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for Economic and Commercial Cooperation
of the Organization of Islamic Cooperation (COMCEC)**

URBAN TRANSPORT IN THE OIC MEGACITIES



**COMCEC COORDINATION OFFICE
October 2015**

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Appendix A – Literature Review Case Studies

Appendix B – 3 Case Studies Meeting Notes

List of Abbreviations

BAU: Business as Usual
BRT: Bus Rapid Transit
EEV: Enhanced Environmentally Friendly Vehicle
GDP: Gross Domestic Product
GHG: Greenhouse Gas
HOV: High Occupancy Vehicle lane
ICT: Information Communication Technology
IPCC: Intergovernmental Panel on Climate Change
ITDP: Institute for Transportation and Development Policy
LEZ: Low Emissions Zone
MDB: Multilateral Development Bank
MFI: Multilateral Financial Institution
NGO: Non-Governmental Organization
NMT: Non-Motorized Transport
UN: United Nations
OECD: Organization for Economic Cooperation and Development
OIC: Organization for Islamic Cooperation
PPP: Public Private Partnership
SWOT: Strengths Weaknesses Opportunities Threats
TfL: Transport for London
TOD: Transit Oriented Development
UHI: Urban Heat Island
USD: United States Dollar

Executive Summary

WYG and Fimotions were commissioned by COMCEC to carry out this study on Urban Transport in OIC Megacities in order to analyse the latest trends in OIC megacities, identify the common challenges these cities are facing and provide insights and suggestions for future policy actions. The ultimate aim of the study is to trigger a serious debate among OIC member countries on urban transport related issues and how to address these efficiently.

Today more than half of the world's population lives in cities and this figure is expected to reach 75% by 2050. Not surprisingly, rapid urbanization is one of the most pressing global issues. At the moment there are 28 megacities in the world, of which six are Islamic. These six cities are Cairo, Dhaka, Karachi, Istanbul, Lagos, and Jakarta. These six cities, along with Tehran, (which is considered as a megacity based on the population of its wider metropolitan area), are examined thoroughly in this report. The Islamic megacities share both differences and similarities, in terms of their size, geographic location, political and economic status and economic development. The cities are divided into three groups: the Asian group, the Arab group, and the African group. All megacities share common transport and transport related issues and all suffer from extreme congestion conditions. In addition, they are faced with serious environmental problems and low levels of liveability in the urban environment, particularly in the central areas. All Islamic megacities have made efforts and received help to carry out reforms and improvements in their transport systems. The levels of success also varies across cities, as well as the level of their organizational and institutional capacity to manage their transport networks and urban development.

The literature review conducted for this project was based on a framework of 10 subject areas, in order to better understand the lessons learned from the best practices and also the mistakes of the developed world megacities, and at the same time to identify the most pressing problems faced by the developed world megacities. The ten areas of the framework, which was used as a basis for the entire report, are: transport network and land use planning, mode availability and shares, freight and servicing, road safety, institutions and organizational structure, urban infrastructure financing, health, climate change, social exclusion, and human dimension. An in-depth investigation of the different aspects of each area was given for developed and developing world contexts.

In addition three case study site visits were conducted in Cairo, Jakarta and Dakar, for which a detailed analysis of the findings is provided. Additional SWOT analyses were conducted for the remaining five megacities of the Islamic world. The results from the literature review, the site visits and the SWOT analyses are summarized in the last section of the report along with the recommendations for the future.

The study concludes with concrete recommendations for the future of transport in OIC megacities. It is stressed that an integrated approach is key for sustainable operations and that understanding the interrelationships between the different areas analysed in the report is vital in order to develop strategic plans for a megacity. It is suggested that the transport network needs to be coordinated with urban transport infrastructure as well as integrated, in order not to cause fragmentation and disrupt the quality of urban life. Land uses should be mixed as separation results in additional needs for trips, which are necessary to be managed efficiently and effectively, particularly in cities of such large scale. In addition, value capture mechanisms and transport oriented development are key in order for the cities to be able to maximize the benefits derived from new infrastructure. At the same time, the focus should shift from private motorized to mass public and non-motorized transport. This means that

transport will be more equitable, sustainable and efficient. Freight operations also make a vital contribution to megacities' economies and sustainability as they account for a big part of most of their income as well as their congestion and deterioration of urban environment.

In terms of organizational and institutional structure, most cities lack a concrete framework of operations and management. It is suggested that central management of operations can enhance the efficiency while it can provide a framework for collaboration with the private sector. At the same time, financing for infrastructure is closely related to institutional arrangements and both need flexibility and clear definition of the role of the private sector in order to succeed. Transparency is very important in both areas as well as public communication of strategies and plans.

In terms of road safety, awareness, training and enforcement are the key areas where efforts should focus. The impacts of transport on health are identified in air quality, low levels of physical activity and urban heat conditions. All three areas are directly related to the use of private, and particularly old, vehicles which should gradually be withdrawn from the cities. The impacts on climate change can be restricted by sustainable strategies but in the case of Islamic megacities it is also stressed that planning for resilience is also vital, as they are more vulnerable than their developed counterparts. Finally, in terms of social exclusion and human dimension, it is considered that the social aspects and impacts of transport should be reviewed in terms of accessibility, permeability of the urban environment, equality and participation.

