Tudu) and Achimota Old Station as well as Pokuase Bus Stops. There are also other mobile agents at many bus stops along the corridor. There are actually two systems in place, the one-time card that passengers would require a valid national identification (ID) to register and keep, and the one-time ticket with validity for one day. The card is registered with the biographic details of the passenger. This is to enable the system to retrieve passenger information and money credit on it in case of misplacement, stolen or damaged for the owner of the card. Climate Group et al, (2011) and the European Union (2014) see the introduction of smart cards for public transportation in cities as an element of smart cities.

Infrastructure Challenges During Test Run

Information gathered from GAPTE indicated that a test run of the Aayalolo bus system in the last quarter of 2016 revealed a number of challenges. The first challenge was drivers logging into a different route code system and hence giving wrong information about stations. The test-run also included workers aboard demonstrating to passengers about how to use the bus cards. It revealed that a lot of education would be required to enable passengers to appreciate how to use the cards. There are three types of stations along the corridors being stations that are for only BRT; stations for only trotro (the BRT buses would not stop at these stations); and stations that are for both BRT and trotro. Trotro drivers did not respect the laid down instructions with regard to the use of stations because there was no enforcement during the test-run.

One other challenge was the differences in the infrastructure of stations for the BRT and the local trotro. Some designated trotro stations without canopy are very close to BRT stations with canopy and neat seats. There is the tendency for trotro passengers to wait at the BRT stations with the potential to create congestion at the BRT stations. The other challenge would be how to control hawkers at the terminals and stations. The Chief Executive Officer of GAPTE explained that:

> *There will be physical enforcement with the use of marshals (uniformed enforcement personnel) to help restore sanity at the terminals and stations*

One infrastructure related challenge is the differences in the condition of the buses. Whereas some buses were air-conditioned, others had none. The economic challenge is that there would be no price differentiation for the different buses. It was explained that as a pilot project, GAPTE was concentrating on creating a level playing field for passengers from different income categories. Price differentiation for different bus conditions and route categories (express and non-express services) would be considered after a successful pilot stage of project implementation.

One particular challenge with the card is the inability of the holder to know the value of travelling credit on the card. There are no means for the holder to verify whether there are enough funds in the card. The holder can only verify at the point of entry.

Infrastructure for Commuter Rail Transit

Train Coaches

The Ghana Railway Company Ltd. (GRC) has two rail systems operating along the two Commuter Rail Transit corridors in the Greater Accra Metropolitan

Area (GAMA). The Tema Commuter Rail Transit corridor is served with two (2) Diesel Multiple Units trains (see Figure 13). "Diesel multiple units (DMUs) are autonomous multiple unit trains which have diesel engines as their power plant and usually provide passenger transportation in urban, suburban and inter-regional service areas which are non-electrified or partially electrified" (Spiryagin, Cole, Yan, McClanachan, Spiryagin & McClanachan, 2014, p.42). The DMU for the Tema corridor is actually a Diesel-Electric (DEMU) system. The Nsawam corridor is however served by one (1) Diesel Hydraulic Locomotive train (see Figure 14).

Figure 13: The Diesel Multiple Unit (DMU) Train for the Accra-Tema Corridor
Source: Agyemang, (2016)

Figure14: Nsawam Corridor Diesel Hydraulic Locomotive Train.

Source: Ministry of Transport (2016)

Train Routes

The Accra-Tema corridor covers a distance of 30.2km. The route starts from the Central Business District (CBD), Kantamanto. There are train stopping points at Nkrumah Circle, Achimota, Airport, Batsona, Adegono and Tema. There are two DMU trains operating along this corridor. The Accra-Nsawam CRT likewise starts from the CBD, following the route of the Accra-Tema railway line to Achimota and subsequently through stations such as Dome, Fisi, Opa, Adzen Kotoku, Papase and Amasaman to Nsawam. It covers a distance of 40.6km as shown in Figure 15.

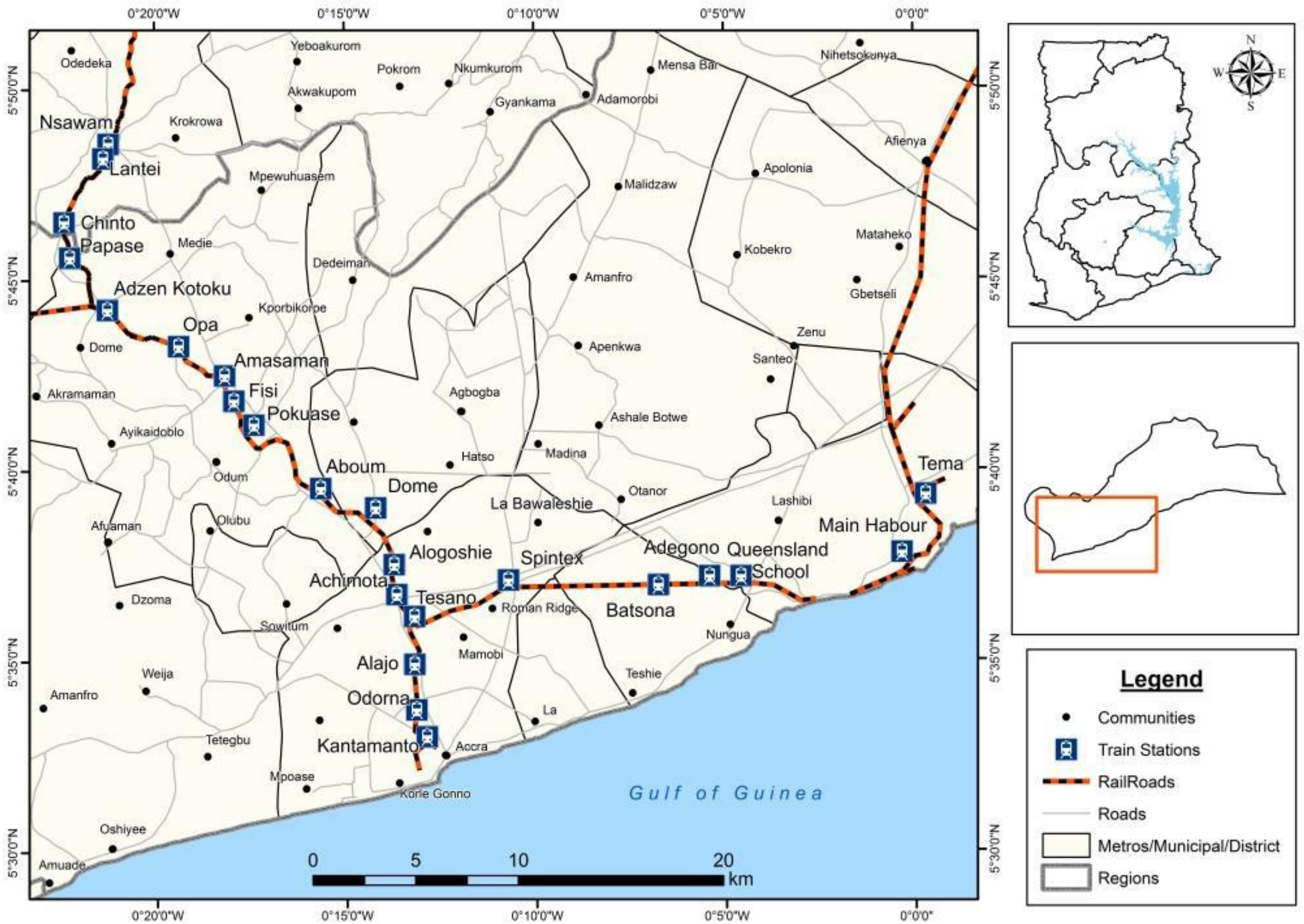

Figure 15: Commuter Rail Transit Routes in GAMA

Source: Agyemang (2016)

Terminals and Stops for CRT

There are a number of stations and halts along the stretches of the two corridors. The halts are not stations but open spaces for boarding and alighting of passengers, usually without the presence of a railway company staff. They are equipped with improvised train stairs (from the ground to the gate of the train).

Figure 16: Tema Train Station

Source: Agyemang (2016)

The Accra-Nsawam corridor has seven (7) stations and thirteen (13) halts whereas the Accra-Tema corridor has seven (7) stations and six (6) halts. The stations along the Tema corridor are quite new and have decent waiting areas for passengers (Figure 16). Conversely, the stations along the Nsawam corridor look old with poorly developed waiting places for passengers as could be seen from Nsawam train station in Figure 17.

Figure 17: Nsawam Railway Station

Source: Agyemang, 2016

Fare Collection System

Fare collection along the two corridors is both pre-boarding and on-board. There are fare conductors in the trains. The payment system is one-time flat payment once you get aboard the train. There is, however, a first-class coach within the Nsawam train which attracts a different fare from that of the ordinary coaches. The fare for the ordinary service was 2 cedis for the two corridors and 3 cedis for the Nsawam first class coach.

Infrastructure Challenges

The railway lines have a gauge of 1, 067 (mm) and look quite old especially the Nsawam corridor railway lines. The existing network has been observed to have obsolete tracks and inadequate stations and platforms. There is a recommendation for rehabilitation in some cases and a total overhaul of the system to create a modern railway to support Ghana's emerging economy (Team Engineering Roma, 2013).

The Ghana Railway Development Authority [GRDA] (2013) enumerates a number of risks that are associated with the infrastructure challenges of the railway sub-sector. The GRDA identified the potential risks that are posed by people trading along railway lines, passengers trying to board the train when it is in motion, and people crossing the railway lines as a thoroughfare.

One other observation is that railway planning is also not linked to the development of the Airport. The nearest station that is close to the Kotoka International Airport is a halt. In an international airport, the development of a railway network that is linked to the airport will afford travellers the full complement of an intermodal journey planning. Travellers could decide to continue their journey to the city and other regional cities using the train from the airport. The Transportation Research Board of USA (2015), acknowledges the contribution of Airport railway to providing the enabling environment for an intermodal transportation system that provides travellers with an alternative means of transportation from the city to other cities without using the already congested internal air travelling system.

The main railway station in the Central Business District of Accra (Tudu) requires a complete redevelopment to befit its status as the main railway station in Accra. There is competition for the land between the Railway authorities and petty traders (Figure 18). It was observed that the structures of the place look quite neglected, rusty and some obsolete. Linked to this is the encroachment on the lands adjoining the railway lines by informal business entities and estate developers. This poses a serious threat to the expansion or development of new railway lines.

Figure 18: Traders at a section of the Accra Central Railway Station.
Source: Agyemang (2016)

The Accra-Nsawam system has peculiar infrastructure challenges. The Diesel Hydraulic Locomotive train is very old and the railway lines are not in a good condition. During the on-board survey, passengers lamented on the state of the train and the service being provided by the Ghana Railway Company. The research team observed on-board that the train was wobbling and very noisy. Passengers had stories on the operations of the train. A 35-year-old trader, in an interview, narrated that:

> *There was a day that some of the coaches got separated from the main train as the train was on its normal journey from Nsawam to Accra.*

A 19-year-old Senior High School student complained:

> *I am scared most of the times I get aboard the train but it is the most affordable means of transportation for me. I also get to school on time when I take the train.*

Infrastructure development is discussed against the background of its importance in the perception of users on service quality. Zeithaml et al (1990) identified tangibles within the broad dimensions of service quality to include physical facilities, equipment, personnel and written materials. The Input-Output Framework of Transport Interventions, the conceptual framework (Figure 5), for the study also identifies infrastructure and services as very important in the development of transport interventions.

Summary

The chapter focused on the infrastructure for the implementation of Mass Rapid Transit (MRT) in the GAMA with the spotlight on BRT and CRT. There are three routes for the type 2 BRT service in the GAMA. Aayalolo bus system has 4 terminals, 15 Type B specific stations and 27 simple stops along the bus route for the pilot project. A Control Centre enables GAPTE to effectively monitor and control the schedule of each bus.

There are two CRT corridors in the GAMA being the Accra-Tema (30.2km) and the Accra-Nsawam (40.6km) corridors. The CRT system has a number of infrastructure challenges. The railway lines look quite old, especially the Nsawam corridor railway lines; railway planning is also not linked to the development of the Airport; and there is encroachment on the lands adjoining the railway lines by informal business entities and estate developers.

The condition of infrastructure is highlighted in view of the fact that the Input-Output Framework of Transport Interventions (IBRD/World Bank, 2010), the conceptual framework identifies infrastructure and services and vehicle fleet as important ingredients of transportation intervention.

CHAPTER SEVEN

PREFERENCES AND MOTIVATIONS FOR BUS RAPID TRANSIT (BRT) AMONG SMALL PRIVATE MOTOR VEHICLE USERS

Introduction

This chapter examines factors that would motivate small private motor vehicle users to park and use Bus Rapid Transit (BRT) if fully implemented in the city. The survey was conducted before the introduction of the BRT Lite system in the city of Accra. One prime objective of the introduction of BRT in many cities is to reduce the number of small private vehicles using the major roads in the cities and hence reduce congestion, time spent in traffic, and carbon dioxide emission into the atmosphere. These objectives would not be achieved if users of small private vehicles do not patronise the BRT system.

It is logically sound to admit that certain factors should motivate small private vehicle owners to park and use BRT if fully implemented in the city. The chapter covers the socio-demographic characteristics of respondents, the resident and workplace of respondents and characteristics of the vehicles used as well as the operational and maintenance cost of the vehicles. Respondents also assessed factors that would motivate them to use BRT on a Likert scale. A Spearman's rank-order correlation was used to analyse the association between variables. These associations were tested at the significant level of 0.05 (95% confidential level).

Socio-Demographic Characteristics of the Respondents

The study involved the administration of 450 questionnaires of which 430 were retrieved. Respondents were small private vehicle owners in the Greater Accra Metropolitan Area (GAMA). The background characteristics of the respondents are discussed next:

The study revealed that the use of small private motor vehicles was dominated by men. Out of 430 respondents, 65.35 percent were males with 34.65 percent being females (see Table 9).

Table 9: Demographic Characteristics of the Respondents

Demographic	Frequency	Percentage (%)
Gender		
Male	281	65.35
Female	149	34.65
Total	430	100.0
Age		
Below 20	4	0.93
20 – 29	94	21.86
30 – 39	148	34.42
40 – 49	129	30.00
50 – 59	47	10.93
60 – 69	8	1.86
Total	430	100.0
Marital status		
Single	131	30.46
Married	283	65.81
Divorced	6	1.39
Widowed	6	1.39
Separated	4	0.93
Total	430	100.0
Household size		
1	22	5.12
2	49	11.39
3	65	15.12
4	115	26.74

Table 9 continued

5	79	18.37
Above 5	100	23.26
Total	430	100.0
Level of education		
No formal education	1	0.23
Basic education	15	3.49
Secondary	62	14.42
Tertiary	338	78.60
Others	14	3.26
Total	430	100.0
Occupation		
Security service	3	0.70
Manufacturing	13	3.02
Construction	9	2.09
Trade	72	16.74
Hotel and restaurant	12	2.79
Transport and comm.	10	2.33
Financial service	71	16.51
Real estate	8	1.86
Public administration	111	25.81
Education	16	3.72
Health/social work	19	4.42
Others	86	20.00
Total	430	100.0
Income status		
Below 1000	75	17.44
1000 – 1999	161	37.44
2000 – 2999	84	19.53
3000 – 3999	38	8.84
4000 – 4999	35	8.14
5000 – 5999	17	3.95
6000 – 6999	3	0.70
7000 – 7999	4	0.93
8000 – 8999	13	3.02
Total	430	100.0

Source: Agyemang (2016)

This is consistent with the general dominance of males in the use of private automobiles in the developing world as attested by Peters (2013) that women in the developing world have generally low access to private automobiles than their male counterparts. A survey in Ashgabat in Turkmenistan also showed that a greater percentage of vehicle users (79.00 %) were men.

Data on respondents revealed that ownership of small private vehicles concentrated within the working population depicted by ages 20 to 59 (see Table 9). The age cohort with the highest frequency of 148 (34.42%) was 30 to 39 years. The lowest, four (0.93 %) was recorded by the age group below 20 years.

Majority of the respondents (65.81 %) were married and a sizeable proportion of 30.46 percent was also single. There were 1.39 percent (6) for both the divorced and widowed whereas those separated, accounted for 0.93 percent (4) (Table 9).

The household, which “is a group of people who live together, pool their money and eat at least one meal together each day” (Glewwe & Grosh, as cited in Beamer & Dillion, 2012) was considered. The household size that accounted for the highest frequency was 4, with a frequency of 115 (26.74%) with the next being the household size of 5 and above with a frequency of 100 (18.37%). The least household size was 1 with 5.11 percent as shown in Table 9.

Analysis of the level of education of respondents revealed that most (78.60%), had obtained a tertiary level education. This was followed by respondents with secondary education with (14.42%). The dominance of respondents with a tertiary level of education (Table 9) reflects the segment of the population with steady jobs and hence are able to own and operate personal small private vehicles. It also depicts how knowledgeable the respondents were and their ability to analyse factors that would motivate them to park their small private vehicles and use BRT if fully implemented in the metropolis.

The occupational distribution of respondents revealed that the highest category was public administration (25.81%) followed by others with 20.00% percent. Other occupational groups with higher levels of small private motor vehicle ownership included financial services (16.51%) and trading (16.74%). The least was security services with 0.70 percent as shown in Table 9.

The average income of respondents as shown in Table 9 indicated that a substantial proportion of them had a monthly income of less than Gh¢2000.00. Respondents with income of Gh¢2000.00 and above constituted 45.11 percent. The highest income earners had between Gh¢8000.00 and 8999.00, being just 3.02 percent.

Other Major Characteristics Respondents

This session reviews other characteristics of respondents that assist in making general decision on transit ridership, explaining the pattern and characteristics of commuters' journeys, as well as used in the determination of the correlation association between variables to help address the objective "determine the factors that would potentially motivate small private motor vehicle users to use Mass Rapid Transit system".

The study area covered 14 MMDAs of which two (i.e. Nsawam Adoagyire Municipal and Awutu Senya Municipal Assemblies) were from Eastern and Central regions respectively and the remaining 12 from the Greater Accra Region (see Table 10). A review of the location of residence of the respondents showed that 94.70 percent resided in the Greater Accra region; 5.10 percent from the Ewutu Senya Municipal; and 0.20 percent from the Nsawam – Adoagyire Municipal. With regard to the districts in the Greater Accra Region, majority were from the Accra Metropolitan Assembly [AMA] (19.53%) and Ga West (14.65%) with only 0.23 percent each from Dangbe East and La Dade Kotopon (Table 10).

Table 10: Local Area of Residence of the Respondents

Locality	Frequency	Percentage
Awutu Senya	22	5.12
Nsawam Adoagyire	4	0.93
Ga West	63	14.65
Ga South	44	10.23
Ga East	57	13.26
Dangme East	1	0.23
Dangme West	2	0.46
TMA	42	9.77
Adenta	54	12.56
Ledzikuku	34	7.90
AMA	84	19.53
La Nkwantanan	8	1.86
La Dade Kotopon	1	0.23
Ga Central	14	3.26
Total	430	100

Source: Agyemang (2016)

The survey also touched on the location of the workplace of the respondents. Accra Metropolitan Assembly being the old Central Business District (CBD) accounted for 60.70 percent and this was followed by Ga East with 8.84 percent. The least was La Nkwantanan with 0.23 percent as shown in Table 11. This depicts the centripetal pattern of commuting by respondents to the inner city. This also provides evidence that jobs are concentrated in the city centre. A similar pattern of jobs location is exhibited in Guangzhou and Beijing in China where jobs are found to be concentrated in the city centres with residential neighbourhoods skewed towards the peripheries of the cities (Zhao, Lu & de Roo, 2010; Zhou, Wu & Cheng, 2013).

Table 11: Local Authority of Workplace of Respondents

Status	Frequency	Percentage
Awutu Senya East	3	0.70
Nsawam Adoagyiri	2	0.47
Ga west	25	5.81
Ga south	36	8.37
Ga east	38	8.84
Dangme east	3	0.70
TMA	22	5.12
Adenta	14	3.26
Ledzikuku	7	1.62
AMA	261	60.70
La Nkwantanan	1	0.23
Ga Central	18	4.18
Total	430	100

Source: Agyemang (2016)

Analysis of distances travelled by respondents from residence to work daily showed that most (30.70%) were commuting within a distance of 10 to14 km. This was followed by the next immediate distance range of 15 to 19km (22.79%). It is of interest to note that the farthest distance (above 25 km) represented 19.77 percent whereas the shortest distance (less than 10 km) accounted for 16.74 percent (see Table 12). The Ghana National Spatial Development Framework document comments on the lack of information on commuting distances in the country. It further explains that commuting distances assist in defining the functional area of a given urban centre (Government of Ghana, 2015c).

Table 12: Daily Commuting Distance by Respondents to Work

Distance	Frequency	Percentage
Less than 10km	72	16.74
10-14km	132	30.70
15-19km	98	22.79
20-24km	43	10.00
Above 25km	85	19.77
Total	430	100

Source: Agyemang (2016)

Longer driving time especially in a traffic jam is a nuisance to motorists and serves as a disincentive for the use of personal small private vehicles in favour of using Mass Rapid Transit systems. It was evident that most respondents (44.65 %) used over 30 minutes to commute from the house to the workplace (Table 13). It is also of interest to observe that 5.2 percent used over 2 hours to journey to the workplace. The reduction of the time spent to reach the office through the introduction of Mass Rapid Transit may serve as an incentive for commuters with small private motor vehicles to park and join public transit.

Time spent in driving from the workplace to the house followed a similar pattern as that driving from the house to the workplace. Majority of the respondents (35.81%) used between 30 to 59 minutes to the house. Respondents using less than 30 minutes accounted for 8.37 percent as shown in Table 13.

Table 13: Time Involved in Driving by Respondents

Response	Driving in the morning to work		Driving in the evening to the house	
	Frequency	Percent	Frequency	Percent
less than 30 mins	69	16.05	36	8.37
30mins to 59mins	192	44.65	154	35.81
1hr to 1hr 29mins	98	22.79	135	31.40
1hr 30mins to 1hr 59mins	49	11.40	49	11.40
2hrs and above	22	5.12	56	13.02
Total	430	100	430	100

Source: Agyemang (2016)

Determination of Motivation Factors

This section focuses on factors that would motivate small private motor vehicle users in the Greater Accra Metropolitan Area (GAMA) to park and use Bus Rapid Transit (BRT). Based on the characteristics of the BRT system from literature and as being implemented in other cities, a number of variables were developed. The variables were grouped into three namely: the condition of buses and bus lanes, terminal development, and customer care. Mean and the standard deviation was employed to rank the various factors within the three groups. The highly ranked factors were selected from each group for further analysis. The results are presented in Tables, 14, 15 and 16.

Table 14: Mean and Standard Deviation Scores of Respondents Under Condition of Buses and Bus Lanes

Factors	N	Min	Max	Mean *(M)*	Std. Dev. *(SD)*
Punctual and frequent buses	430	1	4	3.48	.76
Comfortable and neat	430	1	4	3.42	.80
Safety while riding in the bus	430	1	4	3.37	.81
Rapid travel time	430	1	4	3.37	.82
Segregated lanes for BRT buses	430	1	4	3.29	.88
Buses operating for long hours	430	1	4	3.22	.91
Low price per trip	430	1	4	3.19	.88
Buses using both segregated and non-segregated lanes	430	1	4	2.32	1.0
Buses use the same lanes as other vehicles	430	1	4	1.80	.99

Source: Agyemang (2016)

With regard to the condition of buses and bus lanes, a greater proportion of the respondents strongly agreed that punctuality and frequency of buses were paramount *(M=3.48)*, followed by comfortable and neat buses *(M=3.42)*, safety while riding in the bus *(M=3.37)* and rapid travel time *(M=3.37)* (Table 14). However, segregated bus lanes which are very important in the development of a full BRT system was not given the deserved attention of respondents *(M=3.29)*. The table explains how transit riders attach very much importance to punctuality and service reliability. A study by Talagala & Kalukottege (2014), to determine factors that motivate public transit ridership in Colombo, Sri Lanka, revealed punctuality and service reliability as the most important consideration irrespective of income status and other characteristics of respondents.

One other observation from the Table (14) is that respondents ranked comfortable and neat buses and rapid travel time as more important variables to motivate them to use BRT than the nature of the bus lanes, whether segregated or non-segregated lanes. The preference for neatness and quality of the bus services is evident in a similar observation by Litman (2018) in Canada that some transit users opted for high-quality transit with little consideration of the time they will spend because they can work or rest.

With regard to the nature of the lanes, segregated bus lanes triggered more willingness to park small private vehicles and use BRT than buses using both segregated and non-segregated lanes, and buses using the same lanes as other vehicles. The idea of buses using the same lane as other modes of vehicular transportation attracted the least score among the group variables *(M=1.80)*. It indicated the fear of respondents that is related to the possibility of being in the transit bus for many minutes or hours in a traffic jam.

There is, however, a concern about the cost involved in the construction of bus lanes which serves as a challenge to the implementation of a full BRT system. Litman (2018) noted that bus lanes increase the construction cost and reduce the actual traffic capacity and sometimes price out on-street parking facilities. The implementation of a full BRT is explained as requiring extra road and station space and improving upon the walking space of pedestrians for improved walkability. In spite of these noted challenges, the recognition of the importance of bus lanes in improving public transit system is also noted by the author to include reduced travel time, increased ridership, reduced automobile use and the promotion of a multimodal travel system that incorporates the use of non-motorised modes of transportation.

The second group of variables related to issues of terminal development (Table 15). Respondents ranked adequate security and safety at the bus station as important *(M=3.33)* in motivating small private motor vehicle owners to park and use Bust Rapid Transit (BRT).

Table 15: Mean and Standard Deviation Scores of Respondents Under Terminal Development

Factors	N	Min	Max	Mean *(M)*	Std. Dev. *(SD)*
Adequate security and safety at bus station	430	1	4	3.33	.78
Adequate parking lot	430	1	4	3.21	.89
Ability to switch to different transport modes at terminal	430	1	4	3.16	.83
Ability to get basic goods I need at the main terminal to buy	430	1	4	2.85	.94
Short distance from my house to the bus terminal	430	1	4	2.65	.96

Source: Agyemang (2016)

This was followed by adequate parking lot *(M=3.21)* and the ability to switch to different transport modes at the bus terminal *(M=3.16)*. Ability to get basic goods to buy at the station and short distance from the residence of respondents to the bus terminal were not issues of important consideration in the decision to park and use BRT. The identification of short distance from the residence of respondents to the bus terminal as a minor factor *(M=2.65)* to motivate small vehicle owners to use BRT is at variance with a study to appreciate the differences in attitude of United States (US) population towards the use of public transit that indicated closer distances to transit station/stops as one of the most important determinants of ridership by all age groups (Transit Centre, 2014).

The provision of parking spaces encourages transit ridership. Respondents expressed the importance of adequate parking spaces to encourage park-and-ride. The Government of Ontario, Canada, has witnessed a positive relationship between parking spaces provision and transit ridership. Transportation planning also incorporates comprehensive planning for the provision of terminal parking spaces, including the provision of bicycle racks, to encourage intermodal journey planning by transit users. The ultimate vision is to grow ridership, improve upon customer care and experience and eventually curtail the number of single-occupant vehicles (Metrolinx, 2013).

The ability to switch to different transportation modes at the terminal highlights on the importance of proper terminal development for sustainable intermodal and multimodal transportation planning. The ability of transit riders to get different modes of transportation at transit terminals increases confidence in the public transportation system. It is in line with this certitude that the Ghana Integrated Transport Plan document advocates for a collaboration of agencies for different modes of transport to ensure co-ordination of actions and projects to ensure modal compatibility and for passengers to make effective use of intermodal transportation facilities (Ministry of Finance and Economic Planning, 2010).

On customer care, Table 16 revealed that respondents ranked adequate shelter at the station against rain and sunshine as very important *(M=3.33)*, followed by presence of personnel who know the system and are able to provide travel schedule information readily *(M=3.29)* and the presence of advanced technology and ticketing system at the station *(M=3.28)*.

Table 16: Mean and Standard Deviation Scores of Respondents Under Customer Care

Factors	N	Min	Max	Mean *(M)*	Std. Dev. *(SD)*
Adequate shelter at the station against rain and sunshine	430	1	4	3.33	.86
Presence of personnel who know the system and are able to provide travel schedule information readily	430	1	4	3.29	.82
Presence of advanced technology and ticketing system at the station	430	1	4	3.28	.81
Friendly and helpful staff to customers at the bus terminal and in transit	430	1	4	3.27	.83
Presence of washrooms at the station	430	1	4	3.20	.88
Accessibility of buses to those with disability	430	1	4	3.16	.84

Source: Agyemang (2016)

However, respondents were not much concerned about the presence of washrooms at the station and accessibility of buses to those with a disability. The importance that respondents attached to adequate shelter at the station relates to the impact of weather on transit ridership. Guo and Rahbee (2007) posit that transit riders suffer from the impact of weather conditions on their route to transit stops and during the waiting time to get aboard.

Getting the reliable information on transit schedule and availability is very important for the traveller in today's busy and business environment. Hence respondents were of the view that transit services personnel at terminals and transit stops should be able to provide reliable information on transit modes and schedules. Smart cities are however introducing new technological measures to provide the desired information to transit riders. A study by the American Public Transportation Association (APTA) divulged that there has been a significant reduction in transit ridership in major cities in the country with the exception of New York and Boston cities. It was realised that these cities have adopted smart cities measures with the introduction of technology to help create sustainable transit systems. The introduction of transit services Apps enabled the provision of information and getting transit services more accessible to compete with Uber services.

The presence of advanced technology and ticketing system is an aspect of Intelligent Transportation System (ITS) that covers aspects of smart technology that make transportation journey planning, ticketing and information dissemination easy. Climate Group et al (2011) explains smart transportation measures as one of the characteristics of smart cities. These measures include the use of smart cards that link multiple forms of transport, provision of transport information via mobile phone applications (APPs); and real-time transport displays that will ensure adequate and efficient visibility to public transport users.

The relatively low concern for accessibility of buses to the physically challenged reflects the nature of the respondents, non-wheel chair users and hence cared less for the accessibility of buses by the physically challenged. The buses for the Accra BRT Lite system however, have been made disability friendly with the provision of ramps that are lowered down at stations when necessary for passengers in wheelchairs to have access to the bus or exist similar to Tucson, Arizona, BRT that have low-floors with wheelchair ramps and mechanisms to reduce slopes to make buses accessible to the disabled (Pedestrian and Bicycle Information Centre [PBIC], 2000).

Determination of Variables for Further Analysis

In the determination of variables for further analysis, three best-ranked variables from each of the three groups as seen under Table 20 being condition of buses and bus lanes, terminal development, and customer care were selected to get 9 main variables that will motivate small private motor vehicle owners to park and use BRT. In addition, some basic variables that serve as the major characteristics of BRT systems (from literature) were also included being: presence of advanced technology and ticketing system at the station; buses operating for long hours; low price per trip; buses with segregated lanes, buses using both segregated and non-segregated lanes; and buses using the same lane as other vehicles.

In the main, the following factors were identified for further analysis:

1. Punctual and frequent buses
2. Comfortable and neat
3. Safety while riding in the bus
4. Rapid travel time
5. Adequate security and safety at the bus station
6. Adequate parking lot
7. Ability to switch to different transport modes at terminal
8. Adequate shelter at the station against rain and sunshine
9. Presence of personnel who know the system and are able to provide travel schedule information readily
10. Buses with segregated lanes
11. Buses using both segregated and non-segregated lanes
12. Buses use the same lanes as other vehicles
13. Presence of advanced technology and ticketing system at the station
14. Buses operating for long hours
15. Low price per trip
16. Provision of travel schedule

With the aid of Spearman's rank-order correlation, the association between identified factors (characteristics of BRT) and some selected characteristics of the respondents was determined. The significance of these associations was determined at 0.05 significant level (95% confidential level) throughout.

Table 17: Relationship Between Motivation Factors and Demographic/Some Selected Characteristics of the Respondents

	Age	Marital status	Level of education	Income	Occupation	Distance residence to work	Time - residence to work	Time - work to residence	Cost of maintenance
BRT with segregated lanes	rs= 0.13*	rs= -.03	rs= -.04	rs= 0.05	rs= -.13*	rs= .03	rs= .09*	rs= .05	rs= -.03
	p= 0.009	p= 0.588	p= 0.416	p= 0.343	p= 0.006	p= 0.530	p= 0.047	p= 0.296	p= 0.504
BRT buses use the same lanes	rs= -.05	rs= .06	rs= 0.05	rs= -.11*	rs= 0.01	rs= -.04	rs= .11*	rs= -.09*	rs= -.14
	p= 0.265	p= 0.248	p= 0.352	p= 0.026	p= 0.849	p= 0.454	p= 0.023	p= 0.041	p= 0.003
BRT buses use both segregated and	rs= -.05	rs= .09	rs= 0.09	rs= -.12*	rs= -.04	rs= .11*	rs= .08	rs= .02	rs= -.02
non-segregated lanes	p= 0.322	p= 0.079	p= 0.062	p= 0.011	p= 0.475	p= 0.026	p= 0.086	p= 0.627	p= 0.700
BRT buses are comfortable	rs= 0.15*	rs= -.07	rs= -.01	rs= 0.06	rs= -.00	rs= .08	rs= -.19*	rs= .02	rs= -.02
	p= 0.002	p= 0.154	p= 0.839	p= 0.198	p= 0.956	p= 0.098	p= 0.000	p= 0.682	p= 0.634
BRT buses are punctual	rs= 0.12*	rs= -.08	rs= -.00	rs= 0.08	rs= -.03	rs= .11*	rs= .10*	rs= .09	rs= -.06
	p= 0.015	p= 0.084	p= 0.948	p= 0.118	p= 0.524	p= 0.027	p= 0.036	p= 0.067	p= 0.233
BRT buses operate for long hours	rs= 15*	rs= -.09*	rs= -.04	rs= 0.09	rs= -.10*	rs= .05	rs= -.19*	rs= .07	rs= -.03
	p= 0.002	p= 0.045	p= 0.370	p= 0.078	p= 0.039	p= 0.313	p= 0.000	p= 0.147	p= 0.476
BRT buses are safe on board	rs= 0.08	rs= -.07	rs= .02	rs= 0.01	rs= -.05	rs= .03	rs= 0.09	rs= .08	rs= -.02
	p= 0.107	p= 0.130	p= 0.696	p= 0.780	p= 0.274	p= 0.534	p= 0.067	p= 0.116	p= 0.745
BRT buses have rapid travel time	rs= 0.15*	rs= -.09	rs= .03	rs= 0.09	rs= -.09*	rs= .10*	rs= .15*	rs= .11*	rs= -.05
	p= 0.002	p= 0.052	p= 0.612	p= 0.061	p= 0.049	p= 0.035	p= 0.002	p= 0.022	p= 0.279
BRT buses have low fares	rs = -.01	rs= -.01	rs= .01	rs= -.07	rs= -.14	rs= .03	rs= .06	rs= -.06	rs= .11*
	p= 0.816	p= 0.784	p= 0.800	p= 0.167	p= 0.004	p= 0.596	p= 0.192	p= 0.222	p= 0.022
Adequate space for parking	rs= 0.14*	rs= -.04	rs= -.05	rs= 0.09	rs= -.13*	rs= .08	rs= .16*	rs= .12*	rs= -.04
	p= 0.005	p= 0.372	p= 0.312	p= 0.065	p= 0.010	p= 0.113	p= 0.001	p= 0.011	p= 0.383
Ability to switch to different mode	rs= 0.10*	rs= -.05	rs= -.02	rs= 0.03	rs= -.07	rs= .04	rs= .16*	rs= .12*	rs= -.00
	p= 0.032	p= 0.298	p= 0.645	p= 0.552	p= 0.14	p= 0.403	p= 0.001	p= 0.011	p= 0.952
Safety at the bus station	rs= 0.06	rs= -.01	rs= -.03	rs= 0.05	rs= -.03	rs= .07	rs= .19*	rs= .06	rs= -.05

Table 17 Continued

	p= 0.194	p= 0.798	p= 0.549	p= 0.273	p= 0.520	p= 0.130	p= 0.000	p= 0.188	p= 0.286
Friendly and helpful BRT workers	rs= 0.14*	rs= -.04	rs= -.06	rs = 0.02	rs= -.07	rs= .04	rs= .17*	rs= .00	rs= -.08
	p= 0.004	p= 0.358	p= 0.222	p= 0.741	p= 0.123	p= 0.446	p= 0.000	p= 0.961	p= 0.108
Advanced technology and ticketing	rs= 0.05	rs= -.11*	rs= -.07	rs= -.02	rs= -.11*	rs= .06	rs= .24*	rs= .05	rs= -.05
	p= 0.261	p= 0.029	p= 0.176	p= 0.691	p= 0.023	p= 0.190	p= 0.000	p= 0.292	p= 0.290
Adequate shelter at the terminal	rs= 0.04	rs= -.04	rs= -.05	rs= -.05	rs= -.02	rs= .08	rs= .23	rs= .02	rs= -.13*
	p= 0.444	p= 0.445	p= 0.343	p= 0.324	p= 0.730	p= 0.081	p= 0.000	p= 0.713	p= 0.006
Provision of travel schedule	rs= 0.14*	rs= -.08	rs= -.05	rs= -.01	rs= -.10	rs= .06	rs= .18*	rs= .07	rs= -.07
	p= 0.004	p= 0.113	p= 0.333	p= 0.889	p= 0.038	p= 0.220	p= 0.000	p= 0.151	p= 0.174

* Significant at 0.05

Source: Agyemang (2016)

Discussion

This section of the report discusses the results and analysis of Spearman's rank correlation tests which were run on the association between motivation factors and demographic/some selected characteristics of the respondents (see Table 17).

With respect to whether respondents will park their small vehicles and use a perfect BRT system with segregated lanes, Spearman rank correlation test indicated that there was statistically significant difference between age (r_s=0.13, p = 0.009), occupation (r_s=-0.13, p = 0.006), time involved to travel from residence to work (r_s=0.09, p = 0.047) and the motivation to patronise the BRT with segregated lanes.

There was a positive correlation between using a perfect BRT system with segregated lanes and the age of the respondents. Thus, the older the person was, the more willing to board BRT with segregated lanes. Similarly, there was a positive correlation with a perfect BRT system with segregated lanes and the time involved to travel from residence to workplace. The longer the time travelled the greater the motivation to use a BRT system with segregated lanes. This may be due to the desire to reduce the cost of driving a personal private vehicle for a long distance and the inconvenience of being in traffic for a long time.

Deng and Nelson (2011 & 2013) observed that BRT with dedicated bus lanes generally has the advantage of the most travel time reliability. The advantage that such BRT systems have by way of 'the queue jumper' strategy at intersections enables these buses to have rapid travel time. Similarly, Cervero and Kang (2009) in their work on BRT impacts on land uses and values in Seoul, revealed that the advantages that commuters enjoyed for using BRT (rapid travel time) had a positive impact on land values of areas along the corridor.