The key recommendations of this report are summarized below:

Framework area	Key actions
Transport network and land use planning	<ul style="list-style-type: none"> Make sure transport infrastructure does not cause fragmentation of the urban environment. Plan for land use and transport integration. Promote multiple centre and multiple land use development. Support Transit Orientated Development (TOD).
Mode availability and shares	<ul style="list-style-type: none"> Promote Non-Motorized Transport (NMT). Promote public transport. Reduce motorization and car use using fiscal measures.
Institutional and organizational structure	<ul style="list-style-type: none"> Promote central management and planning of operations. Clearly define the role of the private sector.
Freight and servicing	<ul style="list-style-type: none"> Examine particular local needs. Enhance international freight links.
Urban infrastructure financing	<ul style="list-style-type: none"> Seek help with monitoring and evaluation. Ensure transparency. Clearly define the role of the private sector.
Road safety	<ul style="list-style-type: none"> Provide appropriate training and testing for drivers. Raise awareness.
Health	<ul style="list-style-type: none"> Ban circulation and import of old vehicles. Plan for active transport. Use lighter colours in infrastructure.
Climate change	<ul style="list-style-type: none"> Plan for resilience.
Social exclusion	<ul style="list-style-type: none"> Plan for accessible infrastructure. Introduce flexible transport services for the elderly, women, the urban poor and people with disabilities.
Human dimension	<ul style="list-style-type: none"> Support participation. Plan for small scale.

Furthermore, two key priorities are identified in the case of Islamic megacities. Strengthening the institutional and organizational structure of transport institutions and improving transport network and land use coordination in planning. It is considered that a strong institutional and organizational structure, and a robust transport network and land use planning are two areas to which the majority of lessons from developed countries and cities are related. These two areas are necessary starting points for a change in mindsets and a clear understanding of the strategic needs of cities.

1. Introduction

1.1. Scope and Description of the Study

Since cities are locations that have a high level of accumulation and concentration of economic activity, the most important transport problems are often related to urban areas. Recent decades have witnessed an increasing number of attempts to manage developing cities sustainably and provision of a balanced transport system is widely recognised as central to these actions. Urban transport issues are of utmost importance to support passengers and freight mobility requirements of large urban agglomerations. Transport in urban areas is highly complex because of the modes involved, multitude of origins and destination and the amount and variety of transport modes. Cities are also increasingly involved in trading patterns on a global scale, which makes the efficiency of their transport systems more critical.

COMCEC has clearly recognised the fundamental role of effective and efficient transport in the OIC megacities for the economic development of its Member Countries. One of the six cooperation areas of COMCEC is transport and communications. Transportation is important for COMCEC to ensure the movement of passengers and freight are integrated and facilitated among its member states. Against this background COMCEC has commissioned WYG and Fimotions to carry out the Urban Transport in OIC Megacities study. The purpose of the study is:

- To investigate the latest global megacity transport trends via a desk top literature review.
- To provide an assessment of the urban transport system in three selected megacities of OIC member states.
- To identify the most pressing urban transport problems and identify those that are common to the OIC megacities and present the results in the form of a SWOT analysis.
- To identify common challenges and develop practical recommendations to overcome these obstacles through suggesting a framework for policy actions to be implemented by the authorities of the selected megacities.

The ultimate aim of the study is to trigger a serious debate among OIC member countries on urban transport related issues and how to address these efficiently. As such the study will be presented at the 6th meeting of the COMCEC Transport and Communications Working Group on 22/10/15 in Ankara, Turkey.

1.2. Background to Work Undertaken

A literature review, including desk research of different global megacities (both OIC and non OIC megacities) has been undertaken based on publicly available documents supplemented by WYG/Fimotions dialogue with WYG/Fimotions contacts in the various megacities. The review examined typical issues and problems experienced by megacities including population growth, ageing population, social and health inequality and poverty, poor air quality and pollution, accessibility needs of different social groups (e.g. disabled, older people, unemployed, young people and those working unsociable hours), transport availability, road safety and network constraints. The review also considered freight and servicing issues.

The literature review also summarized the key strategies and policies that cities have applied to solve some of the key problems and challenges. The strategies included (but not limited to); urban growth alternatives such as smart growth policies and transit-oriented development, organization and operation of public transport systems, investment policy in urban transport, traffic management policy, travel demand management, intelligent transportation system applications, strengthening traffic enforcement, building urban transport institutions, affordability of urban transport services, and financing policy.

The literature review paid close attention to Non-Motorized Transport (NMT) (walking and cycling) policies as this is mostly forgotten or neglected in many discussions about urban transport strategies

in non-European countries. NMT is very often considered in relation to urban poverty. Walking and cycling are cheap modes of transport, especially in comparison with the use of a car. After decades of decline in walking and cycling modal shares, many cities throughout the world recognize the advantages of walking and cycling (e.g. low use of space, CO₂ neutral, contributes to a healthy life style) and have developed cycling inclusive policies. Within an urban transport strategy, non-motorized transport modes have often been seen as being complementary to the formalized public transport system (as modes used before and/or after using public transport).

The results from this literature review are presented in the following sections:

- Definition of what is a megacity and identification of the 7 OIC megacities.
- Overview of global trends in world's megacities.
- Analysis of worldwide megacities transport problems, solutions and their critical success factors.

This report presents the results from the work in the following Chapters:

Chapter 2 – Current state in the OIC member states

Chapter 3 – Overview of global trends

Chapter 4 – 3 OIC case studies review.

Chapter 5 – SWOT analysis of OIC megacity transport issues

Chapter 6 – Conclusions and recommendations

2. Current State in the OIC Member States

2.1. Introduction

Over the past century, the urban population of the planet has grown rapidly. In 1900, 10% of the world's population lived in cities. By 2007 this %age had increased to 50%, and it is expected that 75% of the world population will be living in cities by 2050. Today, over half of the world's population (54%) lives in urban areas although there is still substantial variability in the levels of urbanization across countries (Gehl, 2010; United Nations, 2014).