With respect to using BRT buses that operate in the same lanes as other modes of transportation, there was statistically significant difference between average monthly income (r_s=-0.11, p = 0.026), time involved to travel from workplace to residence (r_s=-0.09, p = 0.041), and time involved to travel from residence to workplace (r_s=0.11, p = 0.023). There was a negative association between the income level and the motivation to use BRT using the same lanes as other modes of transportation. The motivation to use BRT in this regard reduced with an increase in income levels. This is in line with a study by Balcombe et al (2004) that concluded that an increase in income has a negative impact on the demand for public transit services.

Generally, there was a positive association between the time involved in journeying with small private vehicles from the house to workplace and back and the motivation to use BRT operating on the same lanes as other transportation modes. The motivation to use BRT increased with an increase in the time involved in the journeys.

The BRT Lite system that is being implemented in the Greater Accra Metropolitan Area uses a combination of segregated and non-segregated lanes. The analysis revealed that there was statistically significant difference between average monthly income (r_s=-0.12, p = 0.011) and the distance respondents travelled from residence to work (r_s=0.11, p = 0.026) and the motivation of the respondents to use BRT buses that use both segregated and non-segregated lanes.

With regard to the income status of the respondents, as respondents' average monthly income increased, the motivation to use BRT buses that use both segregated and non-segregated lanes reduced. On distance, there was a positive association between distance respondents travelled from place of residence to workplace and the motivation of the respondents to use BRT buses that use both segregated and non-segregated lanes. The motivation to use BRT buses improved with distance travelled.

With regard to parking and using BRT buses that are neat and comfortable to ride, the results showed that there was statistically significant difference between age, ($r_s=0.15$, $p = 0.002$), time respondents used to travel from place of residence to workplace ($r_s=-0.19$, $p< 0.001$) and the motivation of the respondents to ride BRT. There was a weak positive correlation between the age of the respondents and the motivation to ride BRT buses that are neat and comfortable as the age increased with the level of motivation to use BRT. Hensher, Stopher, and Bullock (2003) posit that comfort is highly rated by users of public transport. Bus Rapid Transit (BRT) generate a positive impact on customer satisfaction by ensuring quality service through maintaining safety and comfort, swift movement, and reliability (Kathuria, Parida, Sekhar, & Sharma, 2016).

With respect to time, there was a weak negative correlation between the time respondents used to travel from place of residence to workplace and the motivation to ride BRT if buses were neat and comfortable. An increase in the time for journeying to the workplace resulted in a reduction in the motivation to use BRT with neat and comfortable buses. This revelation was quite beyond what was expected as an increase in the time for journeying to work was expected to motivate respondents to use BRT with neat and comfortable seats.

Punctuality is key when it comes to BRT services. Spearman rank correlation test revealed that there was a significant relationship between age *(r_s=0.12, p = 0.015)*, distance from residence to work *(r_s=0.11, p = 0.027)*, time respondents used to travel from residence to work *(r_s=0.10, p = 0.036)* and the motivation of the respondents to ride if BRT buses are punctual. There was a weak positive association between the age of the respondents and the motivation to ride BRT if buses are punctual. The aged would be more motivated to board the BRT if buses are punctual as compared with the young commuters. Wakabayashi, Asaoka, Lida and Kemenda (2003) explained that in assessing the quality of public transport services, commuters generally pay great attention to the frequency of service and adherence to timetables.

With respect to time, there was a positive association between the time involved in journeying from the house to the workplace and from the workplace to the house and the motivation to use BRT buses that are punctual. The motivation to use BRT improved with an increase in the time for using personal private vehicle to journey to the workplace or from the workplace back to the house.

The operation of Mass Rapid Transit (MRT) systems for long hours assures commuters of regular and reliable means of transportation. The Spearman's rank correlation test showed that there was statistically significant difference between age *(r_s=0.15, p = 0.002)*, marital status *(r_s=0.09, p = 0.045), occupation (r_s=-0.10, p = 0.039)* and time spent to travel from residence to work *(r_s=-0.19, $p < 0.001$)* and the motivation of the respondents to ride BRT if buses operate for long hours.

With regard to age, it was found out that there was a weak positive correlation between age of the respondents and the motivation of the respondents to ride BRT if buses operate for long hours as the level of motivation to use BRT improved with an increase in the age of the respondents. For a number of motivation factors considered such as buses operating for long hours, punctual buses, neat and comfortable buses, and BRT with segregated lanes, there seems to be a positive correlation between age and the motivation to use BRT under these factors. The aged were more willing to patronise BRT with the aforementioned conditions. Burian, Zajickova, Ivan, and Mack (2018) however, caution that the age group to concentrate on in promoting public transit should be the 25-50 age group.

Also, there was a weak positive association between the time respondents journeyed from the place of residence to the workplace and the motivation to ride BRT if buses operate for long hours. The time spent travelling from the residence to the workplace increased with the motivation of the respondents to ride BRT if buses operate for long hours, but at a lower rate.

There was no statistically significant difference between sex, age, marital status, level of education, average monthly income, occupation, distance from residence to work, time involved in driving from residence to work, time for driving from work to residence, cost of maintenance and the motivation of the respondents to park and ride if there is safety on board BRT buses. Hence safety aboard a BRT bus was not an important consideration to effect a change in the decision of respondents to park and use BRT irrespective of their demographic and other characteristics. Agarwal and Collins (2016) in their research on opportunities and barriers for public transit use in Canada, also concluded that safety concerns did not surface as an important factor to deter users from patronising transit services.

In considering the decision of respondents to use BRT buses with rapid travel time, the analysis revealed that there was statistically significant difference between age (r_s=0.15, p = 0.002), occupation (r_s=0.09, p = 0.049), distance respondents covered from place of residence to workplace (r_s=0.10, p = 0.035), time respondents used to journey from place of residence to workplace (r_s=0.15, p = 0.002), and time respondent used to journey from workplace to place of residence (r_s=0.11, p = 0.022).

There was a positive association between age of the respondents and the motivation of the respondents to ride BRT if buses have rapid travel time. As the age of the respondents increased, the motivation to board BRT buses with rapid travel time also increased. However, in their work on the travel behaviour of young people in the context of climate change, Line, Chatterjee and Lyons (2010) identified rapid travel time as very important in the decision to use transit, especially by young commuters. The authors explained that many young people use private vehicles to work because of the extra time they would require to travel by transit.

There was also a positive association between the distance travelled from the residence to the workplace and the motivation of the respondents to ride BRT if buses have rapid travel time. The distance travelled by respondents from the residence to the workplace increased with the motivation to ride BRT if buses have rapid travel time. A weak positive relationship was exhibited between the time respondents spent in journeying from the residence to the workplace and back and the motivation to ride BRT with rapid travel time. An increase in the travelling time also propelled a resultant increase in the motivation to use BRT with rapid travel time.

The analysis so far justifies the importance of reduced travel time on the ridership. Commuters would be willing to join BRT to reduce their journey time to the workplace and back to the residence. This is in tune with a survey by TransitCentre (2016) that identified improvement in frequency and travel time as important factors the drive the overall passenger satisfaction with transit. The overall speed of transit is considered as an important factor to encourage ridership of public transit (Agarwal & Collins, 2016).

Buses operating with low fares are supposed to entice commuters using small private vehicles to park and use BRT. There was statistically significant difference between occupation *(r_s=0.14, p = 0.004)* and cost of maintenance *(r_s=0.11, p = 0.022)* and the motivation of the respondents to ride if BRT buses have low fares. It was revealed that there was a positive association between the cost of maintenance of private vehicles and the motivation to use BRT with low fares. The higher the cost of maintenance, the greater the motivation to use BRT with low fares. Generally, an increase in fares will trigger a reduction in the patronage of transit services (Balcombe et al, 2004)

Most MRT systems have park and ride facilities to encourage commuters to have adequate space to park their private vehicles at terminals and join MRT. It was expected that the provision of adequate parking facilities should motivate commuters to use BRT. The results of Spearman's rank correlation indicated that there was statistically significant difference between age *(r_s=0.09, p = 0.045)*, occupation *(r_s=0.13, p = 0.010)*, time involved in driving from residence to work *(r_s=0.16, p = 0.001)*, time involved in driving from work to residence *(r_s=0.12, p = 0.001)* and the motivation of the respondents to ride BRT if there is adequate space for parking.

With regard to age, there was a weak positive correlation between the age of the respondents and the motivation of the respondents to ride BRT if there is adequate parking space. The level of motivation to ride BRT if there is adequate parking space improved with an increase in the age of respondents. Fortunati (2018) however, argues that the availability of park and ride facility alone will not promote transit ridership if the cost of parking makes the total amount that the commuter pays for the entire journey to the workplace and back more expensive than the cost of driving with the personal private vehicle.

A weak positive correlation was exhibited between the time respondents spent in travelling from the residence to the workplace and back and the motivation to ride BRT if there is adequate parking space. As the time spent by respondents from the place of residence to the workplace and back increased, the motivation of the respondents to ride BRT if there is adequate parking space also increased.

Analysis on the association between the ability of respondents to switch to different modes of transportation at transit terminals and the motivation to use BRT indicated that there was statistically significant difference between age *(r_s=0.10, p = 0.032)*, time respondents used to drive from place of residence to workplace *(r_s=0.16, p = 0.001)*, and time involved in driving from work to the residence *(r_s=0.12, p = 0.001)*. Age was very responsive to the ability to switch to a different mode of transport. This may be due to the energy required to walk or travel for a long distance in search of an alternative mode of transport. The adult respondents were, therefore, more willing to ride BRT if there is adequate provision for switching to different modes of transportation at transit terminals.

Also, with time factor, the longer the respondent journeyed from the residence to the workplace and back the greater the motivation to use BRT if there is adequate provision for switching from one mode of transportation to another at transit terminals. The ability to switch from one transport mode to another is an integral component of modal integration. Efficient planning of integration ensures confident in urban public transportation by enabling easy planning of journeys and switching from one mode to another. WSP Canada Inc. (2016) argue that BRT system in Edmonton, Canada, will achieve improvement in ridership if there is effective modal integration.

Safety at transit terminals and stations is seen as very important in transit ridership determination. However, the only factor that had an influence on the decision to ride BRT if there is safety at transit terminals and stations was time involved in driving from residence to work ($r_s=0.17$, $p< 0.001$) which had a positive effect on decision making.

The friendliness and helpfulness of transit services workers at terminals and stations and in the buses socially serve as a motivation for users to make decision on ridership. It came to light that there was statistically significant association between age ($r_s=0.14$, $p = 0.004$), time involved in driving from work to residence ($r_s=0.17$, $p< 0.001$) and the motivation of respondents to ride BRT with staff friendly and helpful to customers. It surfaced that the age of the respondents had a positive influence on the decision to ride BRT if transit workers at terminals, stations and in the buses are friendly. The aged would be more motivated by the friendliness and helpfulness of the workers in deciding on whether to ride BRT buses or not.

With regard to time, there was a weak positive correlation between the time respondents used to travel from the residence to the workplace and the motivation to ride BRT if workers are friendly and helpful. As the time spent in journeying from the residence to the workplace increased, the motivation of the respondents to ride BRT with friendly and helpful workers also increased, but at a lower rate.

Artificial intelligence has been transforming the entire transport ecosystem with the introduction of smart ticketing services and mobile Apps to assist in journey planning for the urban transit user and commuters. There was a statistically significant difference between marital status (r_s=-0.11, p = 0.029), occupation (r_s=0.11, p = 0.023) and time respondents used to journey with small private vehicles from the residence to the workplace (r_s=0.24, p< 0.001) and the motivation to ride BRT buses if there are advanced technology and ticketing.

There was a weak positive correlation between the time respondents used to travel from place of residence to the workplace and the motivation of the respondents to ride BRT if there are advanced technology and ticketing. The motivation to use BRT if there are advanced technology and ticketing improved as the time involved in driving with small private vehicles from the residence to the workplace increased. In their study on electronic ticketing in public transport, the European Metropolitan Transport Authorities [EMTA]

(2008) explained that the advantages that customers derive from the use of electronic-ticketing such as fare integration of different transport modes, enjoying discounts, and ensuring adequate information for effective journey planning are likely to attract new customers and to instil the loyalty (European Metropolitan Transport Authorities [EMTA, 2008]).

With respect to the provision of adequate shelter at transit terminals and stations, the results indicated that there was a significant positive association between the cost of maintenance *(r_s=0.13, p = 0.006)* and the motivation of the respondents to use BRT buses if there is adequate shelter at the terminals and stations. The higher the cost of maintenance, the higher the motivation to use BRT buses if there is adequate shelter at terminals and stations. Passengers waiting for transit would prefer to have neat, comfortable, safe, and adequate shelter to ensure protected from the weather conditions (Balcombe et al, 2004).

Provision of adequate travel schedule information also assists in journey planning for the transit user. It has become very important in transit ridership determination. It surfaced that there was statistically significant difference between age ($r_s=0.11$, $p=0.023$) and the time respondents use to travel from place of residence to place of work ($r_s=0.18$, $p<0.001$) and the motivation to use BRT if there is provision of travel schedule information.

It was found out that there was a weak positive correlation between the age of the respondents and the motivation of the respondents to ride BRT if there is provision of adequate travel schedule information. As the age of the respondents increased, the motivation to board BRT if there is provision of travel schedule information also increased. Therefore, the grown-ups were more motivated to board the BRT as compared with the youth when there is provision of travel schedule information. It was however expected before this revelation that the youth would have been more interested in travel-related technology and information to enable them to plan their daily travel schedule effectively.

There was also a weak positive correlation between the time respondents used to travel from the residence to the workplace and the motivation to ride BRT if there is provision of travel schedule information. The greater the time spent in travelling from place of residence to the workplace, the greater the motivation of the respondents to ride BRT if there is adequate provision of travel schedule information (but at a lower rate).

Summary

The chapter focused on the factors that would motivate small private vehicle owners to park and use BRT in the Greater Accra Metropolitan Area. It involved analyses of 430 questionnaires. The chapter commenced with a description of the socio-demographics as well as other characteristics that assist in making general decision on transit ridership and explaining the pattern and nature of journeys of the respondents. With the aid of Means (*M)* and Standard Deviations *(SD)* of a 4-point Likert scale, the analysis revealed that the three most important factors that would motivate small private motor vehicle users to park and use BRT were punctuality and frequency of buses (*M*=3.48), comfortable and neat buses (*M*=3.42), and safety while riding in the bus (*M*=3.37).

Generally, there was a negative correlation association between income and transit ridership. There was also a positive correlation between age and transit ridership. Distance from the residence to the workplace was well as from the workplace to the residence exhibited a positive correlation association with buses having rapid travel time. The findings affirm the assertion of the Input-Output Framework of Transport Interventions (IBRD/World Bank, 2010), the conceptual framework, that the desired outputs of transport interventions should include mobility, accessibility, quality, efficiency and safety.

CHAPTER EIGHT

PASSENGER PERCEPTION OF TRAIN OPERATION

Introduction

This chapter commences with the historical development of railways in the country. A description of the demographic and other characteristics of the Commuter Rail Transit (CRT) users in the Greater Accra Metropolitan Area follows. Another section of the chapter addresses the perception of commuters using the CRT. Based on the characteristics of the CRT system from literature and as being implemented in other cities, a number of perceived factors were developed. The various perceived factors of the train were grouped into five: customer care, terminal development, the condition of coaches, train services and train operation. Means *(M)* and Standard Deviations *(SD)* were used to identify the major factors that were highly perceived as positive by the respondents in the two corridors (Tema and Nsawam) and in general. With the aid of Spearman's rank-order correlation, the relationship between identified factors and some selected characteristics of the respondents were determined.

Historical Development of Railways in the Country

During the late 1800s, the colonial government saw the need to commence the development of railways in the country. A number of railway lines were proposed to be constructed but later abandoned for some reasons. In 1873, the proposed railway line to connect the colonial capital of the period, Cape Coast, and Kumasi, the capital of the Ashanti Kingdom, to assist in sending troupes to fight Ashanti was abandoned due to the early end of the war. Governor Griffith also proposed a railway line from Saltpond through Oda to Kumasi in 1893 to assist in connecting the oil palm belt around Oda to Kumasi. This could not materialise with the retirement of the Governor in 1895. Similarly, a proposed line from Accra to Kpong in 1898 to open up oil palm and cotton cultivation in the area by Governor Hodgson was approved in 1903 but abandoned after he retired in 1904. His successor, Governor Rodger, favoured the construction of the Eastern line which started in 1909 (Jewad & Moradi, 2011).

Railway in Ghana commenced under the management of the Gold Coast Civil Service in 1898. Construction of railway lines started with the construction of the 66km Sekondi to Tarkwa track in 1902; 133 km Tarkwa to Obuasi track in 1903; and the 68km Obuasi to Kumasi stretch. The year 1912 saw the completion of the Tarkwa to Prestea 29km and the Accra to Mangoase lines. Other developments included the completion of the Accra to Kumasi track by 1923; the completion of the Dunkwa to Awaso branch line in 1944; Achimota Junction to Tema in 1954; and the completion of the 81km Achiase to Kotoku in 1956 (African Rail Ghana Limited, 2010).

The Ghana railway system is made up of a network of 950 kilometres rail track with 1.067m (3’6’’) gauge. The network is mostly single-track lane, concentrated within the southern sector of the country. In the 1960’s the Ghana Railway Corporation was very vibrant, carrying 8 million passengers and 2.3 million tons of freight in 1965. The company witnessed a decline (especially in the 1980s) due to factors such as the changing world economy, inefficient management of the rail system, competition from the road sector, the decline in world commodity prices and the shift in the demand for railway as a mature means of transport in the country. The company also suffered from increasing cost of maintenance, inability to match revenue with the sizable labour cost and the demand for modernisation. These factors culminated in the drop in service quality, customer confidence and hence patronage and revenues (Ministry of Local Government and Rural Development, 2012a; Ministry of Transport, 2008).

After the construction of the Takoradi Harbour, the headquarters was moved to Takoradi under the management of the Ghana Railway and Ports Authority until the SMCD 95 of 1976 separated the Port from Railway operations. This led to the creation of Ghana Railway Corporation, a public corporation, which was transformed into a limited liability company, Ghana Railway Company Limited (GRCL) in 2001 (African Rail Ghana Limited, 2010).

The state of the railways now shows a rail network that is broken down with only partial freight services on the Western Line and some passenger services in Accra. “Signal and communication equipment are obsolete and inoperable, track infrastructure has deteriorated and, where lines have remained unused for years, encroachment has taken place. Rolling stock is poorly maintained and much of the stock has remained unused for years” (Ministry of Finance and Economic Planning, 2010, p.57).

Currently, the Ghana Railway Company Limited operates two railway corridors in the Greater Area Metropolitan Area being the Accra to Nsawam and the Accra to Tema lines as shown in Figure 15.

Demographic Characteristics of Passengers

This section deals with the demographic characteristics of respondents. The survey involved a total number of 830 respondents who commute with train along two railway corridors of the Greater Accra Metropolitan Area being the Accra to Tema and the Accra to Nsawam corridors. In terms of the distribution of respondents by different corridors, the Nsawam corridor accounted for 51.80 percent (430) with the respondents from the Tema corridor having a percentage share of 48.20 percent (400).

The total number of respondents by sex is shown in Table 18. Generally, the male respondents represented 65.06 percent (540) with the female respondents accounting for 34.94 percent (290). The two corridors exhibited a similar pattern of male-female distribution. The Tema corridor had the highest percentage of male respondents, 68.75 percent with a female percentage of 31.25 percentage. With regard to the proportion of female respondents per the two corridors, the Nsawam corridor had a bigger percentage female respondent, being 38.37 percent.

The age cohort distribution of respondents was skewed towards the age groups 20-29 and 30-39 which generally accounted for 53.85 percent of the respondents as shown in Table 18. At the Nsawam corridor, the age groups from 20 to 39 accounted for 47.68 percent whereas the Tema corridor had 60.50 percent. The age group 60 and above had no significant representation in the distribution. The pattern of age distribution reveals the high propensity of the young working age group to commute to work. This observation was similar to the results of a census by the Greater London Authority (2014) that revealed that commuters from outside London local authority concentrated on the age groups 25 to 34 with 33.00 percent and 35 to 49 with 37.00 percent.

Table 18: Demographic Characteristics of CRT Passengers

Demographic	Corridor Category		
	Tema F(%)	Nsawam F(%)	All F(%)
Gender			
Male	275(68.75)	265(61.63)	540(65.06)
Female	125(31.25)	165(38.37)	290(34.94)
Total	400(100)	430(100)	830(100)
Age			
Below 20	67(16.75)	114(26.51)	181(21.81)
20 – 29	127(31.75)	104(24.19)	231(27.83)
30 – 39	115(28.75)	101(23.49)	216(26.02)
40 – 49	46(11.50)	63(14.65)	109(13.13)
50 – 59	43(10.75)	44(10.23)	87(10.48)
60 – 69	2(0.50)	0(0.00)	2(0.24)
70 and above	0(0.00)	4(0.93)	4(0.48)
Total	400(100)	430(100)	830(100)
Marital status			
Single	216(54.00)	178(41.40)	394(47.47)
Married	163(40.75)	220(51.16)	383(46.14)
Divorced	5(1.25)	8(1.86)	13(1.57)
Widowed	12(3.00)	16(3.72)	28(3.37)
Co-habiting	4(1.00)	8(1.86)	12(1.45)
Total	400(100)	430(100)	830(100)
Household size			
1	12(3.00)	20(4.65)	32(3.86)
2	44(11.00)	28(6.51)	72(8.67)
3	50(12.50)	44(10.23)	94(11.33)
4	59(14.75)	100(23.26)	159(19.16)
5	86(21.50)	66(15.35	152(18.31)
Above 5	149(37.25)	172(40.00)	321(38.67)
Total	400(100)	430(100)	830(100)
Level of education			
No formal education	8(2.00)	32(7.44)	40(4.82)
Basic education	50(12.50)	126(29.30)	176(21.20)
Secondary	116(29.00)	164(38.14)	280(33.73)
Tertiary	221(55.25)	108(25.12)	329(39.64)
Others	5(1.25)	0(0.00)	5(0.60)
Total	400(100)	430(100)	830(100)
Occupation			

Table 18 continued

Security service	11(2.75)	4(0.93)	15(1.80)
Construction	31(7.75)	8(1.86)	39(4.70)
Trade	75(18.75)	242(56.28)	317(38.19)
Hotel and restaurant	13(3.25)	20(4.65)	33(3.98)
Transport and comm.	23(5.75)	12(2.79)	35(4.22)
Financial service	27(6.75)	12(2.79)	39(4.70)
Real estate	6(1.50)	4(0.93)	10(1.20)
Public administration	54(13.50)	20(4.65)	74(8.92)
Education	87(21.75)	48(11.16)	135(16.27)
Health/social work	10(2.50)	12(2.79)	22(2.65)
Others	30(7.50)	24(5.58)	54(6.50)
Total	400(100)	430(100)	830(100)
Income status			
Below 1000	67(16.75)	278(64.65)	345(41.57)
1000 – 1999	127(31.75)	72(16.74)	199(23.98)
2000 – 2999	118(29.50)	32(7.44)	150(18.07)
3000 – 3999	33(8.25)	32(7.44)	65(7.83)
4000 – 4999	24(6.00)	12(2.79)	36(4.34)
5000 – 5999	16(4.00)	4(0.93)	20(2.40)
6000 – 6999	5(1.25)	0(0.00)	5(0.60)
7000 – 7999	2(0.50)	0(0.00)	2(0.24)
8000 – 8999	8(2.00)	0(0.00)	8(0.96)
Total	400(100)	430(100)	830(100)

Source: Agyemang (2016)

With regard to the marital status of respondents (Table 18), it was evident that majority were either married (46.14%) or single (47.47%). This pattern was exhibited in the two corridors with 40.75 percent and 51.16 percent married respondents from the Tema and Nsawam corridors respectively and with 54.00 percent and 41.40 percent single. The percentage of respondents who were either divorced, widowed or cohabiting fell below 4 percent in each case both in the overall as well as within the individual corridor classifications.

The household size with the highest frequency was above 5 which accounted for 38.67 percent (321 out of the total of 830). This was followed by the household size of 4 with 19.16 percent and 5 with 18.31 percent. At the individual corridors level, the household size with the highest frequency was above 5 with a percentage 40.00 for Nsawam and 37.25 for the Tema corridor. Household size of 1 accounted for the lowest frequency with an overall total of 3.86 percent and 4.65 and 3.00 percent for Nsawam and Tema respectively (Table 18).

Table 18 presents the educational level of the respondents from the respective corridors. The overall review showed that the most dominant level of education for respondents was tertiary, which accounted for 39.64 percent (329). This was followed by respondents with secondary education with 33.73 percent and basic education with 21.20 percent. With regard to the different corridors, it was realised that Tema corridor had a high proportion, 55.25 percent, of respondents having tertiary education as against 25.12 percent of respondents from the Nsawam corridor. The percentage of respondents with secondary education was, however, higher for the Nsawam corridor (38.14%) than Tema corridor (29.00%). The proportion of respondents without formal education was only 4.82 percent.

The major occupation for the respondents included trading (38.19%), education (16.27%) and public administration (8.92%) (Table 18). The Nsawam corridor had proportionally more commuters being traders (56.28%) as against 18.75 percent for the Tema corridor. The proportion of education and public administrative workers was higher for commuters using the Tema train. Education accounted for 21.75 percent for Tema as against 11.16 percent for Nsawam. Public administration workers also accounted for 13.50 percent of commuters using the Tema train with only 4.65 percent for commuters using the Nsawam train. Other major occupations for commuters using the

Tema corridor train were manufacturing 8.25 percent, construction 7.75 percent and financial services 6.75 percent.

The average monthly income of commuters using train services in the Greater Accra Metropolitan Area is shown on Table 18. Generally, the average income level for the two corridors concentrated around Gh¢1000.00 per month to between Gh¢4000.00 and Gh¢4999.00. The distribution of income also showed a reduction in the number of commuters as income increased. A similar study by Belmonte (2014) indicated that respondents in the highest income quintile households were less likely to use transit than respondents in the lowest income quintile.

With regard to the two different corridors, commuters using the Tema train exhibited relatively higher income levels than the Nsawam train users. Whereas commuters earning less than Gh¢1000.00 constituted 16.75 percent (87) of the Tema train passengers, it constituted 64.65 percent of the Nsawam train passengers. On the other hand, passengers with income levels, Gh¢1000.00 to Gh¢1999.00 constituted 31.75 percent of the Tema corridor passengers but 16.74 percent of passengers using the Nsawam train. No passenger from the Nsawam train corridor earned more than Gh¢5999.00.

Other Major Characteristics of Respondents

This session reviews other characteristic of respondents which assist in making general decision on transit ridership, explaining the pattern and characteristics of the intermodal and multimodal journeys, as well as used in the determination of the correlation association between variables to help address the objective "assess the perception of users of the pilot Commuter Rail Transit system in Accra of its performance"

Figure 19 depicts distances travelled by commuters daily to work. Commuters who travelled for more than 25 kilometres had the highest percentage for both corridors. There were 47.44 percent (204) commuters from the Nsawam corridor and 44.25 percent (177) from the Tema corridor. The next highest proportion was for commuters journeying for 10-14 km to work with 20.75 percent (83) from the Tema corridor and 13.95 percent (60) from the Nsawam corridor. Generally, over 58.00 percent of commuters from both corridors journeyed for 20km and above to work with the train. This portrays the major role that Mass Rapid Transit will play in commuting workers daily from the outskirts of the city to the inner city if fully implemented.

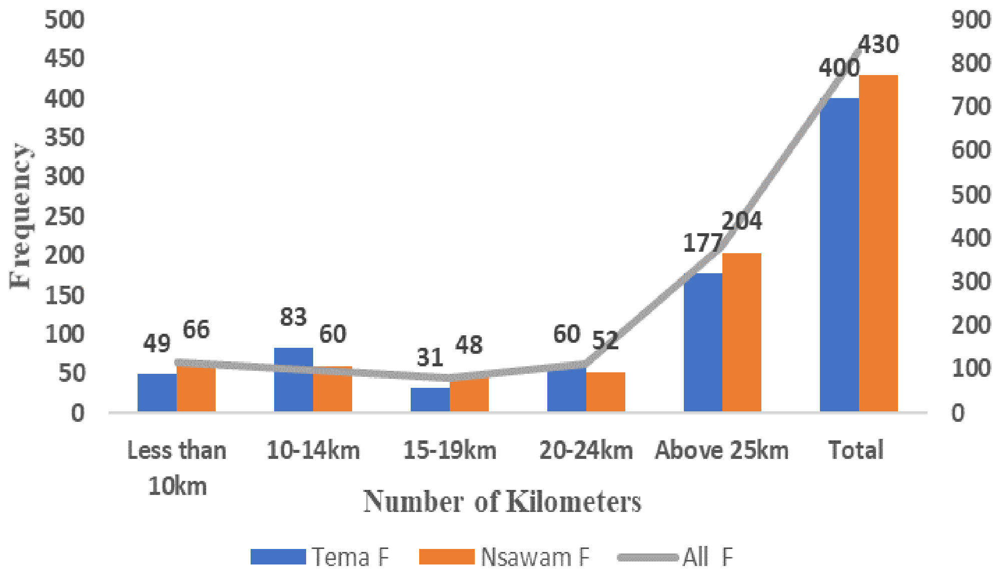

Figure 19: Distances Commuters Travel to Work

Source: Agyemang (2016)

The number of years that commuters had been using the train network was also an issue of interest. From Figure 20 commuters who had been using the train for 1 to 4 years constituted 40.72 percent of the total for the two corridors. Similarly, the figures for commuters using the train for 1 to 4 years constituted 40.50 percent for the Tema corridor and 40.93 percent for the Nsawam corridor. Commuters who had used the train for 5-9 year constituted the lowest proportion of 5.54 percent for the total and 7.50 percent and 3.72 percent for the Tema and Nsawam trains respectively. Generally, the data indicate that the patronage of the train in the Greater Accra Metropolitan Area increased significantly during the period four years and below.

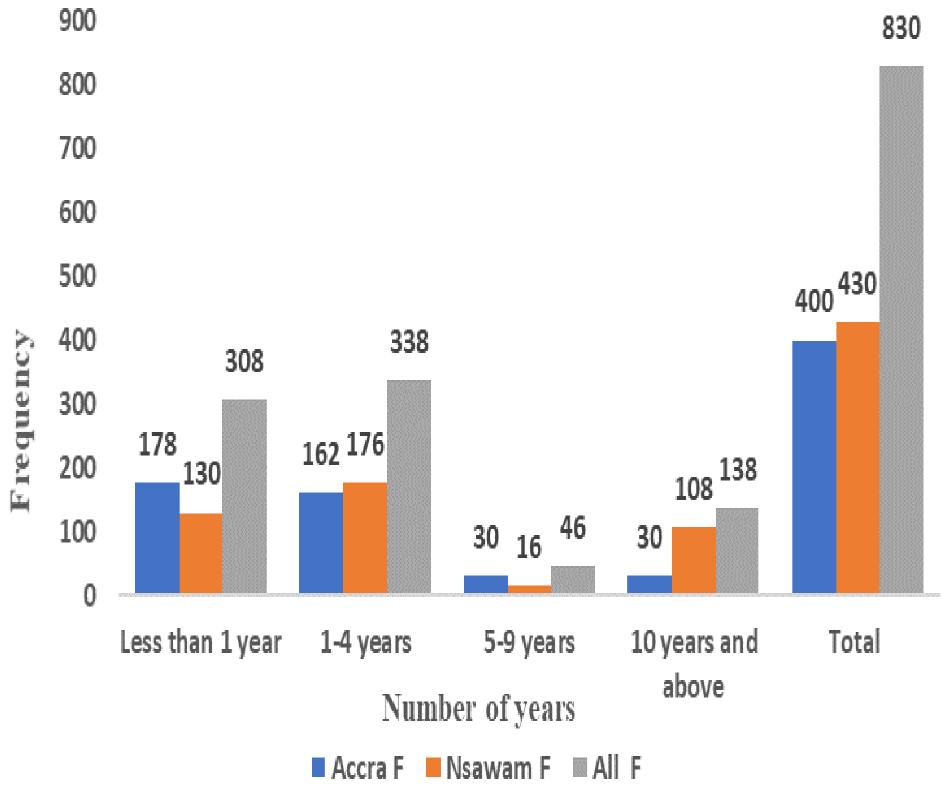

Figure 20: Number of Years Train Passengers Have Been Commuting

Source: Agyemang (2016)

A sizeable proportion of the respondents spent Gh¢4.00 a day using the train to commute. This accounted for 73.32 percent of the total, 84.50 percent of Tema train passengers, and 62.79 percent of Nsawam train passengers. This was followed by train passengers paying Gh¢2.00 with 15.30 percent of the total. Only a few passengers paid Gh¢5.00, being 1.08 percent of the total (Table 19).

Table 19: Respondents Daily Expenditure on Train Service

	Corridor category					
	Tema		Nsawam		All	
Cost	F	%	F	%	F	%
GH 2	59	14.75	68	15.81	127	15.30
GH 3	0	0.00	28	6.51	28	3.37
Gh 4	338	84.50	270	62.79	608	73.25
GH 5	1	0.25	8	1.86	9	1.08
GH 6	2	0.50	56	13.02	58	6.99
Total	400	100	430	100	830	100

Source: Agyemang (2016)

The cost of using alternative transportation by respondents when the train is not used was also given (Table 20). Whereas respondents spending more than Gh¢4.00 constituted 79.76 percent of the total train passengers, respondents spending Gh¢4.00 or less on alternative transportation constituted 20.24 percent of the total passengers for the two corridors. The highest proportion of respondents who claimed to have spent Gh¢6.00 on alternative forms of transportation accounted for 41.69 percent of the total; 41.50 percent for the Tema corridor, and 41.86 percent for the Nsawam corridor. Juxtaposing Tables 19 and 20, there is evidence that passengers paid more when they used alternative forms of transportation. This shows how the train service has been beneficial to commuters by cutting down the cost of commuting to work daily. Litman (2018) explains that although some transit services that target non-drivers may be relatively costly per trip, they offer a cheaper means of transit than alternatives such as taxis.

Table 20: Expenditure on Using Alternative Form of Transportation

	Corridor category					
	Tema		Nsawam		All	
Cost	F	%	F	%	F	%
Gh¢ 2	1	0.25	20	4.65	21	2.53
Gh¢ 4	57	14.25	90	20.93	147	17.71
Gh¢ 6	166	41.50	180	41.86	346	41.69
Gh¢ 8	97	24.25	76	17.67	173	20.84
Gh¢ 10	45	11.25	32	7.44	77	9.28
Gh¢ 12	20	5.00	16	3.72	36	4.34
Gh¢ 14	10	2.50	16	3.72	26	3.13
Gh¢ 16	2	0.50	0	0.0	2	0.24
Above Gh¢16	2	0.50	0	0.0	2	0.24
Total	400	100	430	100	830	100

Source: Agyemang (2016)

The most popular form of alternative transport for the respondents was commercial ‘trotro’ minibuses which constituted 81.33 percent of the total with, 79.25 percent for the Tema corridor and 83.26 percent for the Nsawam train corridor. The use of taxis for commuting was second to the use of trotro and this accounted for 7.23 percent of the overall total. The use of personal private vehicles as an alternative means of commuting accounted for just 5.66 percent of the overall total (Table 21).

Table 21: Forms of Transportation by Respondents

	Corridor Category					
	Tema		Nsawam		All	
	F	%	F	%	F	%
Personal vehicle	27	6.75	20	4.65	47	5.66
Commercial	317	79.25	358	83.26	675	81.33
Trotro bus	28	7.00	32	7.44	60	7.23
Taxi	22	5.50	12	2.79	34	4.10
MMT	6	1.50	8	1.86	14	1.68
Total	400	100	430	100	830	100

Source: Agyemang (2016)

The distance from the residence of respondents to train stations and halts is represented in Table 22. A high proportion of commuters (42.53%) journeyed for about two kilometres from their residence to the train stations.

Table 22: Distance from Residence of Respondents to Train Stations and Halts

	Corridor Category					
	Tema		Nsawam		All	
Distance	F	%	F	%	F	%
Less than a km	15	3.75	106	24.65	121	14.58
1km	47	11.75	44	10.23	91	10.96
2km	199	49.75	154	35.81	353	42.53
3km	25	6.25	32	7.44	57	6.87
4km	97	24.25	32	7.44	129	15.54
5km	15	3.75	12	2.79	27	3.25
Above 5km	2	0.50	50	11.63	52	6.27
Total	400	100	430	100	830	100

Source: Agyemang (2016)

The dominance of trotro or minibuses as the preferred choice of respondents in the absence of the use of public transit is also reflected in the other transport studies in Ghana. The Ministry of Transport (2008) also affirms that trotro and buses carry 68.00 percent of passengers and use 32.00 percent of road space. On the different corridor basis, 49.75 percent from the Tema corridor and 35.81 percent from the Nsawam corridor journeyed for two kilometres from the residence to the train station. There was a relatively high proportion of train users from the Nsawam (24.65%) train journeying for less than one kilometre to the train station than that of users of the Tema train (3.75%). This reflects the high patronage by communities along the Accra-Nsawam railway corridor of the services of the train.

The mode of transportation from the commuters' residences to the train stations was also reviewed. It surfaced that the most important mode of transportation from the residences of commuters to train stations was walking which accounted for 64.46 percent. This was followed by trotro with 20.96 percent and taxi 11.33 percent. The same trend was exhibited by the commuters from the two train corridors as shown in Figure 21.

The interest in the mode of transport from the residence of respondents to the station has been generated by the promotion of intermodal forms of transportation in recent transportation development literature. It has been explained that efficient intermodal transportation development would require careful attention to connectivity, co-ordination and co-operation. It would also require proper planning of terminals (Southwest Region University Transport Centre, 1995). The introduction of bicycle racks on buses and the development of walking routes from communities to transit stations enabled the city of

Tuckson, Arizona, to achieve a well-co-ordinated intermodal transportation system (Pedestrian and Bicycle Information Centre [PBIC], 2000).