2.2. What is a Megacity?

The urban population growth of the 19th Century was fuelled more by migration from rural areas to manufacturing centres than by absolute population growth. As a result, last decades have witnessed the emergence of a number of megacities. The most common definition of a megacity is a city with a population of 10 million or more. This definition is also used in the "World Urbanization Prospects: The 2014 Revision" report published by the United Nations (2014), which is the basis for the classification used in this report. In this report, the term urban agglomeration¹ is used instead of the term city. This term was considered appropriate for the present study as transport problems and solutions for a city are not and should not be limited to its administrative or geographical boundaries. Cities and megacities in particular, have significantly larger trip catchment areas especially for commuting purposes (Schubel and Levi, 2000).

The estimates of the proportion of the population that is urban and the size of urban agglomerations presented in "World Urbanisation Prospects: The 2014 Revision" are based on national statistics. Population censuses are the most commonly used sources of data, although estimates obtained from population registers or administrative statistics are also incorporated for some countries. It is recognised that there is no common global definition of what constitutes an urban settlement and the definitions given by various national statistics offices vary widely across countries. In estimating the proportion of urban in the World Urbanization Prospects, adjustments were made to the national estimates only to ensure consistency of the definitions of urban settlements within countries across time (United Nations, 2014).

Table 1 below, includes a list of 28 megacities of 10 million inhabitants or more.

Table 1: Population size and ranking of urban agglomeration as of 1 July 2014

Urban Agglomeration	Country or area	Population(thousands)			Rank			Average annual rate of change (percent) 2010-2015
		1990	2014	2030	1990	2014	2030	
Tokyo	Japan	32530	37833	37190	1	1	1	0.6
Delhi	India	9726	24953	36060	12	2	2	3.2
Shanghai	China	7823	22991	30751	20	3	3	3.4
Cuidad de Mexico (Mexico City)	Mexico	15642	20843	23865	4	4	10	0.8
Sao Paulo	Brazil	14776	20831	23444	5	5	11	1.4
Mumbai (Bombay)	India	12436	20741	27706	23	8	5	4.6

¹A large locality of a country (that is to say, a city or a town) is often part of an urban agglomeration, which comprises the city or town proper and also the suburban fringe or thickly settled territory lying outside, but adjacent to, its boundaries. The urban agglomeration is therefore not identical with the locality but is an additional geographical unit, which may include more than one locality. In some cases, a single large urban agglomeration may comprise several cities or towns and their suburban fringe" (United Nations, 2013b).

Kinki M.M.A. (Osaka)	Japan	18389	20123	19976	2	7	13	0.8
Beijing	China	6788	18591	24502	24	8	6	3.6
New York – Newark	USA	16086	18591	19885	3	9	14	0.2
Al-Qahirah (Cairo)	Egypt	9892	18419	24502	11	10	8	2.1
Dhaka	Bangladesh	6621	16982	27374	24	11	6	3.6
Karachi	Pakistan	7147	16126	24838	22	12	7	3.3
Buenos Aires	Argentina	10513	15024	16956	10	13	18	1.3
Kolkata (Calcutta)	India	10890	14766	19092	7	14	15	0.8
Istanbul	Turkey	6552	13954	16694	25	15	20	2.2
Chongqing	China	4011	12916	17380	43	16	17	3.4
Rio de Janeiro	Brazil	9697	12825	14174	13	17	23	0.8
Manila	Philippines	7973	12764	16756	19	18	19	1.7
Lagos	Nigeria	4764	12614	24239	33	19	9	3.9
Los Angeles- Long Beach- Santa Ana	USA	10883	12308	13257	8	20	26	0.2
Moskva (Moscow)	Russian Federation	8987	12063	13257	8	20	26	0.2
Guangzhou, Guangdong	China	3072	11843	17574	63	22	16	5.2
Kinshasa	Democratic Republic of the Congo	3686	11116	19996	50	23	12	4.2
Tianjin	China	4558	10860	14655	37	24	22	3.4
Paris	France	9330	10764	11803	14	25	33	0.7
Shenzhen	China	875	10680	12673	308	26	29	1.0
London	United Kingdom	8054	10189	11467	18	27	36	1.2
Jakarta	Indonesia	8175	10176	13812	17	28	25	1.4

Source: United Nations, 2014

2.3. OIC Megacities Examined in This Report

Keeping in mind that there are different definitions across countries, further information on demographics was sought for two more OIC cities for which the World Urbanization Prospects report estimates a population below 10 million; Tehran and Lahore. For Tehran the population estimate provided by the United Nations is 8.4 million and for Lahore is 8.5 million (United Nations, 2014).

According to the Iranian Census report for 2011, the province of Tehran had a population of 12.2 million and made up 21% of the country's 53.6 million of urban population. This means that in the province of Tehran 11.2 million people live in an urban environment. In addition, the average population growth rate for the urban areas of the Tehran province is 1.7% and for the rural areas is -1.1% (Statistical Centre of Iran, 2011). Based on this information, Tehran is considered a megacity and will be examined in this report.

Given the fact that latest official population census from Pakistan dates back to 1998, other sources were used to identify if the city of Lahore and its wider metropolitan are home to more than 10 million people who therefore affect its transport needs and patterns. None of the sources assessed gives an estimate of more than 9 million (Shirazi and Kazmi, 2014; reliefweb, 2014) and therefore Lahore is not considered a megacity and will not be examined in this report.

Therefore, the seven OIC megacities considered in this report are summarized in Table 2 below:

Table 2: Megacities examined in this report

Urban Agglomeration	Country or area	Population(thousands)			Rank			Average annual rate of change (percent) 2010-2015
		1990	2014	2030	1990	2014	2030	
Al-Qahirah (Cairo)	Egypt	9892	18419	24502	11	10	8	2.1
Dhaka	Bangladesh	6621	16982	27374	24	11	6	3.6
Karachi	Pakistan	7147	16126	24838	22	12	7	3.3
Istanbul	Turkey	6552	13954	16694	25	15	20	2.2
Lagos	Nigeria	4764	12614	24239	33	19	9	3.9
Jakarta	Indonesia	8175	10176	13812	17	28	25	1.4
Tehran	Iran	6365	8353	9990	26	40	42	0.9

Source: United Nations, 2014

2.4. Overview of OIC Megacities Transport

Of the 7 megacities examined in this report one is in Africa (Lagos), one in the Arab World (Cairo) and 5 in Asia (Istanbul, Tehran, Karachi, Dhaka and Jakarta). Cairo is the city with the largest population, with 18.4 million, followed by Dhaka (with 17.0 million) and Karachi (with 16.1 million). Istanbul has a population of 14.0 million, Lagos has 12.6 million and Jakarta 10.2 million. Finally, as explained above, Tehran has a population of 8.4 million, but nearly 11 million live in its wider urban area. Cairo is currently the 10th largest city in the world is expected to be the 8th largest by 2030, as it grows by 2.1% annually. However, Dhaka and Karachi are growing significantly faster (3.6 and 3.3% annually respectively) and are therefore expected to have a larger population than Cairo by 2030. Dhaka is expected to be the 6th largest city in the world and Karachi the 7th. In addition, Lagos, which is now the 19th largest city in the world, is expected to be the 9th largest by 2030 as its annual average population growth rate is 3.9%.

The OIC megacities examined in this report share both differences and similarities in their economies, cultural characteristics, institutional arrangements and, inevitably, transport problems. To begin with, Islamic megacities borrow the characteristics of the wider area where they belong. For example, Lagos shares common characteristics with other African cities, Cairo has common characteristics with other Arabic cities, and Istanbul is also influenced by both Europe and Western Asia. The geographic location of cities does not only influence their societal characteristics but also their governance and best practice sharing. Although cities are beginning to build larger networks and share information using information communication technologies, it is still more likely that cities that are closer geographically will seek advice and borrow practices and policies from each other. In addition, these elements shared between countries may not necessarily be considered practice, with informal transport being a prominent example of shared practices (with minibuses prevailing in Africa and tricycles in South Asia). The three selected case studies (Dakar for Africa, Cairo for the Arab World, and Jakarta for Asia) will reveal these differences and similarities between cities that belong to these three regions of the Islamic world.

In addition, the megacities examined in this report differ in terms of economic and political development. Most of these cities saw their populations growing exponentially around and after the 1950s, primarily as a result of internal migration. Some of the cities examined in this report, such as Istanbul and Cairo, have long histories and have been vibrant, strategically located cities for many years. On the other hand, cities such as Lagos and Karachi mainly gained power as trade cities during colonial times. Colonial cities also grew rapidly after independence (Nigeria gained independence in 1960 and Pakistan in 1947) but at the same time had to go through the political transition from the colonial era. In both cases, transport systems in these cities had to cope with rapidly rising demand while they were not expanded accordingly. At the same time, transport institutions in these cities had

limited capacity to manage the demand as well as plan and implement strategies to alleviate the mounting problems. In addition, the lack of coordination between land use and transport planning resulted in heavy concentration of economic activities in the central business areas of the cities, leading to even worse traffic conditions, limited accessibility and deterioration of the urban environment.

While demand for transport constantly grew, few people were able to afford private cars. Despite the fact that the modal share of private cars remains low in OIC megacities, they occupy the largest part of streets causing congestion, accidents and environmental pollution. At the same time, public, as well as non-motorized transport, are often unable to meet the mobility needs of the citizens. Although the availability of public transport systems differs significantly between OIC megacities, congestion is a common problem. Some of the cities examined in this report are or have been among the most congested cities in the world (Istanbul, Dhaka) or are among those with the poorest air quality conditions (Karachi). The wider impact of congestion is not limited to air pollution, economic losses and accidents but is also contributing and increasing the cities' vulnerability to climate change, causing long term health problems to the population, increasing the levels of social exclusion, and causing a general deterioration of the urban environment which loses its human dimension and offers fewer opportunities for human interaction.

However, it should be noted that many OIC megacities have taken significant steps in order to battle congestion, solve transport problems and improve the urban environment. For example, Istanbul is working towards becoming a multimodal city, and Tehran has gained worldwide recognition for its efforts to improve its traffic conditions. Most cities have managed to implement successful plans with the support of Multilateral Development Banks and Multilateral Financial Institutions such as the World Bank, the Japan International Cooperation Agency and the Islamic Development Bank. Different financing mechanisms have been used in different countries and cases while except for funding, support mechanisms also include management, monitoring and evaluation services as well as capacity building. The ultimate purpose of such mechanisms is to leave the cities with useful lessons and frameworks on which new plans can be based, along with sustainable, integrated infrastructure.

At the same time OIC megacities are making efforts to maintain their cultural and regional identity while improving urban transport and quality of life. It is often the case that infrastructure and policy programmes introduced as part of economic development strategies do not take into account all local needs. Mega infrastructure projects are a very characteristic example of interventions that give little attention to the needs of local people, often causing fragmentation of the local environment and radically reducing the accessibility for non-motorized modes. Such projects undoubtedly increase the accessibility to certain areas of the cities (usually the Central Business Districts) and for certain modes and people (private motorized vehicles and those who need to access specific areas) but fail to provide wider social benefits. Istanbul and Tehran have taken significant steps to improve affordable public transport integrated with interventions for non-motorized modes by introducing Bus Rapid Systems and restricting the access of private cars to key urban areas. Such interventions help citizens remain in close contact with the city and each other and as result strengthen the social sustainability and cultural cohesion of the megacities.