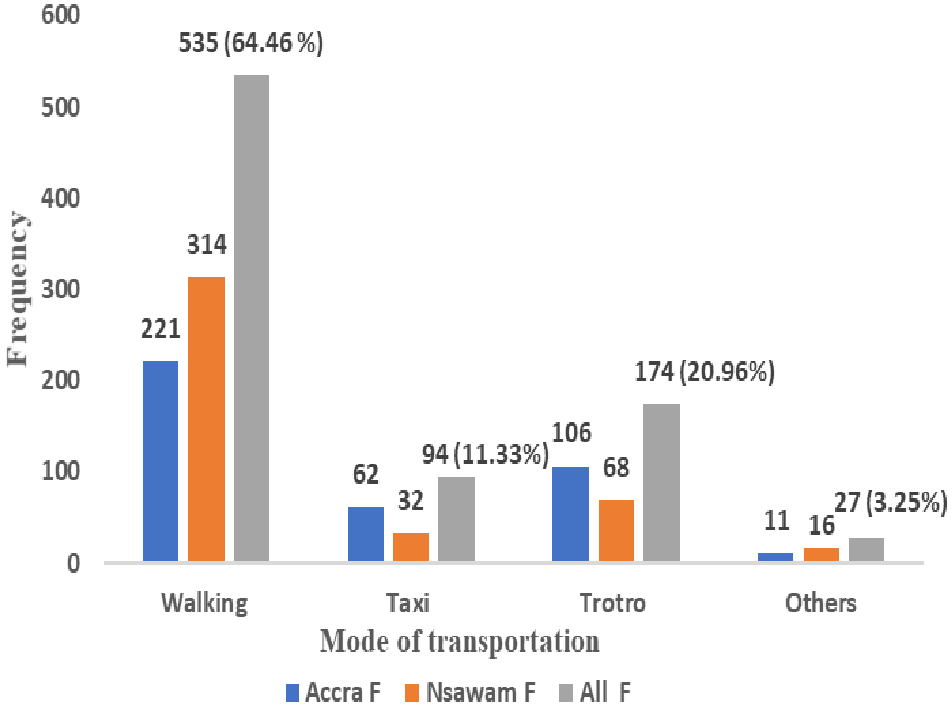

Figure 21: Mode of Transportation from Commuters' Residences to Train Station

Source: Agyemang (2016)

Table 23 shows distances that train passengers covered from the train station to the workplace. Overall, respondents who journeyed for about 2 kilometres accounted for the highest proportion of 40.72 percent followed by respondents covering an average of 3km from the train station to the workplace. With respect to train passengers from the two corridors, the trend did not change with respondents covering 2 km from the train station to the workplace accounting for 49.50 percent of passengers from the Tema train and 32.56 percent of Nsawam train passengers. The data also explains that the workplaces that were 5 km or more were not all that significant. For instance, no passenger from the Tema train journeyed more than 5 km from the train station to the workplace.

Table 23: Distance from the Train Station to Workplace

	Corridor Category					
	Tema		Nsawam		All	
	F	%	F	%	F	%
Less than a km	21	5.25	50	11.63	71	8.55
1km	96	24.00	22	5.12	118	14.22
2km	198	49.50	140	32.56	338	40.72
3km	35	8.75	151	35.11	186	22.41
4km	40	10.00	35	8.14	75	9.04
5km	10	2.50	8	1.86	18	2.17
Above 5km	0	0.00	24	5.58	24	2.89
Total	400	100	430	100	830	100

Source: Agyemang (2016)

The most popular mode of transport from the train station to the workplace was walking, with an overall total of 73.61 percent, and 72.75 percent for train passengers from the Tema corridor and 74.42 percent for train passengers from the Nsawam corridor (Table 24). The next popular means of transportation from the train station to the workplace was trotro with an overall total of 19.04 percent (158).

Table 24: Means of Transport from the Train Station to Workplace

	Corridor Category					
	Tema		Nsawam		All	
	F	%	F	%	F	%
Walking	291	72.75	320	74.42	611	73.61
Taxi	25	6.25	16	3.72	41	4.94
Trotro	76	19.00	82	19.07	158	19.04
Others	8	2.00	12	2.79	20	2.41
Total	400	100	430	100	830	100

Source: Agyemang (2016)

Determination of Perception of CRT Passengers of its Operation

This section of the research analyses perception of the users of the Commuter Rail Transit of its operations. Based on the characteristics of the CRT system from literature and as being implemented in other cities, a number of perceived factors were developed. The various perceived factors were grouped into five: customer care, terminal development, the condition of coaches, train services and train operation. The individual factors under each group were ranked with the aid of means and standard deviations to identify the major factors that were highly perceived as positive by the respondents in the two corridors and in general. The results are presented in Tables 25, 26, 27 28 and 29.

Train Operation

For train operation (Table 25), with the aid of Means (*M)* and Standard Deviations *(SD)* of a 4-point Likert scale, generally, respondents were of the perception that the train spends little time in traffic *(M=3.16)*, has helped reduce their travelling time to work *(M=2.95),* the price per trip for using the train was also perceived as affordable *(M=2.88).* Respondents were also of the opinion that the train leaves on time *(M=2.73)* while a few perceived that it operates for long hours.

With respect to the different corridors, in Tema, the perception of many of the respondents with regard to the operation of the train reflected as follows: it spends no time in traffic *(M=3.24)* the price per trip for using the train was affordable *(M=3.09)*, it has helped to reduce their travelling time to work *(M=3.04)*, and it has also helped to reduce their travelling time from the

Table 25: Mean and Standard Deviation Scores of Respondents' Perception of Train Operation

Statement	All		Tema		Nsawam	
Train Operation	Mean	Std Dev.	Mean	Std Dev.	Mean	Std Dev.
It leaves on time	2.85	.879	2.84	.837	2.86	.917
It spends less time in traffic	3.16	.796	3.24	.788	3.08	.798
It gets to its destination on time	2.73	.853	2.76	.807	2.70	.862
It has helped reduced my travelling time to work	2.95	.983	3.04	.830	2.86	.836
It has helped reduce my travelling time from the workplace to home after work	2.01	.925	2.92	.930	2.60	1.005
It does not break down and is able to get me to my destination	2.50	.773	2.21	.989	1.82	.819
It has rapid travel time	2.69	.912	2.79	.842	2.40	.738
Price per trip for using the train is affordable	2.88	.914	3.09	.830	2.26	.902
It operates for long hours	2.29	.891	2.33	.879	2.46	.952
It is frequent	2.50	.773	2.59	.879	2.60	.965

Source: Agyemang (2016)

workplace to home after work *(M=2.92)*. Only a few of the respondents were of the perception that the train operates for long hours and does not break down frequently.

Respondents from the Nsawam corridor were of the perception that the train spends less time in traffic *(M=3.08)*, leaves on time *(M=2.86)*, and has helped to reduce their travelling time to work *(M=2.86)*. A small number of the respondents also perceived that the train does not break down, is able to get them to their destination and has helped to reduce their travelling time to the house after work.

The high perception of commuters using the Commuter Rail Transit (CRT) with regard to the swift movement of the train by not spending time in traffic and leaving on time are positive indicators that would augur well for the development of CRT in the Greater Accra Metropolitan Area (GAMA) and in other major cities of the country. In a comparative study, Marinov, Bigotte, Prioette and Gerenska (2014) related to customer satisfaction of the services of the Docklands Light Rail, the United Kingdom and Metro Sul do Tejo, (Almada, Portugal), it came to light that the punctuality and reliability are the factors with the greatest influence on customer satisfaction.

Train Services

With respect to train services, the general perception of a larger proportion *(M=2.65)* of the respondents was that it was safe while riding in the train and it announced stops well in advance. Only a few of the respondents were of the perception that the train had the following services on board: security personnel, first aid kits, fire extinguishers, and visible train routes and direction information (Table 26). The research team however observed that there were no visible train routes and direction information displayed in the train.

A significant proportion of respondents *(M=2.85)* in the Tema train felt secured while riding and were also of the perception that the train had first aid kits and fire extinguishers. A few were also of the perception that there were security personnel and transit routes and direction information in the train.

Table 26: Mean and Standard Deviation Scores of Respondents' Perception of Train Services

Statement	All		Tema		Nsawam	
Train Services	Mean	Std Dev.	Mean	Std Dev.	Mean	Std Dev.
It announces stops well in advance	2.02	.914	2.06	.941	1.98	.887
First aid kits and fire extinguishers are available on the train	1.90	.934	2.30	.980	1.53	.715
It is safety while riding in the train	2.65	.894	2.85	.780	1.79	.783
Routes and direction information are visible on the train	1.90	.832	2.02	.867	2.46	.952
There is security personnel on the train	1.87	.841	2.03	.984	1.72	.759

Source: Agyemang (2016)

At the Nsawam corridor, most of the respondents ($M= 2.46$) perceived that there were routes and direction information displayed in the train and it announces stops well in advance. Only a small proportion of the respondents ($M=1.87$) were of the perception that there were security personnel, first aid kits and fire extinguishers aboard the train.

Condition of Coaches

With regard to the condition of coaches, in general, most of the respondents perceived that the coaches of the trains were comfortable

(M=2.48), there was the availability of handrail or grab bars on trains *(M=2.35)* coaches and were not overcrowded *(M=2.33)*. A few of the respondents were of the perception that the coaches were clean and had adequate lighting system (Table 27).

Table 27: Mean and Standard Deviation Scores of Respondents' Perception of Condition of Coaches

Condition of coaches	All		Tema		Nsawam	
	Mean	Std Dev.	Mean	Std Dev.	Mean	Std Dev.
Coaches are comfortable	2.48	.904	2.68	.805	1.96	.844
Train is clean	2.21	.904	2.48	.890	2.29	.832
Coaches are not overcrowded	2.33	.971	2.44	.966	2.22	.964
Availability of hand rail or grab bars on trains	2.35	.983	2.82	.905	1.90	.838
There are adequate seats for passengers	2.26	.912	2.50	.923	2.03	.842
Coaches have adequate lighting system	2.17	.933	2.65	.877	1.73	.751

Source: Agyemang (2016)

The perception of respondents with respect to the condition of coaches along the Tema corridor was generally a step ahead of the perception of respondents along the Nsawam corridor. At the Tema corridor, respondents perceived that the coaches were equipped with handrail or grab bars *(M=2.82)*, comfortable *(M=2.68)*, and had adequate lighting system *(M=2.65)*. Passengers from the Nsawam corridor, however, had the following perception: coaches equipped with handrail or grab bar *(M=1.90)*, comfortable coaches *(M=1.96)* and adequate lighting system *(M=1.73)*. Generally, commuters using the Tema train perceived the condition of the train coaches of the corridor to be better in comparison with the perception of their counterparts using the Nsawam train. The research team witnessed differences in the condition of the train coaches during the on-board survey (Figures 22, 23).

Figure 22: Tema Commuter Rail Transit Coach

Source: Agyemang (2016)

Figure 23: Nsawam Commuter Rail Transit Coach

Source: Agyemang (2016)

Terminal Development

With respect to terminal development (Table 28) generally respondents were of the perception that they travelled a short distance from the house to the terminal *(M=2.38)*, there was adequate shelter at the station *(M=2.19)*, and it was easy to switch from one mode to another *(M=2.09)*. Respondents further agreed that there were clean benches at the terminal. There was a low level of perception of respondents on issues such as the availability of video monitors at the station *(M=1.73)*, safety from crime due to the presence of security *(M=1.95)*, and easy accessibility of terminals to persons with disability *(M=1.73)*. There were some differences with respect to certain conditions in the different corridors on terminal development. Respondents using the Tema train perceived that there were washrooms, adequate shelter, clean benches, and adequate parking space at the terminal which was not the perception of respondents from the Nsawam terminal.

The appreciable level of perception with regard to the ease to switch to different transport modes is an incentive for efficient modal integration in the medium term. Modal integration could include synchronising of the timetables of different modes of transport and harmonising of tickets to generate a single ticket for different modes (such as the BRT and train services) to promote intermodality of passengers (Marinov, Bigotte, Prioette & Gerenska, 2014).

Table 28: Mean and Standard Deviation Scores of Respondents' Perception of Terminal Development

Statement	All		Tema		Nsawam	
Terminal development	Mean	Std Dev.	Mean	Std Dev.	Mean	Std Dev.
Adequate parking for passengers who want to park their vehicles at the station and ride on the train to work	1.89	.888	2.16	.954	1.65	.742
Easily switch to different transport modes around terminal	2.09	.870	2.18	.878	2.00	.854
Easily get basic goods you need at the main terminal to buy	1.96	.840	1.90	.821	2.02	.854
Safe from crime because of the presence of security at the station	1.95	.882	2.09	.915	1.82	.830
Travel short distances from house to train terminal	2.38	.951	2.56	.918	2.22	.953
Benches at the station are clean	2.00	.949	2.30	.988	1.73	.825
Easily accessible to those with disability	1.73	.808	1.84	.907	1.63	.689
Video monitor at the station	1.73	.822	1.83	.868	1.63	.766
Adequate shelter at the station against rain and sunshine	2.19	.976	2.41	.987	1.98	.918
Washrooms at the station	2.00	.915	2.27	.932	1.74	.822

Source: Agyemang (2016)

Customer Care

On customer care (Table 29), there was the general view that personnel at the train stations were friendly and helpful *(M=2.47)*. Respondents' perception of Intelligent Transport System (advanced technology and ticketing system) within the Commuter Rail Transit operation was generally, very low *(M=1.87)*. Commuters also did not witness the presence of public address system at the terminal. The outcome was consistent with the observation of the research team during the on-board survey.

Table 29: Mean and Standard Deviation Scores of Respondents' Perception of Customer Care

Customer Care	All		Tema		Nsawam	
	Mean	Std Dev.	Mean	Std Dev.	Mean	Std Dev.
Friendly and helpful staff at the train stations	2.47	.910	2.60	.934	2.35	.871
Advanced technology and ticketing system at the station	1.87	.850	1.91	.918	1.83	.780
PA system announcement at the station	1.60	.690	1.69	.766	1.52	.602
Personnel knows the system and are able to provide travel schedule information	1.87	.880	1.94	.885	1.80	.870

Source: Agyemang (2016)

Generally, there will be the need for improvement in communicating travel information to passengers. In a study on analysis of train passengers' responses on provided services by two train companies in Indonesia and Sweden, came to the realisation that "clear and readily available travel information is a vital service to customers" (p.52).

Reliability Test

There was the need for a reliability test on the consistency in the response of the respondents. The individual factors were put together and their reliability test conducted with the aid of alpha Cronbach as shown in Table 30. The reliability test shows that (r=0.849) there was consistency in the response of the respondents. “The closer Cronbach’s alpha coefficient is to 1.0 the greater the internal consistency of the items in the scale” (Gliem & Gliem, 2003, p.87). The factors were therefore used against the characteristics and some selected characteristics of the respondents in determining the association between them. The next section presents the results of such relationships.

Table 30: Reliability Test on the Various Factors of Train Perception

Factor	Mean	Std. Dev	Cronbach’ Alpha if Item Deleted
Operation	2.6806	0.49063	
Services	2.0652	0.59143	
Coaches	2.2987	0.62480	
Terminal development	1.9911	0.60812	
Customer care	1.9517	0.64372	
Total	10.9872	2.34678	0.849

Source: Agyemang (2016)

Discussion

The Association Between Train Operation and Demographic/ Some Selected Characteristics of Respondents

Spearman's rank-order correlation was run to determine the association between train operation and demographic/ some selected characteristics of respondents at a significant level of 0.05. According to Table 31, there was a statistical significant association between sex, age, income and number of years of commuting with the train and the perception of respondents of train's operation.

In general, there was a negative association between the income of the respondents (*r_s=-0.19, p = 0.012)* and their perception of the train's operation. Respondents with higher income had a lower perception of the train's operation than their counterparts with lower monthly income. This was reflected at the Nsawam (*r_s=-0.09, p = 0.042)* and the Tema (*r_s=-0.14, p< 0.001)* corridors.

Table 31: The Association Between Perception of Trains' Operation and Selected Characteristics of Respondents

Selected characteristics	All		Nsawam		Tema	
	Rho	Sig.	Rho	Sig.	Rho	Sig.
Age	r= -.04	p= 0.231	r= .03	p= 0.532	r= -.13*	p= 0.008
Marital status	r= .06	p= 0.080	r= .01	p= 0.835	r= 0.07	p= 0.160
Education	r= .04	p= 0.296	r= -.08	p= 0.086	r= -.03	p= 0.591
Income	r= -.09*	p= 0.012	r= -.09*	p= 0.042	r= -.14*	p= 0.000
Occupation	r= .02	p= 0.576	r =-.03	p= 0.571	r= 0.03	p= 0.500
Number of years of community	r= -.14*	p= 0.000	r= -.06	p= 0.200	r= -.16*	p= 0.001
Cost Alternative modes of transportation	r= -.03	p= 0.351	r= -.09	p= 0.053	r= -.05	p= 0.302
Distance residence-work	r= -.04	p= 0.261	r= -.07	p= 0.165	r= -.01	p= 0.883

Source: Agyemang (2016)

On the number of years of commuting, there was a negative association in general (*r_s=-0.14, p< 0.001)*. The perception of respondents, with regard to the operation of the train, reduced with an increase in the number of years they had been commuting. This could be attributed to the fact that respondents who had been using the train for a long time were able to observe changes, especially declining quality of services, of the train's operation. This was similar for the Tema corridor (*r_s=-0.16, p = 0.001)*, although there was no significant association between the number of years of commuting and respondents' perception of the train's operation at the Nsawam corridor. In a study of the level of satisfaction of train users in the European Union, it surfaced that 48 percent of commuters who used the train on a daily basis were dissatisfied with issues that were related to the punctuality and reliability of trains, whereas the proportion of passengers who took the train less regularly and dissatisfied with the same issues were between 31 and 37 percent (European Commission, 2011b).

The Association Between Train Services and Demographic/ Some Selected Characteristics of Respondents

A Spearman's rank-order correlation was run to determine the association between train services and demographic/ some selected characteristics of respondents at a significant level of 0.05. According to Table 32, there was a statistically significant association between age, income, marital status, educational status, cost of an alternative mode of transport and number of years of commuting with the train and respondents' perception of train's services.

Table 32: The Association Between Perception of Train Services and Selected Characteristics of Respondents

Selected characteristics	All		Nsawam		Tema	
	Rho	Sig.	Rho	Sig.	Rho	Sig.
Age	r=-.19*	p=0.000	r=-.19*	p=0.000	r=-.21*	p=0.000
Marital status	r=.17*	p=0.000	r=.17*	p=0.000	r=0.11*	p=0.031
Education	r=-.04	p=0.315	r=-.14*	p=0.003	r=-.18*	p=0.000
Income	r=-.14*	p=0.000	r=-.17*	p=0.000	r=-.30*	p=0.000
Occupation	r=.10*	p=0.004	r=.08	p=0.107	r=0.07	p=0.154
Number of years of community	r=-.17*	p=0.000	r=-.02	p=0.635	r=-.25*	p=0.000
Cost Alternative modes of transportation	r=-.06	p=0.085	r=-.10*	p=0.035	r=-.12*	p=0.017
Distance residence- work	r=0.01	p=0.755	r=.05	p=0.311	r=-.05	p=0.342

Source: Agyemang (2016)

In general, there was a negative association between age of the respondents (*r_s=-0.19, p< 0.001*) and their perception of services provided by the train. Thus, the higher the age of the respondents, the lower their perception of services provided. This was consistent with the Tema (*r_s=-0.23, p< 0.001*) and Nsawam (*r_s=-0.19, p< 0.001*) corridors. The study of the level of satisfaction of European train passengers, however, concluded that generally, the age of the passenger had a positive correlation with the level of satisfaction of the operation and services of the trains generally. The older the person was, the higher the level of satisfaction with the general operations and services of the train (European Commission, 2011b).

On marital status, there was a positive association between marital status of the respondents and their perception of train services in general (*r_s=-0.17, p< 0.001*), Nsawam (*r_s=-0.17, p< 0.001*) and Tema (*r_s=-0.11, p= 0.031*) corridors. Married respondents had a high perception of services of the train than respondents who were single or widowed.

On the number of years of commuting, there was a negative association between the number of years of commuting and perception of respondents in general (r_s=-0.17, $p < 0.001$) and in the Tema corridor (r_s=-0.25, $p < 0.001$) with regard to the train's services. This means that the higher the number of years of commuting of the respondents, the lower their perception of the train's services. There was, however, no significant relationship between the number of years of commuting and the train's services at the Nsawam corridor. The results are in tune with a study by Douglas Economics (2006) which examined passenger attitudes towards New South Wales train and service quality in Australia. It came to light that older passengers had lower ratings for the services of the train when compared with their younger counterparts. Passengers who could be classified as regular users also had poor ratings for the services of the train than infrequent passengers.

In another study by Eboli, Fu, and Muzzulla, (2016) on the multilevel comprehensive evaluation of the railway service quality in the Milan, Italy, Metropolitan area, it was revealed that habitual passengers who journeyed regularly with the train to work regarded information provided aboard the train and at the stations as very important. This was not the case of occasional users who attached more importance to cleanliness.

In general, there was a negative association between the average monthly income of respondents and their perception of the train's services (r_s=-0.14, $p < 0.001$). Respondents' perception of the train's services reduced with an increase in the monthly income levels. This was true for all the corridors, Tema (*r_s=-0.30, p< 0.001) and Nsawam* (*r_s=-0.17, p< 0.001).*

On both corridors (Accra (*r_s=-0.18, p< 0.001)* and Nsawam (*r_s=-0.14, p= 0.003*), there was a negative association between the education level of respondents' and their perception of train services. The higher the level of education of the respondents, the lower they perceived train services.

Analysis on the cost of using an alternative mode of transport also revealed that there was a negative association between the cost of alternative means of transport and respondents' perception of train services for the general (*r_s=-0.10, p< 0.001)* and the Tema corridor (*r_s=-0.20, p< 0.001).* An increase in the cost of alternative means of transport such as "trotro" and "taxi" resulted in a decrease in respondents' level of perception of the train's services. This was however not expected as an increase in the cost of an alternative mode of transport was expected to trigger an increase in the perception of the train's services.

The Association Between Perception of the Condition of Coaches and Demographic/ Some Selected Characteristics of Respondents

A Spearman's rank-order correlation at a significant level of 0.05. indicated that there was a statistically significant relationship between income, marital status, educational status and number of years of commuting with the train and respondents' perception of the condition of coaches (Table 33). In general (*r_s=0.09, p= 0.007),* there was a positive association between marital status and respondents' perception of the condition of coaches. This relationship was also exhibited at the Nsawam corridor (r_s=-0.15, $p< 0.002$) whereas there was no significant association exhibited at the Tema corridor.

Table 33: The Association Between Perception of the Condition of Coaches and Selected Characteristics of Respondents

Selected characteristics	All		Nsawam		Tema	
	Rho	Sig.	Rho	Sig.	Rho	Sig.
Age	r= .01	p=0.696	r= -.04	p=0.358	r= -.04	p=0.394
Marital status	r= .09*	p=0.007	r= .15*	p=0.002	r= -.02	p=0.661
Education	r= .04	p=0.240	r=-.26*	p=0.000	r= -.12*	p=0.033
Income	r= -.02	p=0.677	r= -.08	p=0.106	r= -.14*	p=0.006
Occupation	r= .15*	p=0.000	r= .11*	p=0.021	r= 0.08	p=0.107
Number of years of commuting	r= -2.1	p=0.000	r= -.06	p=0.168	r= -.20*	p=0.000
Cost Alternative modes of transportation	r=0.11*	p=0.002	r= .04	p=0.470	r= .02	p=0.682
Distance residence- work	r= -.03	p=0.467	r= -.03	p=0.478	r= - .02	p=0.742

Source: Agyemang (2016)

Pertaining to the level of education of respondents, the results indicated that was a negative association between the educational status of the respondents and their perception of the condition of the train's coaches at the Tema (r_s=-0.12, $p< 0.033$) and Nsawam (r_s=-0.23, $p< 0.001$) corridors but not the general situation. The higher the level of education of the respondents, the lower the level of perception of the condition of coaches. the perception on condition of coaches reduce. A study by the European Commission (2011b) on the level of satisfaction by European train passengers also concluded that the higher the level of education of the passenger, the higher the level of dissatisfaction with most of the features of the train.

On the number of years of commuting with the train, there was a negative association in general (r_s=0.15, $p< 0.001$) and in both corridors

(Tema and Nsawam). The level of perception of the condition of coaches reduced with an increase in the number of years of commuting. Although there was a negative association between the perception of respondents and their monthly income amongst respondents from the Tema corridor ($r_s=-0.14$, $p= 0.006$), there was no significant association at the Nsawam corridor and in general.

In general ($r_s=0.11$, $p= 0.002$), there was a positive association between the cost of alternative means of transport and respondents' perception of the condition on coaches. As the cost of an alternative mode of transport increased, the perception of respondents of the condition of coaches also increased. With respect to the individual corridors (Tema and Nsawam), the cost of alternative means of transport had nothing to do with respondents' perception of the condition of coaches.

The Association Between Perception of Terminal Development and Demographic/ Some Selected Characteristics of Respondents

There was a statistically significant association between marital status, income, educational status and the number of years of commuting with the train and the perception of respondents of terminal development (Table 34). In general, there was a positive association between marital status ($r_s=0.13$, $p< 0.001$) and respondents' perception of terminal development. Married respondents had a positive impression of the terminal than single and divorced respondents. This was similar at the Nsawam corridor ($r_s=0.26$, $p< 0.001$), whereas there was no significant association exhibited at the Tema corridor.

Table 34: The Association Between Perception of Terminal Development and Selected Characteristics of Respondents

Selected characteristics	All		Nsawam		Tema	
	Rho	Sig.	Rho	Sig.	Rho	Sig.
Age	r=-.06	p=0.075	r=-.16*	p=0.001	r=0.04	p=0.422
Marital status	r=.13*	p=0.000	r=.26*	p=0.000	r=-.06	p=0.198
Education	r=-.08*	p=0.016	r=-.20*	p=0.000	r=-.19*	p=0.000
Income	r=-.08*	p=0.830	r=-.11*	p=0.029	r=-.13*	p=0.008
Occupation	r=.18*	p=0.000	r=.22*	p=0.000	r=0.09	p=0.083
Number of years of commuting	r=-.14	p=0.000	r=-.08	p=0.090	r=-.14*	p=0.006
Cost Alternative modes of transportation	r=0.05	p=0.157	r=.02	p=0.644	r=.01	p=0.808
Distance residence- work	r=-.03	p=0.464	r=-.08	p=0.090	r.04	p=0.385

Source: Agyemang (2016)

There was a negative association between the educational status of the respondents and their perception of terminal development. The level of perception reduced with an increase in the level of education. This was the situation for the two corridors, Tema *(r_s=-0.19, $p<$ 0.001)* and Nsawam *(r_s=-0.20, $p<$ 0.001)* and in general *(r_s=0.11, $p=$ 0.002)*.

With regard to the average monthly income of the respondents, there was a negative association between the income level of respondents' and their perception of terminal development. The level of perception reduced with an increase in income level. This was consistent with the two corridors (Accra *(r_s=0.11, $p=$ 0.002)* and Nsawam *(r_s=-0.11, $p=$ 0.029))* and in the general situation *(r_s=0.08, $p=$ 0.016)*.

The association between the number of years of commuting and the perception of respondents with respect to terminal development only produced a significant result at the Tema corridor. The number of years of commuting was negatively related to respondents' perception of terminal development (r_s=*-0.14, p= 0.006)*. The perception of respondents reduced with the increase in the number of years of commuting.

The Association Between Perception of Customer Care and Demographic/ Some Selected Characteristics of Respondents

A Spearman's rank-order correlation was run to determine the association between customer care and some selected characteristics of respondents at a significant level of 0.05. Table 35 shows that there was a statistically significant relationship between age, income, marital status, educational status, distance from residence to workplace and number of years of commuting with the train and respondents' perception of customer care.

In general, there was a negative relationship between age (r_s=*-0.07, p= 0.045)* of the respondents and their perception of customer care. This was similar in Nsawam corridor (r_s=*-0.13, p= 0.009)*, but there was no significant association exhibited at the Tema corridor. The perception of respondents reduced with an increase in age.

On the educational status, the results show that there was a negative relationship between the educational status of the respondents and their perception of customer care. The level of perception reduced as the level of education progressed. This occurred in both corridors (Tema (r_s=*-0.23, p< 0.001)* and Nsawam (r_s=*-0.27, p< 0.001)*) and in general (r_s=*-0.19, p< 0.001)*. With respect to the impact of income levels on the respondents' perception of customer care, generally (r_s=*-0.12, p< 0.001)*, and at the Tema corridor (r_s=-

0.19, p<0.001), there was a negative relationship between the average monthly income of the respondents and their perception of customer care.

Table 35: The Association Between Perception of Customer Care and Selected Characteristics of Respondents

Selected characteristics	All		Nsawam		Tema	
	Rho	Sig.	Rho	Sig.	Rho	Sig.
Age	r=.-.07*	p=0.045	r=-.13*	p=0.009	r=-.02	p=0.751
Marital status	r=.67	p=0.062	r=.12*	p=0.015	r=-.03	p=0.525
Education	r=-.19*	p=0.000	r=-.27*	p=0.000	r=-.23*	p=0.000
Income	r=-.12*	p=0.000	r=-.09	p=0.072	r=-.19*	p=0.000
Occupation	r=.14*	p=0.000	r=.19*	p=0.000	r=0.08	p=0.131
Number of years of commuting	r=-.05	p=0.124	r=.01	p=0.866	r=-.07	p=0.148
Cost Alternative modes of transportation	r=.05	p=0.155	r=.05	p=0.282	r=.02	p=0.668
Distance residence- work	r=.08*	p=0.027	r=.09*	p=0.042	r=.06	p=0.256

Source: Agyemang (2016)

Respondents with low income perceived high customer care and vice versa. With regard to marital status, there was a positive association between the respondents' perception and customer care. This was exhibited at the Nsawam corridor (r_s*=0.12, p= 0.015)* but not for the Tema corridor or in general. It showed that married respondents had a high perception of customer care than single and widowed.

There was a positive correlation between distance covered from the place of residence to the workplace and respondents' perception of customer care. This was common among the respondents in general (r_s*=0.08, p= 0.027)* and from the Nsawam corridor (r_s*=0.09, p= 0.042)*. The longer the distance travelled by respondents from the place of residence to the workplace, the higher they perceived customer care.

Summary

The chapter gave a historical perspective on the development of railways in the country. Generally, it focused on the perception of Commuter Rail Transit (CRT) users in the Greater Accra Metropolitan Area (GAMA) of its services. It covered the two CRT corridors of the GAMA, being the Accra - Tema and the Accra -Nsawam train corridors. The survey involved 400 and 430 respondents from the Tema and Nsawam corridors respectively. With the aid of Means (*M)* and Standard Deviations *(SD)* of a 4-point Likert scale, the analysis revealed that, users of the CRT ranked the most important attributes of the train as: spending no time in traffic jam (*M*=3.16); reducing travelling time to work (*M*=2.95); and charging affordable price per trip (*M*=2.88).

Overall, there was a negative correlation association between the age, income level and number of years commuting on one hand and passengers' perception of train services. Age, income and level of education also exhibited a negative correlation association with customer care. Age and the level of education similarly, showed a negative correlation association with passengers' perception of terminal development and the condition of coaches. There was however, a positive correlation association between distance from the residence to work and commuters' perception of customer care.

The results justify the need to accord special attention to quality and efficiency as part of the desired outputs of transport interventions. It further highlights one major component of transport intervention, infrastructure and services, as explained by the Input-Output Framework of Transport Interventions (IBRD/World Bank, 2010), the conceptual framework.

CHAPTER NINE

SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

Introduction

The National Urban Policy Framework Policy document revealed that Accra has grown to encompass areas in some adjoining districts of the city. This has resulted in an increase in the number of commuters from the outskirts and hinterlands of the city to work in Accra. As part of the solution to the policy objective of promoting a spatially integrated hierarchy of urban settlements, the policy framework proposes minimising the travel time between core areas or service centres and their surrounding areas of influence (Ministry of Local Government and Rural Development, 2012a).

The number of commuters who enter the city every day, especially with small private vehicles, contribute towards the level of traffic congestion in the city. In the quest to find a sustainable solution to traffic congestion and vehicular pollution in the city, Mass Rapid Transit (MRT), "a passenger transport service, usually local in scope that is available to any person who pays a prescribed fare" (Deutsche Gesellschaft fur Technische, 2004 p.2), has been proposed. Mass Rapid Transit systems that have been suggested include Bus Rapid Transit (BRT) and Commuter Rail Transit (CRT). A successful MRT system will require the needed institutional capacity development, adequate infrastructure development to attract public confidence to ensure acceptance and sustainability.

With the aforementioned argument in view, the study sought to explore factors that would make the introduction of Mass Rapid Transit systems work in Accra and other urban areas in Ghana. Specifically, the objectives included to:

- Explore the institutional arrangements for effective Mass Rapid Transit in the Greater Accra Metropolitan Area;
- Investigate the available infrastructure for the Mass Rapid Transit in the Greater Accra Metropolitan Area.
- Determine the factors that would potentially motivate small private motor vehicle users to use Bus Rapid Transit system; and
- Assess the perception of users of the pilot Commuter Rail Transit system in Accra of its performance.

Summary of the Research Process

The study dwelt on both the positivists and interpretivists' research approach, using both quantitative and qualitative approach. The study adopted a cross-sectional and descriptive research design. Descriptive research is explained to mean "surveys and fact-finding enquiries of different kinds" and utilising methods such as comparative and correlation methods (Kothari, 2004, pp. 2-3). The descriptive study became a preferred research design due to the large sample sizes that were involved in different aspects of the research.

The study area for the research comprised of the 13 Metropolitan, Municipal and District Assemblies that operate under the Greater Accra Passenger Transport Executive (12 in the Greater Accra Region and Awutu Senya East Municipality in the Central Region; and the Nsawam-Adoagyiri

Municipal Assembly in the Eastern Region which was included because of the Nsawam-Accra commuter train corridor.

Data were gathered on factors that will motivate small private motor vehicle users to pack and use Bus Rapid Transit (BRT); the perception of the users of the Commuter Rail Transit of it its performance; institutional arrangements for the implementation of Mass Rapid Transit (MRT) in the Greater Accra Metropolitan Area (GAMA); and on infrastructure for the implementation of MRT in GAMA.

A multistage sampling procedure was used in the selection of small private motor vehicle users. Accra was purposively divided into 5 cluster zones. Quota sampling was used at the next stage for dividing the sample size of 450 by five (5) to get the actual sample size for each of the five zones. In each of the five (5) zone, snowball and accidental sampling techniques were employed in getting small private vehicle users to respond to the questionnaires. Additionally, on-board survey was used to accidentally select passengers who were regular users of Commuter Rail Transit, along the two corridors, for the survey on the perception of train passengers of its performance.

In-depth interviews were used in gathering qualitative data from relevant stakeholder institutions being Ministry of Transport, Ministry of Roads and Highways, the National Development Planning Commission, Town and Country Planning Department, the Department of Urban Roads, and the Greater Accra Passenger Transport Executive (GAPTE). Others are Ghana Railway Company (GRC), Ghana Private Roads Transport Union (GPRTU), Amalgamated Bus Rapid Transit Company Ltd. and Co-operative Transport

Association. The total number of respondents for the study was 1266. Observation was also employed in gathering some qualitative data from the field and on-board the commuter train.

Contents analysis was used for analysing the qualitative data whereas descriptive statistics such as frequencies, percentages, means and standard deviations were calculated for all the nominal data and other characteristics of the respondents. A Spearman's rank-order correlation was used to analyse the association between variables. These associations were tested at the significant level of 0.05(95% confidential level).

Major Key Findings of the Study

Public Acceptance of Mass Rapid Transit

Generally, respondents accept the importance of urban transportation in the development of the metropolis. This is similar to sentiments by respondents in the Conduent Business Services (2017) research on factors that would lure small private vehicle owners to pack and use public transport. It surfaced that 58 percent appreciated the importance of public transportation in national development.

In spite of the challenges of the Commuter Rail Transit along the two corridors of the GAMA, users acknowledged the role that the train service has been providing in reducing the commuting time and serving as an alternative to the trotro and taxi.

Institutional Arrangements for MRT Implementation

Weak Relationship among some stakeholder Institutions

One important observation of the study is the weak relationship among certain transport related institutions, especially between the Ghana Railway Company and the other transport operating organisations. This does not augur well for the development of intermodal and multimodal urban transportation development. The development of a full BRT system would benefit from an integrated transportation system that takes into consideration terminal development for different modes of transportation to guarantee easy transfer from one mode to another.

Important Co-ordinating Role of GAPTE

The role that GAPTE has been playing in the implementation of the BRT Lite system in Accra is worth mentioning. The coordination role of GAPTE has increased the confidence of the private transport operators in the BRT system to strengthen their conviction that the BRT is not a ploy by the government to compete or flush away the private sector from the public transport business. The sustainability of financing GAPTE was also brought to the fore. A self-sustaining funding plan would be required to keep GAPTE viable and sustainable.

Legal and Regulatory Framework

From the perspective of the legal and regulatory framework for the implementation of MRT, to help in the achievement of the objective of reviving the railway sub-sector, the Ghana Railway Act, 2008, Act 779 established the Ghana Railway Development Authority (GRDA) as the regulatory body for railway operations in the country. The revision of the by-laws of the MMDAs also assisted in the creating the enabling environment for the incorporation of Private Public Partnership into the implementation of the BRT Lite project in Accra.

Infrastructure for MRT Implementation

Infrastructure for BRT Implementation

The initial proposal was for the construction of a full BRT system with median routes in Accra. This was however changed to a BRT Lite system because of budget constraints. The Amasaman, Achimota, Tudu corridor was selected for a pilot type 2 BRT or 'BRT Lite'. The bus lane is made up of both segregated and non-segregated routes with engineering measures to discriminate in favour of public transport vehicles at selected junctions and intersections. There is a pre-boarding fare payment system, 4 terminals, 15 Type B specific stations and 27 simple stops along the bus route. There is a centralised control system, CCTV internal cameras in the bus, and Geographic Positioning System (GPS) for monitoring and tracking of buses.

Some infrastructure challenges include trotro passengers sharing BRT stations with BRT passengers in situations where the two stations are very close; controlling hawkers at the station; buses with air condition and others without air condition charging the same fair; and the inability of the bus cardholder to know the value of travelling credit on the card.

Infrastructure Challenges of the Railway Sub-Sector

The study also identified the infrastructure challenges of the railway sub-sector. The railway lines were quite old, especially railway lines along the Accra – Nsawam corridor. Railway stations along the two corridors demand attention. The redevelopment of the main Railway station in Accra will assist in boosting public confidence in the railway sector. Generally, the two corridors would require the introduction of new and efficient railway coaches to help sustain and improve the current level of ridership. The impact of encroachment on the redevelopment of the railway industry was also noted during the study.