All OIC megacities examined in this report have recognized the importance of urban transport for achieving sustainability and viability. Efforts to improve transport availability and quality vary across the megacities in terms of scale and success. Some of the OIC megacities have cooperated with other megacities in order to learn from their policies and plans (for example, Tehran has put forward its Bus Rapid Transit plans after a visit in Bogota, Colombia) while others have implemented locally driven successful plans (for example, Istanbul has improved and expanded its tram network using its pre-war network as a backbone). It is considered that all megacities have the potential to make significant improvements in their transport systems and become best practice examples for other cities in both the developing and the developed world. This report analyses the status of seven OIC megacities as well as Dakar, and identifies their Strengths, Weaknesses, Opportunities and Threats in order to conclude with recommendations for the future, specifically adjusted to the needs of these cities.

3. Overview of Global Trends in World's Megacities

3.1. Introduction

Size confers undeniable advantages in cities. The concentration of wealth means concentration of employment opportunities, investments, markets forces and opportunities for networking. Furthermore, the availability of public infrastructure and systems to deliver social services can achieve significant efficiencies of scale, and larger cities can have increased capacities to stimulate creativity, innovation and economic development. Big cities are also places of dynamic social interaction and cultural expression that shape the identity of urban life and make it recognizable by its inhabitants and its visitors (Schubel and Levi, 2000).

However, the rapid growth of urban populations is a catalyst for many problems and challenges. In less developed cities in particular, the increasing pressure for housing has resulted in the spread of large informal housing areas that are densely populated, primitively constructed and often lack all forms of basic services. The pressure on cities also leads to overpopulation of existing housing areas, overpowers utilities and transport networks and public spaces. Although each city has its own characteristics and deserves separate, in-depth analysis, there are some common problems identified in all large cities and megacities (Gehl, 2010).

Congestion is one of the problems found in all megacities, regardless of their economic status or their urban structure. As a result, the accompanying externalities of congestion (e.g. accidents, travel time losses and pollution) are on the top of the list of issues to be addressed in all megacities. It is argued here that congestion is always the result of a series of unsustainable land-use, transport and social practices combined and not simply a problem in itself. Therefore, we suggest that transport related issues should always be analysed and addressed taking into account the wider context rather than in isolation.

Probably the most important contextual factor that determines the nature and the extent of transport related issues is the level of economic development of a city and a country. There is a fundamental difference between the priorities in high income cities where the main concerns are over the levels of pollution and consumption related burdens, and those in low income cities, where the main issues are more short term and health related. The challenges for low income cities are even greater as they have other pressing issues to address such as the provision of clean water and electricity, waste management and sanitation (Banister, 2011).

In terms of the megacities of developed countries, despite the differences that are found between them, a common characteristic they all share is that, to a degree, they have all started with an automobile oriented culture which they are now trying to curb using policies to limit private car usage and ownership levels. From the compact central network and high public transport mobility in London to low network densities and automobile oriented culture in Los Angeles, these cities are trying to make a shift towards more sustainable mobility. A variety of measures is employed in these cities' transport plans that aim to promote modal shift, reduce travelled distances, improve efficiency of transport and reduce the need to travel (Banister, 2008).

However, despite the progress developed countries make in reducing the impacts of transport on the environment and in optimizing operations to achieve economic and social benefits, studies have shown that their global contribution to the reduction of environmental impacts of transport can only be limited. For example, in terms of reducing CO₂ emissions, it has been estimated that the maximum possible contribution technological innovation in the UK transport sector can make would be about 21Megatons Carbon (MtC) until 2030. This is about half the levels required to achieve a 60% reduction, equivalent to the targets set by the Intergovernmental Panel on Climate Change (IPCC) over the longer period to 2050 (Banister, 2011).

If developing countries continue to follow the same unsustainable paths, any improvement made by developing countries will soon be eclipsed by rapidly growing economies such as India, China and Brazil. Some positive suggestions have been made regarding the potential of developing economies to decouple transport usage from economic growth, given the rise of a service economy based upon information technologies. By extension, developing countries can potentially leap frog past transport intensive stages of economic growth and proceed directly into a new, less vehicle dependent transport paradigm. However, in reality, developing economies are showing little evidence in the projected trends for anything other than continued motorization (Cervero, 2013; Wight and Fulton, 2005).

The imperative need for economic development of the cities in developing economies is currently taking precedence over any other environmental or social need in most developing world countries. The increasing number of trips to new workplaces, the rapid urban growth and the large concentrations of urban population pose significant pressure to the existing transport infrastructure in these megacities. Cars and motorcycles are grid-locked in traffic and travel times increase for everyone, along with associated problems with noise, air pollution and traffic accidents. Congestion costs in developing countries are tremendous. In addition, the dramatic development of traffic has had a significant effect on opportunities for expression and life quality of large groups of population, especially the economically poorest (Gehl, 2010).

In most developing world cities, the inefficient use of scarce urban space by private vehicles outpaces the provision of road infrastructure or public transit alternatives. Traditionally, walking and cycling have played a great role in the mobility of low income population groups, while public transport is typically weakly developed and expensive. Increasing levels of motorization dramatically reduce the opportunities for walking and cycling, and while some groups become more mobile, even larger groups find themselves less mobile and in some cases without any real transport options. This provides a particular challenge for developing cities and poses the extraordinary tensions on the local governments that need to address all these issues using scarce resources (Gehl, 2010).