Political Will for BRT Implementation

Political will to implement BRT project was seen by stakeholders as a major challenge to the implementation of a full BRT system in the GAMA. This is against the background of the influence of private transport operators who have virtually taken over public transportation in the country after the collapse of government-run public transportation corporation decades ago. Full-scale BRT is possible in Africa with the needed political will and commitment. The city of Dar es Salaam, in Tanzania, commissioned a full-scale BRT in May 2016. The BRT route covers 21km with an average daily passenger ridership of 160,000, and a bus fleet of 140. The successful implementation of BRT earned the city 2017 Sustainable Transport Award by the Institute for Transportation and Development Policy, a global advocacy and non-profit organisation (Sustainable Transit Award, 2017).

The lack of proper political will to implement a full-scale BRT could partly be explained by the approach of the country towards solving urban transportation problem with the emphasis on supply-side measures with a focus on infrastructure development. Hence there is little effort towards transport demand management measures including transit development. Porter and Porter and Abane (2008) for instance noted that transport research in the country has been dominated by planning and provision of infrastructure with emphasis on construction and maintenance of roads.

Most Important Factors That Will Motivate Small Private Motor Vehicle Users to Join BRT

It came to light that the three most important factors that would be considered by small private motor vehicle users in their decision to park and ride a BRT were punctuality and frequency of buses (*M*=3.48), comfortable and neat buses (*M*=3.42), and safety while riding in the bus (*M*=3.37). The other fourth factor of interest was rapid travel time (*M*=3.37). With regard to decision making to park and ride BRT that was related to the nature of the bus lanes, segregated lanes (*M*=3.29) or a full BRT system was preferred with the least preferred being buses using the same lane as other vehicles (*M*=1.80) The results above indicate that punctuality and frequency of buses deserve paramount attention in the operation of a Bus Rapid System.

In spite of the fact that punctuality and frequency of buses, comfortable and neat buses and safety while riding were seen as the most important issues of consideration in the decision to park and use BRT by small private motor vehicle users, segregated bus lanes were seen as very important for the development of a BRT system.

Some Important Correlation Issues Related to BRT

Generally, there was a negative correlation between income and transit ridership. The motivation for small private motor vehicle users to use BRT reduced with a rise in income with regard to factors such as BRT using the same lane as other modes of transportation, buses using both segregated and non-segregated lanes, buses with rapid travelling time, friendly staff of BRT.

There was also a positive correlation between age and transit ridership. The motivation to use BRT increased with an increase in the age of the small private vehicle owners with regard to factors such as BRT with segregated lanes, comfortable and neat buses, punctual buses, buses operating for long hours, adequate parking space, adequate travel time schedule

Another issue that is of interest is the positive correlation between distance travelled and the motivation to use BRT based on factors such as, buses using both segregated and non-segregated lanes, buses with rapid travelling time and adequate travel time information. This was related to the time that respondents spent in driving with small private vehicles from the residence to the workplace and back which also exhibited a positive correlation with motivation to use BRT with regards to many of the factors considered.

Perception of Commuter Rail Transit Passengers of its Performance

The Commuter Rail Transit (CRT) generally obtained some good commendation from respondents which pertained to issues such as spending no time in traffic jam (*M*=3.16); reducing travelling time to work (*M*=2.95); charging affordable price per trip (*M*=2.88); leaving on time (*M*=2.85); and getting to its destination on time (*M*=2.73). Respondents, however, gave low appraisal ratings for conditions such as the presence of public address system at the stations (*M*=1.60); the train is easily accessible to persons with disability (*M*=1.73); the presence of video monitor at the station (*M*=1.73); and the use of advanced technology and ticketing system at the station (*M*=1.87).

On individual corridor basis, respondents from the Tema corridor gave high commendation for the train on issues such as spending no time in traffic jam (*M*=3.24); affordable price per for using the train per trip (*M*=3.09); reducing travelling time to work (*M*=3.04); reducing travelling time from workplace to home after work (*M*=2.92); and safety while riding in the train (*M*=2.85). Respondents using Tema CRT however, were of the view that the train performed low with respect to the presence of public address system at the station (*M*=1.69); the presence of video monitor at the station (*M*=1.83); accessibility of the train to persons with disability (*M*=1.84) and ability to get basic goods to buy at the station (*M*=1.91).

Respondents using the Nsawam CRT had the good commendation for the train not spending time in traffic jam (*M*=3.08); reducing travelling time to work (*M*=2.86); leaving on time (*M*=2.86); getting to the destination on time (*M*=2.70); and reducing travelling time from workplace to home after work (*M*=2.60). The CRT had poor ratings with respect to issues such as the presence of public address system at the station (*M*=1.52); presence of first aid kits and fire extinguishers on the train (*M*=1.53); accessibility of the train to persons with disability (*M*=1.63); and the presence of video monitor at the station (*M*=1.63).

Some Important Correlation Issues Related to CRT

There was a weak negative relationship between the income of commuters and their perception of the CRT based on issues such as the train's operation, the services of the train and terminal development. There was a negative relationship between the number of years that commuters have been using the CRT and their perception of the train based on issues such as the train's operation, services of the train and condition of coaches. The age of respondents was also negatively related to their perception of the CRT with regard to issues such as services provided by train and customer care. There was also a negative correlation between the level of education and their perception with regard to factors such as the services of the train, terminal development and customer care.

Policy Implications of the Findings

The study was informed by a number of concepts and theories that have implications for the implementation of a Mass Rapid Transit system. Additionally, the conceptual framework for the study provides a monitoring tool for the assessment of an urban transportation system.

The concept of liveable cities provides that cities should aspire to ensure efficient mobility and connectivity (Centre for Liveable Cities and Urban Land Institute, 2013), build the city for people and not for vehicles (European Union, 2011) encourage Mass Rapid Transit systems (GTZ, 2010), and focus on the integration of transport policy and urban planning, parking controls with emphasis on public transport as the mode of transport for all but not only for the poor and the elderly (Laconte, 2011). Achieving liveable cities status for our primate cities would require effective transportation planning where the emphasis will not be on only the supply side measures such as widening of roads and increasing road infrastructure generally but also paying attention to demand-side measures (Transport Demand Management [TDM]) such as interventions to help reduce the demand to travel, MRT systems development, the promotion of non-motorised transportation modes of urban transportation and complete streets concept.

The concept of smart cities has as one of its elements, smart mobility which advocates for as ICT supported integrated transport systems. This includes interconnected transport systems such as trams, buses, trains, metro, cars, and cycles with adequate provision for pedestrians (The European Union, 2014). Smart transportation is viewed as having four quadrants that must be well connected to achieve sustainable mobility and accessibility (Figure 1). These quadrants are service, technology, product/mode, and design (UMTRI & TCAUP, 2011). Achieving an effective Mass Rapid Transit system would require effective planning and connectivity of individual unimodal systems to achieve interconnected multimodal and intermodal MRT system.

The discussion of smart cities paves the way for the introduction of technology, mobile phone Apps to assist in making urban transportation very efficient. It has been realised that the current day travellers need to be assured of swift movement and reliability to help lure them out of small private vehicles to join public transportation. A survey by Conduent Business Services (2017) to determine how to lure small private vehicle owners to join public transportation system concluded that the current day traveller cherished predictability and reliability in deciding about transport mode. Efficient public transportation that focuses on the use of intelligent transportation systems, and Apps to guarantee reliability should be the way forward.

Transit Oriented Development (TOD) advocates for high density, mixed residential and, employment and commercial development around public transit nodes (The California Department of Transport, 2002). Although Transit Oriented Development has not obtained the deserved attention in the country, integration of urban land use planning and transportation planning will assist in meeting the challenge of concentration without congestion in our cities.

Reflections on the Conceptual Framework

The Input-Output Framework of Transport Interventions identifies desired inputs that could be controlled to some extent to assist in interventions that would yield desired outputs. The study results confirmed the importance of these desired inputs in the planning and implementation of Mass Rapid Transit (MRT) in the Greater Accra Metropolitan Area. The study revealed the importance of stakeholder collaboration in Bus Rapid Transit implementation and Mass Rapid Transit in general. The implementation of the enhanced BRT system faced initial challenges before stakeholder collaboration effort was intensified.

The inclusion of institutions in the model is further confirmed by the identification of the need for proper institutional capacity development for effective transport interventions development and implementation. This is evident in the role that GAPTE, organised private transport operators and the schedule Ministry for Transport have been playing. Policy and regulations in the model are also explained to mean having the requisite legal and regulatory framework for the implementation of transport interventions. Changing of the by-laws of the Metropolitan/Municipal/District Assemblies (MMDAs) under GAPTE paved the way for a shared mission and vision for the MMDAs to collaborate with GAPTE for the BRT implementation. Furthermore, the preparation of the requisite legal contractual agreements helped in instilling the confidence of the private transport operating companies in the process.

Physical systems and technology as used in the model reflect the role of Intelligent Transportation System (ITS) in the implementation of the BRT Lite system in the GAMA. The use of the smart card, a security camera that is connected to the Central Control Room, and other modern technology are aiding in the implementation of the BRT.

The Desired outputs as enumerated in the model also reflect some of the results of the study. The importance of quality and efficiency has been revealed in both the segments of the study on factors that will motivate small private motor vehicle operators to park and use BRT and on the perception of commuters on the operation of the Commuter Rail Transit in Accra. It was revealed that transit riders cared very much about quality and efficiency. The importance of safety also surfaced as a necessary variable to encourage transit riders to continue using MRT. Affordability also emerged as a factor that will motivate small private motor vehicle owners to use BRT, although not a strong factor as quality and efficiency.

Generally, the conceptual framework affirmed the ideals of the concepts such as smart cities, liveable cities and transit-oriented development that were revealed in the study. The concepts highlight the need for transportation interventions to be holistic to include land use and Transportation Demand Management (TDM) issues, infrastructure and the needed services development.

Contribution to Knowledge

The study contributed towards the knowledge base of transportation planning and Mass Rapid Transit, building on the work of earlier researchers such as Abane (2009, 2011), Cengiz (2017), Heather (2013), Fellesson and Friman (2008), Iseki and Taylor (2010), and Moller (2010), The study added a different dimension to the determination of transit ridership by determining what will motivate small private motor vehicle users to use BRT before the project is fully implemented. The BRT study focused on private vehicle owners who commute daily with their vehicles to work in Accra. It led to the discovery of the most important factors that will encourage small private motor vehicle users to join transit.

The originality of the work in terms of the collection of primary data and analysing is a major form of contribution to knowledge. European Universities Association [EUA] (2010, p.2) explained that “the core component of doctoral training is the advancement of knowledge through original research”. The study on CRT unearthed the perception of users on its operation as a maiden work of such nature in recent times in the country. The comparative analysis of differences and similarities of passengers from the two different corridors paved way for deeper analysis of the mode of operations and passenger perception from the two corridors.

The contribution to policy formulation by the study is an added contribution to knowledge. Policy formulation should be based on sound research and consultations with relevant stakeholders. The study has enabled a series of consultations, analysis of data and provision of policy options for sustainable transport and mobility planning.

Recommendations

The study revealed that there was little effort towards the planning of stations and terminals to ensure the development of intermodal and multimodal transportation system. Effective intermodal and multimodal system assist in widening the choices that transit users have and their ability to switch from one mode to another. It is therefore recommended that the Ministry of Transport, Land use and Spatial Planning Authority and the MMDAs should liaise with the transport operators in the designing of Mass Rapid Transit (MRT) routes to ensure the integration of different transportation modes and infrastructure.

Major stakeholders of the transport industry were of the opinion that with the desired political will, the implementation of a full-scale BRT system would be possible in Accra and ultimately major cities of the entire country. The implementation of a complete BRT system in Dar es Salem, Tanzania, attests to the fact that the implementation of a full-scale BRT system is possible in Ghana. It is therefore recommended that Ministry of Transport should collaborate with transport providing institutions and other relevant organisations for the designing of full-scale BRT routes to be implemented in phases.

Today's traveller requires information on the availability of transit and the amount of money in the smart card. The inability of the holder of the BRT smart card to know the amount of money that is in the card is not helpful in commuter journey planning. It is therefore recommended that GAPTE should engage the services of an Intelligent Transportation System consultant for the development of App that will assist in providing the necessary information about transit services available and transport fare credit that is available to the cardholder.

Central railway stations serve as the iconic buildings and tourist attraction of some cities. The central railway station is in a poor state that does not befit its status as the central railway station of Accra. It is therefore recommended that as part of the redevelopment of the railway sub-sector by the Ghana Railway Development Authority (GRDA), the station should be refurbished to include the transit station as well as a commercial zone to enable transit users to have access to shopping facilities within the station.

The intricate relationship between land use and transportation planning emerged as very important for the development of sustainable cities. It is therefore recommended that a conscious effort is made in bringing transportation stakeholders and land use planners together in the designing of new land use schemes, estate schemes, urban renewal and regeneration.

Recommendations for Further Research

The study touched on a number of issues with respect to the development of sustainable cities with a focus on implementing Mass Rapid Transit in the Greater Accra Metropolitan Area. Based on the scope of the study a number of areas have been proposed for further studies to complement what has been unearthed by the researcher:

- It is recommended that a similar study is conducted on factors that will motivate small private motor vehicle users in Kumasi to park and use BRT. This has been informed by the fact that Kumasi Metropolitan Area has also been earmarked for the implementation of Bus Rapid Transit by the Ghana Urban Project and the Ministry of Transport.
- Similarly, the city of Kumasi has also been earmarked for the reintroduction of Commuter Rail Transit. It is therefore proposed that a study is conducted on the willingness of the residence of the city to patronise CRT to help identify the perception and concerns of the residents of the city on the proposed project.
- The initial attempt at implementing BRT in Accra faced the challenge of not eliciting the needed support from private commercial drivers. This was due to the fear of the government taking over public transportation in the cities. To help offset this challenge, it is recommended that a study is conducted on the perception of private commercial drivers on the implementation of Mass Rapid Transit in Ghana.

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APPENDIX A

Sample Size Determination

1. Sample size determination for the objective on 'determining the factors that would potentially motivate small private motor vehicle users to use Mass Rapid Transit system'

   Total number of Road worthy small private motor vehicles in Accra in 2014 = 100, 662 (DVLA, 2015).

Yamane (1967) provides a formula to calculate same size at a 95% confidence level with a probability of 0.5

$$n = \frac{N}{1 + N\,(e)^2}$$

Where:

n= sample size

N= population size = 105662

e= desired level of precision = 0.5

$$n = \frac{105662}{1 + 105662\,(0.05)^2}$$

n= 398.491

2. Sample size determination for the objective on 'assessing the perception of users of the pilot Commuter Rail Transit system in Accra on its performance'.

a. Tema Corridor:

   Average number of passengers for a week 3138

Yamane (1967) formula for same size calculation at a 95% confidence level with a probability of 0.5 is calculated as follows:

$$n = \frac{N}{1 + N(e)^2}$$

Where: n= sample size

N= population size = 3138

e= desired level of precision = 0.5

$$n = \frac{3138}{1 + 3138\,(0.05)^2}$$

n= 354

b. Nsawam Corridor:

Average number of passengers for a week 8664.

Yamane (1967) formula for same size calculation at a 95% confidence level with a probability of 0.5 is calculated as follows:

$$n = \frac{N}{1 + N(e)^2}$$

Where:

n= sample size

N= population size = 8664

e= desired level of precision = 0.5

$$n = \frac{8664}{1 + 8664\,(0.05)^2}$$

n= 382

APPENDIX B

UNIVERSITY OF CAPE COAST
DEPARTMENT OF GEOGRAPHY AND REGIONAL PLANNING
FACULTY OF SOCIAL SCIENCES
COLLEGE OF HUMANITIES AND LEGAL STUDIES

Questionnaire for Small Private Motor Vehicles Owners

Dear Sir/Madam

This study seeks to investigate the factors that could motivate users of small private vehicles to park their vehicles and use Bus Rapid Transit (BRT) if such a system is fully implemented in Accra. You are therefore being invited to share your views on the issues under investigation. The responses will be used for purely academic purposes. Your confidentiality is fully assured and thank you sincerely for agreeing to participate.

BACKGROUND INFORMATION

1. Where is your residence?...................
2. Sex a. Male [ ] b. Female [ ]
3. Age a. below 20 [ ] b. 20-29 [c. 30-39 [ ]

   d. 40-49 [ ] e. 50-59 [ ] f. 60-69 [ ]

   e. 70 and above [ ]
4. Marital Status:

   a. Married [ ] b. Single [ ] c. Divorced [ ]

   d. Widowed [ ] e. Separated [ ] f. Co-habiting [ ]
5. Number of persons in your household:

   a. 1 [ ] b. 2 [ ] c. 3 [ ] d. 4 [ ]

   e. 5. [ ] f. above 5 [ ]

6. What is your level of education?

   a. No formal education [ ] b. basic education [ ] c. Secondary [ ]

   d. Tertiary [ ] e. Other (please specify)……………

7. What is your occupation?...

8. How would you rate your average net monthly income?

   a. below 1000 Gh¢ [ ] b. Gh¢1000 to Gh¢ 1999 [ ]

   c. Gh¢2000 to Gh¢ 2999 [ ] d. Gh¢ 3000 to Gh¢ 3999 [ ]

e. Gh¢ 4000 to Gh¢ 4999 [ ] f. Gh¢ 5000 to Gh¢ 5999 [ ]

g. Gh¢ 6000 to Gh¢ 6999 [ ] h. Gh¢ 7000 to Gh¢ 7999 [ ]

i. Gh ¢ 8000 and above [ ]

9. Which Local Authority area do you reside?

a. AMA [ ] b. Adenta [ ] c. Ashiaman [ ]

d. Ga Central [ ] e. Ga East [ ] f. Ga South [ ]

g. Ga West [ ] h. Kpone Katamanso [ ] i. La Dade Kotopon [ ]

j. La Nkwantanan-Madina [ ] k. Ledzokuku-Krowor [ ] l. TMA [ ]
m. Awutu Senya East [ ] n. Nsawam-Adoagyiri [ ]

10. Which Local Authority area is your work located?

a. AMA [ ] b. Adenta [ ] c. Ashiaman [ ]

d. Ga Central [ ] e. Ga East [ ] f. Ga South [ ]

g. Ga West [ ] h. Kpone Katamanso [ ] i. La Dade Kotopon [ ]

j. La Nkwantanan-Madina [ ] k. Ledzokuku-Krowor [ ] l. TMA [ ]
m. Awutu Senya East [ ] n. Nsawam-Adoagyiri [ ]

11. Name the specific community that your work is located? …………………

12. What is the distance from your residence to your work station?

a. Less than 10 km [ ] b. 10-14 km [ ] c. 15-19 km [ ]

d.20-24 km [ ] e. above 25km [ ]

13. What is the period of time that you have been commuting from your current residence to your place of work?

a. less than 1 year [ ] b. 1 – 4 years [ ]

c.5 – 10 years [ ] d. 10 years and above [ ]

DESCRIPTION OF VEHICLE AND RELATED ISSUES

14. What is the make of your vehicle ? (please specify, e.g. Toyota, Nissan, etc.)
…………………..

15. What is the engine capacity of your vehicle?

a. 1.5 or below [ ] b. 1.5 -1.9 [ ] c. 2.0-2.4 [ ]

d. 2.5 – 2.9 [ ] e. 3.0 and above [ ]

16. How much do you spend on fuel per month?

a. less than 200 Gh¢ [ ] b. 200 – 299 Gh¢ [ ] c. 300 – 399 Gh ¢ [ ]

d. 400 – 499 Gh¢ [ ] e. 500 – 599 Gh¢ [ ] f. 600 Gh¢ and above [ ]

17. How much do you spend on maintenance per quarter (three months) ?

a. less than 200 Gh¢ [ ] b. 200 – 299 Gh¢ [ ] c. 300 – 399 Gh ¢ [ ]

d. 400 – 499 Gh¢ [ ]e. 500 – 599 Gh¢ [ ] f. 600 Gh¢ and above [ ]

18. How many persons are allowed in the vehicle?

a. 2 [ ] b. 4[ ] c. 5 [ ] d. 6 [ ] e. 7 [ ] f. 8 [ ]

19. How many persons are usually in your vehicle in the morning when driving to work?

a. 1 [ ] b. 2 [ ] c. 3 [ ]

d. 4 [ ] e. 5 [ ] f. 6 or above 6 [ ]

20. How many persons are usually in your vehicle when driving back from the work place to home?

a. 1 [ ] b. 2 [ ] c. 3 [ ]

d. 4 [ ] e. 5 [ ] f. 6 or above 6 [ ]

21. How much time do you spend driving from your residence to your place of work in the morning?

a. less than 30 minutes [ ] b. 30minutes to 59 minutes [ ]

c. 1hour to 1 hour 29 minutes [ ] d. I hour 30 min. to 1 hour 59 min. [ ]

e. 2 hours and above [ ]

22. How much time do you spend in driving from your place of work to home after work?

a. less than 30 minutes [ ] b. 30 minutes to 59 minutes [ ]

c. 1hour to 1 hour 29 minutes [ ] d. I hour 30 min. to 1 hour 59 min. [ ]

e. 2 hours and above [ ]

MOTIVATION FACTORS FOR USING BUS RAPID TRANSIT

23. Please indicate the extent to which you agree or disagree with the statements below on what would motivate or encourage you to use bus rapid transit using a scale where 1= Strongly Disagree (SD), 2= Disagree (D), 3= Agree (A), 4= Strongly Agree (SA)

	CONDITION OF BUSES AND BUS LANES	SD	D	A	SA
A1	I would park my vehicle and use BRT if buses have segregated lanes to avoid being in traffic jam.				
A2	I would park my vehicle and use BRT if buses use the same lanes as other vehicles.				
A3	I would park my vehicle and use BRT if buses use both segregated and non-segregated lanes.				