3.2. Analysis of Transport Problems in Megacities

Understanding the key role transport is playing in an urban environment and the interaction between mobility, accessibility and almost every urban function is vital in order to formulate an effective strategy. This report examines the common transport related problems of megacities and their roots, and provides examples of best practice that could be applicable in OIC megacities. The analysis of the problems is made using a framework of ten areas which will be used throughout the report. These areas are: transport network and land use planning, mode availability and shares, freight and servicing, road safety, institutions and organizational structure, urban infrastructure financing, health, climate change, social exclusion, and human dimension. An in-depth investigation of the different aspects of each area is given for developed and developing world contexts. Although the framework is made up of ten parts it is stressed that effective planning for sustainable mobility requires a coordinated approach that combines different measures and the engagement of key stakeholders, so that they understand the reasoning behind different policy initiatives and support their introduction (Banister, 2008).

The case studies are presented independently in the text, as it is suggested that the best practice always follows a multidisciplinary approach that treats transport as part of the complex urban dynamics and not in isolation.

It is noted that reference is also made to cities with populations less than 10 million when it is considered that despite the difference in population size, valuable lessons can be learned and successful practices can be applied to a bigger scale.

3.3. Transport Network and Land Use Planning

The importance of coordination between land use and transport planning has been extensively analysed in academic literature and research as a key to sustainable urban development. Given the strong interrelationship between urban form and transport, the integration of land use and transport planning represents a unique policy opportunity. On the one hand, the provision of transport infrastructure plays a critical role in forming the long term shape and character of a city and any stage of its development along with the citizens' mobility patterns and modal choices. On the other hand, land use planning and effective management of urban growth are essential to promoting compact and sustainable urban development. A planning approach that engages both with existing flows and urban form can contribute to identifying how best to sequence, coordinate and integrate various infrastructure investments with land use development, which in turn will determine the city's energy efficiency, economic performance and competitiveness in the long term (Banister, 2008; Cervero, 2013; Gehl, 2010; Rode et al, 2014).

The transport network and land use patterns of the megacities in the developed and developing world differ significantly, mainly as a result of their political and economic history. The cities of the developed world have generally enjoyed longer periods of economic and political stability allowing coordination between urban expansion and infrastructure but also the establishment of unsustainable mobility patterns and an automobile culture. On the other hand, most megacities of the developing world started to expand in terms of size and economic capabilities after 1950. Until 1950, 10 of the 15 largest cities were in the developed world. This number fell to 6 in 1990 and today only 3 cities are in the developed world (UN, 2014b). While there are certain exceptions, rapid urbanization has resulted in huge investment demand for infrastructure and other services which is beyond the capacity of developing countries. In addition, the high urbanization rates are putting much strain on the institutional capacity of these countries given that governance structures take some time to evolve before they are able to deal with the consequences of such rapid growth (Newman and Kenworthy, 1996; Morichi, 2005).

3.3.1. Transport network and infrastructure

The type and scale of urban transport infrastructure critically determines the mobility patterns within a city and is one of the most important factors affecting modal choice, especially in the long term. This section provides an overview of the reasons that have led to the current form of urban transport infrastructure for all modes in developed and developing countries and an overview of how the current capacity can be managed and changed in order to achieve efficiency and sustainability in urban mobility.

3.3.1.1. Transport network and infrastructure of megacities in developed countries

After World War II, most cities in the developed world adopted a "predict and provide" approach in transport planning. Conventional transport analysis has been based on the premise that travel is a cost and travel times should be as short as possible. The continuous provision of new infrastructure to meet the projected traffic growth led to the occupation of large sections of the urban area by highways, and the destruction natural environments and food producing areas. Although urban growth inevitably leads to such results, roads have been built and widened as a measure to reduce congestion, save fuel and reduce emissions. On the other hand, public and non-motorized transport infrastructure has been widely neglected in a planning process optimized for automobile centred mobility (Banister, 2008; Kenworthy, 2006).

Although part of the academic community argues that automobile oriented planning is deeply embedded in urban governance structures), a shift towards sustainable transport infrastructure planning is being observed in many cities around the world. To begin with, a growing amount of evidence and research on persisting congestion in urban areas has shown that traffic can be induced by additional infrastructure. Completely new trips that have never been predicted are generated when new road facilities become available. In addition, the focus on travel time savings changes as new

technology allows much greater travel time flexibility, including mobile working. Travel can be replaced by more “at home” activities such as working from home, shopping and booking holidays. As such the key policy objective now becomes that of reasonable and reliable travel time, rather than travel time minimization (Low and Astle, 2009; Banister, 2008).

Various policies to manage the existing network capacity have been applied across the world, with different levels of success. Regulatory policy instruments have played an important role in shaping urban transport performance. Measures to manage car use and optimize the use of the existing network capacity commonly include parking restrictions, emissions standards and driving restrictions. Although such measures theoretically cover a wide range of objectives including improving air quality, reducing congestion and increasing the efficiency of network utilization, many case studies show that regulatory measures alone often fail to fulfil their potential.

3.3.1.2. Transport network and infrastructure of megacities in developing countries

In developing countries, the monocentric form of street design and planning that characterised many cities in the colonial era started to change in the 20th century and accelerated with the independence of countries from the 1950s onwards. Street designs became more irregular following the peripherisation of urban growth and the displacement of poorer groups to the outskirts of cities. The levels of road infrastructure vary among countries of the developing world, reflecting to a large extent the economic status of each country. Less than 10% of land area is devoted to roads in many cities of Africa, South and Southeast Asia (e.g. Nairobi, Kolkata, and Jakarta) compared to 15-20% in many rapidly emerging economies (e.g. Seoul and Sao Paulo), 20-25% in much of the continental Europe (e.g. London and Paris) and 35% or more in America’s largest automobile oriented cities (e.g. Houston and Atlanta). However, the biggest problem for developing countries is that the infrastructure provision and its development are inconsistent with the growth in traffic volumes. In India, the annual traffic growth rate in the 1990s was around 5% in Mumbai, 7% in Chennai and 10% in Delhi despite the fact that these cities only expanded their network by 1% (United Nations, 2013a; Cervero, 2013).