A4	I would park my vehicle and use BRT if buses are comfortable and neat.				
A5	I would park my vehicle and use BRT if buses are punctual and frequent.				
A6	I would park my vehicle and use BRT if buses operate for long hours.				
A7	I would park my vehicle and use BRT if there is safety while riding.				
A8	I would park my vehicle and use BRT if there is rapid travel time.				
A9	I would park my vehicle and use BRT if price paid by trip is low.				
	TERMINAL DEVELOPMENT	SD	D	A	SA
B1	I would park my vehicle and use BRT if there is adequate parking at the terminal.				
B2	I would park my vehicle and use BRT if there is the ability to switch to different transport modes at the terminal.				
B3	I would park my vehicle and use BRT if I can get basic goods I need at the main terminal to buy.				
B4	I would park my vehicle and use BRT if there is adequate security and safety at bus stations.				
B5	I would park my vehicle and use BRT if there is a short distance from my house to the bus terminal.				
	CUSTOMER CARE	SD	D	A	SA
C1	I would park my vehicle and use BRT if staff are friendly and helpful to customers at the bus terminal and in transit.				
C2	I would park my vehicle and use BRT if there is advanced technology and ticketing system at the station.				
C3	I would park my vehicle and use BRT if benches at the station are clean.				
C4	I would park my vehicle and use BRT if bus is accessible to those with disability.				
C5	I would park my vehicle and use BRT if there is video monitor at the station.				
C6	I would park my vehicle and use BRT if there is adequate shelter at the station against rain and sunshine.				
C7	I would park my vehicle and use BRT if there are washrooms at the station.				
C8	I would park my vehicle and use BRT if I can hear PA system announcement at the station.				
C9	I would park my vehicle and use BRT if personnel know the system and are able to provide travel schedule information readily.				

24. Kindly list five factors in order of importance that would motivate you to use BRT or Mass Rapid Transit in general.

a. …………………………………………………………………………………

b. …………………………………………………………………………………

c. …………………………………………………………………………………

d. …………………………………………………………………………………

e.……………………………………………………………………………………

25. In your view kindly list five things or situations in order of difficulty that would not allow you to use BRT or Mass Rapid Transit in general.

a.……………………………………………………………………………………

b. ……………………………………………………………………………………

c. ……………………………………………………………………………………

d.…………………………………………………………………………………

e.………………………………………………………………………………………

APPENDIX C

UNIVERSITY OF CAPE COAST
DEPARTMENT OF GEOGRAPHY AND REGIONAL PLANNING
FACULTY OF SOCIAL SCIENCES
COLLEGE OF HUMANITIES AND LEGAL STUDIES

Questionnaire for Commuter Train Passengers

Dear Sir/Madam
This study seeks to investigate into the perception of users of the Commuter Train passengers about the operation of the train service. You are therefore being invited to share your views on the issues under investigation. The responses will be used for purely academic purposes. Your confidentiality is greatly assured.

Background Information

1. Where is your residence?..

2. Sex: Male [ ] Female [ ]

3. Age : a. below 20 [ ] b. 20-29 [ ] c. 30-39 [ ]
d. 40-49 [ ] e. 50-59 [ ] f. 60-69 [ ]

g. 70 and above [ ]

4. Marital Status:
a. Married [ ] b. Single [ ] c. Divorced [ ]

d. Widowed [ ] e. Co-habiting [ ]

5. Number of persons in your household:
a. 1 [ ] b. 2 [ ] c. 3 [ ] d. 4 [ ] e. 5 [ ] f. above 5 [ ]

6. What is your level of education?
a. No formal education [ ] b. Basic education [ ] c. Secondary [ ]
d. Tertiary [ ] e. Other (please specify)……………

7. What is your occupation?..

8. How would you rate your average net monthly income?
a. below 1000 Gh¢ [ ] b. Gh¢1000 to Gh¢ 1999 [ ]

c. Gh¢2000 to Gh¢ 2999 [ ] d. Gh¢ 3000 to Gh¢ 3999 [ ]

e. Gh¢ 4000 to Gh¢ 4999 [ ] f. Gh¢ 5000 to Gh¢ 5999 [ ]

g. Gh¢ 6000 to Gh¢ 6999 [ ] h. Gh¢ 7000 to Gh¢ 7999 [ ]

i. Gh ¢ 8000 and above [ ]

9. Which Local Authority area do you reside?

a. AMA [ ] b. Adenta [ ] c. Ashiaman [ ]

d. Ga Central [ ] e. Ga East [ ] f. Ga South [ ]

g. Ga West [ ] h. Kpone Katamanso [ ] i. La Dade Kotopon [ ]

j. La Nkwantanan-Madina [ ] k. Ledzokuku-Krowor [ ] l. TMA [ ]
m. Awutu Senya East [ ] n. Nsawam-Adoagyiri [ ]

10. Which Local Authority area is your work located?
b. AMA [ ] b. Adenta [ ] c. Ashiaman [ ]

d. Ga Central [ ] e. Ga East [ ] f. Ga South [ ]

g. Ga West [ ] h. Kpone Katamanso [ ] i. La Dade Kotopon [ ]

j. La Nkwantanan-Madina [ ] k. Ledzokuku-Krowor [ ] l. TMA [ ]
m. Awutu Senya East [ ] n. Nsawam-Adoagyiri [ ]

11. Name the specific community that your work is located?
…………………………

12. What is the distance from your residence to your work station?
a. Less than 10 km [ ] b. 10-14 km [ ] c. 15-19 km [
]
d. 20-24 km [ ] e. above 24km [ ]

13. What is the period of time that you have been commuting with the train?
a. less than 1 year [ ] b. 1 year to 4 years [ ]
c. 5 years to 9 years [ ] d. 10 years and above [ ]

14. How much do you spend on train service every day? ……………

15. What is the alternative form of transportation to work outside the train service?
a. Personal vehicle [ ]b. Commercial trotro bus [ ] c. Taxi
[ ]
d. Metro Mass Transport Bus [ ] e. Other [ ] please specify
…………

16. How much do you spend on the alternative form of transportation that is mentioned in 15 (per day) when you use it?.................................

17. What is the distance from your house to the train station?
……………………………….

18. What is your means of transport from the house to the train station?
a. Walking [ ] b. Taxi [ ] c. Trotro [ ]
d. Other [ ] please specify ……………………

19. What is the distance from the train station to your work place……………….

20. What is your means of transport from the train station to your work place?
a. Walking [ ] b. Taxi [ ] c. Trotro [ ]
d. Other [ ] please specify…………………………….

21.Please indicate the extent to which you agree/disagree with the statements below on a scale where 1= Strongly Disagree (SD), 2= Disagree (D), 3= Agree (A), 4 = Strongly Agree (SA)

	TRAIN OPERATION	**SD**	**D**	**A**	**SA**
A1	The train leaves on time				
A2	The train spends no time in traffic				
A3	The train gets to its destination on time				
A4	The train has helped reduced my travelling time to work				
A5	The train has helped reduced my travelling time from the workplace to home after work				
A6	The train does not break down and is able to get me to my destination				
A7	The train has rapid travel time				
A8	The price per trip for using the train is affordable				
A9	The train operate for long hours				
A10	The train is frequent				
	TRAIN SERVICES				
B1	The train announces stops well in advance				
B2	First aid kits and fire extinguishers are available on the train				
B3	There is safety while riding in the train				
B4	Routes and Direction Information are visible on the train				
B5	There is security personnel on the train				
	CONDITION OF COACHES	**SD**	**D**	**A**	**SA**
C1	The coaches are comfortable and neat				
C2	The train is clean				
C3	The coaches are not overcrowded				
C4	There is availability of hand rail or grab bars on trains				

C5	There are adequate seats for passengers on the train				
C6	The coaches have adequate lighting system				
	TERMINAL DEVELOPMENT	**SD**	**D**	**A**	**SA**
D1	There is adequate parking for passengers who want to park their vehicles at the station and ride on the train to work.				
D2	You can easily switch to different transport modes around terminal				
D3	You can easily get basic goods you need at the main terminal to buy				
D4	I feel safe from crime because of the presence of security at the station				
D4	I have to travel short distance from my house to the train terminal				
D6	Benches at the station are clean				
D7	Train is easily accessible to those with disability				
D9	There is video monitor at the station				
D10	There is adequate shelter at the station against rain and sunshine				
D11	There are washrooms at the station				
	CUSTOMER CARE	**SD**	**D**	**A**	**SA**
E1	There are friendly and helpful staff at the train stations				
E2	There is advanced technology and ticketing system at the station				
E3	I can hear PA system announcement at the station				
E4	Personnel knows system and are able to provide travel schedule information readily				

17. Kindly list 5 challenges in order of importance that is associated with the operation of the train.

……………………………………………………………………………………
……………………………………………………………………………………
……………………………………………………………………………………
……………………………………………………………………………………
……………………………………………………………………………………

18. What recommendations do you have to assist in the operation of an efficient train system?

……………………………………………………………………………………
……………………………………………………………………………………
……………………………………………………………………………………
……………………………………………………………………………………

APPENDIX D

UNIVERSITY OF CAPE COAST
DEPARTMENT OF GEOGRAPHY AND REGIONAL PLANNING
FACULTY OF SOCIAL SCIENCES
COLLEGE OF HUMANITIES AND LEGAL STUDIES

Interview Guide for Transport Operating Organisations

Dear Sir/Madam
This study seeks to investigate the preparedness of transport operating organisations for the implementation of Bus Rapid Transit (BRT). You are therefore being invited to share your views on the issues under investigation. The responses will be used for purely academic purposes. Your confidentiality is fully assured and thank you sincerely for agreeing to participate.

1. Name of Organisation……………………………………………………….

2. When was the organisation established?

3. What is the nature of service you provide? (e.g. Bus, Trotro etc.)

4. What are your main routes of operation?

5. What do you know about the Bus Rapid Transit (BRT) to be implemented in Accra?

6. a. Are you comfortable with the complementary role that the Bus Rapid Transit system will be playing? YES [ ] NO [ ]

   b. Please assign reasons for your answer.

7. Do you have intentions to operate buses under the Bus Rapid Transit system?

8. If YES to 7 what preparations have you made so far?

9. How are you mobilising members of your organisation for the implementation of the BRT?

10. Are you negotiating with government for a role in the Bus Rapid Transit system?

11. Are you negotiating with other transport companies for a partnership role in the BRT?

12. What most important benefits do you foresee in the implementation of the BRT to your organisation? Please list in the order of the first most important to the least.

a………………………………………………………………………………

b. ……………………………………………………………………………..

c. ………………………………………………………………………………

13. What are the most serious challenges that are associated with the implementation of the BRT from the perspective of your organisation. Please list in the order of the first most important to the least.

a…………………………………………………………………………………

b. ………………………………………………………………………………

c. ………………………………………………………………………………

14. What measures will you suggest to help solve the challenges enumerated above in order of importance? Please list in the order of the first most important to the least.

a.………………………………………………………………………………

b…………………………………………………………………………………

c…``……………………………………………………………………………
…

15. What is your relationship with the following organisations: (please answer with VERY STRONG, STRONG, NEUTRAL, FAIR, WEAK, VERY WEAK)

Relationship among Transport Organisations

	MOT	MRH	DUR	TCPD	GAPTE	GRC	NDPC	Private Transport Operating Orgs.	Pseudo Private Transport Orgs.
GPRTU									
Amalgamated Bus Rapid Transit Company Ltd.									
Co-op Transport Association									
Ministry of Transport (MOT)									
Ministry of Roads and Highways (MRH)									
Department of Urban Roads (DUR)									
Town & Country Planning Department (TCPD)									
Greater Accra Passenger Transport Executive (GAPTE)									
Ghana Railway Company (GRC)									
National Development Planning Commission (NDPC)									
VS: Very Strong; S: Strong; N: Neutral; F: Fair; W: Weak; VW: Very Weak									

16. Are there any views on the issue you could share to help improve the urban transport systems?

APPENDIX E

UNIVERSITY OF CAPE COAST
DEPARTMENT OF GEOGRAPHY AND REGIONAL PLANNING
FACULTY OF SOCIAL SCIENCES
COLLEGE OF HUMANITIES AND LEGAL STUDIES

Interview Guide for Urban Transportation Planning Institutions

Dear Sir/Madam
This study seeks to assess the introduction of Mass Rapid Transit (MRT) in Accra with focus on Bus Rapid Transit (BRT) and Commuter Rail Transit (CRT). You are therefore being invited to share your views on the issues under investigation. The responses will be used for purely academic purposes. Your confidentiality is greatly assured. Thank you sincerely for agreeing to participate.

1. Name of institution……………………………………………………….

2. What has been the role of your institution in urban transportation planning in the country?

3. What has been the role of your institution in the implementation of Mass Rapid Transit in Accra?

4. Which other institutions have you been collaborating with in the implementation of Mass Rapid Transit in Accra?

5. What has been the nature of collaboration between these institutions and your institution?

6. What are the main missing functions to be performed by your organisation to enhance urban transportation planning?

a.……………………………………………………………………………

b.………………………………………………………………………………

c……………………………………………………………………………………

7. What are the main missing functions to be performed by your organisation to enhance the implementation of Mass Rapid Transit (MRT) in Accra?

a.…………………………………………………………………………………

b.……………………………………………………………………………………

c.…………………………………………………………………………………

8. What are the major challenges in urban transportation planning? Please list in the order of the first most important to the least.

a.……………………………………………………………………………………

b.……………………………………………………………………………………

c.……………………………………………………………………………………

9. What measures will you suggest to help solve the challenges enumerated above in order of importance? Please list in the order of the first most important to the least.

a.…………………………………………………………………………………

b.…………………………………………………………………………………

c.…………………………………………………………………………………

10. What are the major challenges in the implementation of Mass Rapid Transit in Accra?

11. How can the challenges in the implementation of MRT in Accra be addressed?

12. What is your relationship with the following organisations: (please answer with VERY STRONG, STRONG, NEUTRAL, FAIR, WEAK, VERY WEAK)

GPRTU									
Amalgamated Bus Rapid Transit Company Ltd.									
Co-op Transport Association									
Ministry of Transport (MOT)									
Ministry of Roads and Highways (MRH)									
Department of Urban Roads (DUR)									
Town & Country Planning Department (TCPD)									
Greater Accra Passenger Transport Executive (GAPTE)									
Ghana Railway Company (GRC)									
National Development Planning Commission (NDPC)									
VS: Very Strong; S: Strong; N: Neutral; F: Fair; W: Weak; VW: Very Weak									

13. Are there any views on the issue you could share to help improve the urban transport systems?

APPENDIX F

Observation Checklist for Bus Rail Transit

Category	Specific Item	GPS Location (Where necessary)	Available	Not Available	Condition/Comments
Bus Station	Developed station structure				
	Waiting seats				
	Light				
	Proximity to terminal/station of other transport modes				
	Commercial activities close to station				
Bus Routes	Segregated routes				
	Non-segregated routes				
	Neat seats				
Other observations					

APPENDIX G

Observation Checklist for Commuter Rail Transit

Category	Specific Item	GPS Location (Where necessary)	Available	Not Available	Condition/Comments
Train Station	Developed station structure				
	Waiting seats				
	Light				
	Proximity to terminal/station of other transport modes				
Railway Lines	Commercial activities close to rail lines				
	Proximity of constructed structures close to rail lines				
	Good looking rail lines				
Coaches	Neat seats				
	Light				
	Hand rail or grab bars				
	Cleanliness of coaches				
	Disability friendly boarding system				
Others					

APPENDIX H

UNIVERSITY OF CAPE COAST

COLLEGE OF HUMANITIES AND LEGAL STUDIES

FACULTY OF SOCIAL SCIENCES

DEPARTMENT OF GEOGRAPHY & REGIONAL PLANNING

Our Ref: GRP/G.4A/Vol.1/15/116

Your Ref:

UNIVERSITY POST OFFICE
CAPE COAST, GHANA
WEST AFRICA

11th January, 2016.

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Dear Sir/Madam,

LETTER OF INTRODUCTION
TO WHOM IT MAY CONCERN

The bearer of this letter, **Mr. Kwabena Koforobour Agyemang**, is a PhD student at the Department of Geography and Regional Planning, University of Cape Coast. He is conducting a research on the topic: ***Implementing Mass Transit in Accra and Surrounding Areas.***

An aspect of the research requires that he collects data from your Organization to enhance his work.

We shall therefore be very grateful if your institution could assist him with any information that would be useful for his work.

Thank you.

Yours faithfully,

Dr. Simon Mariwah.
HEAD

APPENDIX I

GHANA RAILWAY COMPANY LTD.

MANAGING DIRECTOR'S OFFICE
P.O.BOX 251
TAKORADI

Telex: 2437 RAIL. TK. GH.
Telex: 2297 RAIL. GH.

Telephone: 031-2022652
Fax: 031-2023797

Reference: G/HQRS.33/2588

13th NOVEMBER, 2015.

THE HEAD,
FACULTY OF SOCIAL SCIENCES
DEPARTMENT OF GEOGRAPHY AND REGIONAL PLANNING,
UNIVERSITY OF CAPE COAST,
CAPE COAST.

Dear Sir,

RESEARCH WORK – MR. KWABENA KOFOROBOUR AGYEMAN

Your letter introducing the above named PhD student to collect data for his research work from our organization refers.

Approval is granted Mr. Kwabena Koforobour Agyeman, to contact the undersigned for the assistance he requires for his research work on the topic: Implementing Mass Transit in Accra and Surrounding Areas.

Yours faithfully,

K. GRANT-BINEY
PERSONNEL/ADMINISTRATIVE MANAGER