In the countries with the lowest levels of road network development, except for the lack of road capacity, another major issue is the lack of road hierarchy that allows for efficient traffic flows from local streets to distributor/collectors and to main arterials. For instance, Nairobi, Kenya, a city of 4 million inhabitants, has few collector streets and major through roads compared to similar sized developed cities. In addition, the city’s arterial roads are mostly radial and the lack of circumferential roads brings heavy amounts of traffic through the central business district with significant effects on traffic flows. The situation is similar in Lome, Togo, a city of nearly 1.5 million (INSSSED-Togo, 2015), where the trucks leaving the port are directed into the core of the city in the absence of bypass road around the city (Cervero, 2013).

Another crucial problem in developing countries is the lack of maintenance of existing transport infrastructure, which is being neglected in favour of starting new, highly visible projects. According to the World Bank, the fact that many countries tend to favour new construction, rehabilitation, or reconstruction over maintenance has led to a steady increase in the parts of the network that need to be repaired and a loss of development impact. For example, in Sub-Saharan Africa, for every kilometre of road rehabilitated, an estimated three kilometres of road fall into disrepair, leading to a net deterioration in the total road network. In a rapidly growing urban environment, the condition of the poorly maintained road network is aggravated by a high number of vehicles using the network and particularly heavy trucks as wear and tear exponentially rises with the dead axle weight of a vehicle. In turn, poorly maintained streets slow trucks more than lighter vehicles, which results in increased vehicle operating costs and has an overall effect on congestion (Rioja, 2003; Burningham and Stankevich, 2005; Cervero, 2013).

However, the need for additional, key infrastructure in the cities and megacities of the developing world is not always addressed using what is considered best practice. On the contrary, in many cases, the adopted solutions involve increasing the capacity of the network and the provision of parking

spaces. This poses a huge burden on public administrations to finance and build urban infrastructure including roads, transit systems, and utilities such as water, sewerage and electricity. It is estimated that under a Business As Usual (BAU) scenario, India's urban growth alone will require almost 600 billion USD of investment by 2030, including 2.5 billion square metres of roads and 7,400 km of metros and subways. This is 20 times the capacity added in the past decade (Rode et al, 2014).

Alternatively, more cost effective forms of urban development which actively prioritise compact urban growth, affordable mass transit and high levels of non-motorized transport use could bring significant benefits to the current and future megacities of the developing world. Existing evidence suggests that key urban infrastructure, particularly linear and networked infrastructures such as streets, railways and other utilities, comes at a considerably lower cost per unit when the levels of urban density are higher. For example, the World Bank suggests that more compact city development in China could save up to 1.4 billion USD in infrastructure spending, equivalent to 15% of the country's GDP in 2013 (Rode et al 2014).

Within urban transport infrastructure provision, considerable capital cost savings can be generated as a result of a shift away from private car infrastructure towards public transport, walking and cycling. Furthermore, innovative urban transport systems such as Bus Rapid Transit (BRT) offer significant cost savings compared to traditional metro and regional rail at similar capacity levels. For example, Bogota's TransMilenio BRT infrastructure had a capital cost of 5.8 million USD per km (or 0.34 USD per passenger), compared with estimates for metro rail of 101 million USD per km (or 2.36 USD per passenger) over three years. In addition, maintenance costs, which are frequently underrepresented within major infrastructure cost appraisals, are substantially lower on a per capita basis for affordable mass transit and non-motorized transport (Rode et al, 2014).

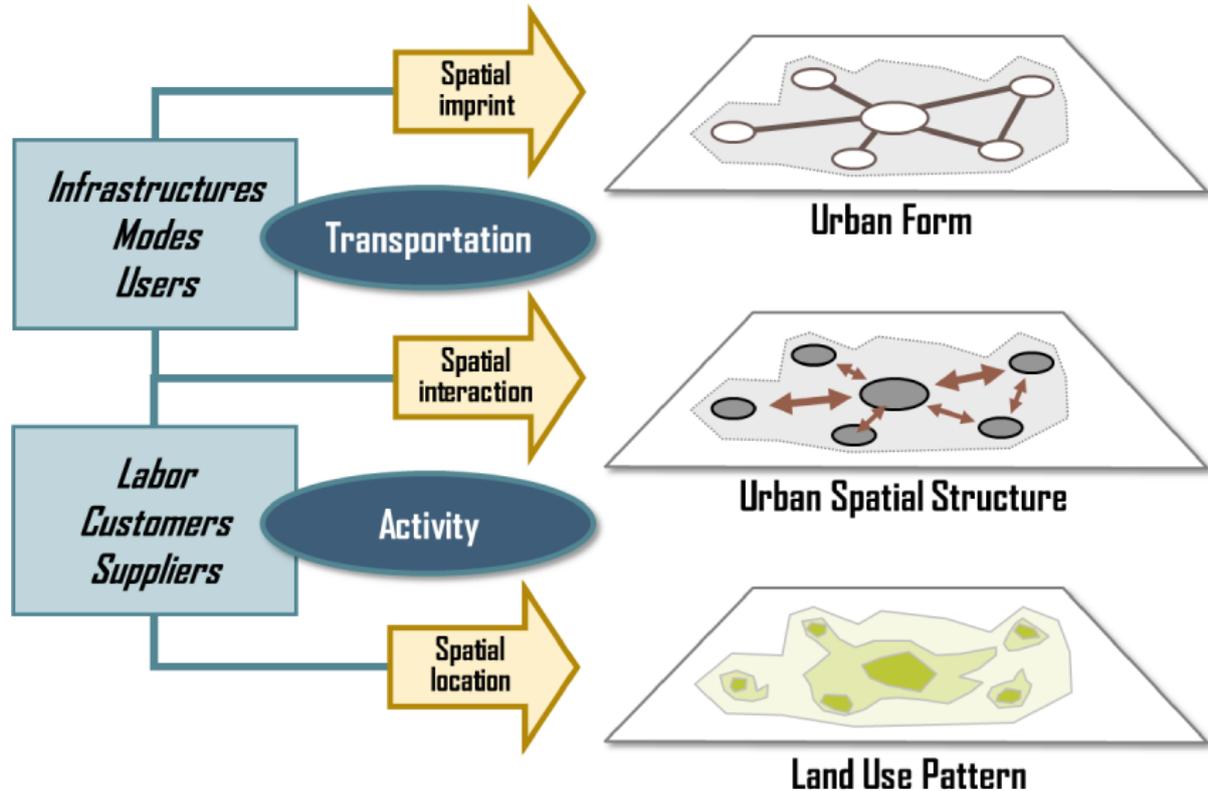
The operational costs of urban transport are also directly informed by urban form characteristics, with sprawling urban development leading to higher costs and greater capital requirements relative to higher density development. Low density urban development increases costs for both private and public motorized transport, but it also undermines the viability of public transport provision for which cost efficient operation is only possible above certain threshold density levels. Similarly, non-motorized transport essentially relies on threshold densities. As a result, higher density cities have greater opportunities for cost efficient transport provision (Rode et al, 2014).

3.3.2. Land use and urban form

3.3.2.1. Introduction

The physical separation of activities in an urban environment inevitably leads to longer distances travelled (Figure 1). Coordinated transport and land use planning allows authorities to build sustainable mobility into the patterns of urban form and layouts, which may in turn lead to a switch to green modes of transport. Policies that can contribute to the reduction of distances travelled include increasing densities and concentration through mixed use development, housing location, design of buildings, space and route layouts, public transport oriented development and transport development areas, car free development and establishing size thresholds for the availability of services and facilities. It is estimated that the timescale over which sustainable mobility might be realised is similar to the turnover of the building stock (about 2% per annum), but decisions on the location of new housing can have dramatic effects over the lifetime of housing (Banister, 2008).

Figure 1: Relationship between transport and land use



Source: Rodrigue et al, 2013

3.3.2.2. Land use and urban form of megacities in developed countries

The combination of the features of 20th century modernism and rise of the automobile before and mostly after World War II created some distinct, particularly unsustainable urban land use patterns in many of the cities of the developed world. On the one hand, the urban planning ideology of modernism introduced separation of the uses of the city and emphasized free standing individual buildings that did not relate an urban context, a history or a local community. On the other hand, as automobile technology developed, it made it possible for a city to develop in any direction and at lower densities. In addition, as a reaction to the industrial city, town planning began separating functions by zoning, followed by decentralization and dispersion of the city (Gehl, 2010; Jacobs, 1961; Newman and Kenworthy, 1996).

Relatively different patterns are observed between American and Australian, and European cities. Many cities in Europe, such as Stockholm, managed to maintain a transit, and non-motorized transport oriented urban core. Car based suburbs and villages on the fringe are also a common European feature, for example in many cities in the UK, Oslo and Frankfurt. On the other hand, Australian and North American cities like Canberra and Phoenix have grown exclusively along with the rise of the automobile. Their automobile based, low density suburbs became a normal living environment for their citizens who largely had not been in contact with other styles of urban development. However, suburbs that were beyond a distance of 50 km from the city centre became inevitably isolated from traditional urban functions as the levels of traffic increased and the benefits of automobile decreased (Newman and Kenworthy, 1996).

A departure from automobile oriented and modernist planning practices has been observed over the past two decades. Smart growth and compact city development have gained wide policy interest in North America, Europe and Australia. Valuable progress has been made in spatial planning aiming to

reverse the unsustainable mobility patterns of the past. The new mobility paradigm suggests that land-use development, including planning and regulations, needs to be integrated, so that physical restraint measures and development patterns are used to support shorter travel distances. Improved levels of proximity are considered to reduce distance travelled, and to contribute to trip reduction and modal split changes (Cervero, 2013; Banister, 2008).

More specifically, experience in urban planning has shown that successful measures include minimum density standards, mixed use regulation and a density bonus for developers. Such measures support compact city development with a hierarchy of higher density and mixed use clusters around public transport nodes. A further key priority for compact city policy is reforming inappropriate building density limitations. Similarly, shifting from minimum to maximum parking requirements for urban development facilitates compaction and lower levels of car use. District level interventions, combined with the redistribution of road space away from private vehicles, have been proven successful in promoting modal shift and sustainable mobility. Furthermore, human scale urban design considerations require a shift away from road capacity oriented street planning to a focus on finer urban fabric, including smaller block sizes, higher building densities and mixed use to facilitate micro accessibility, last mile connectivity, walkability and social interaction (Rode et al, 2014).

Transit Oriented Development (TOD) is a term that describes *“the process of focusing the development of housing, employment, activity sites and public services around existing or new railway stations and transit interchange nodes served by frequent, high quality and efficient intra-urban services”* (Knowles, 2012, pg. 251). TOD has been an important part of broader smart growth strategies applied in the United States and some large Asian cities, including Hong Kong, Singapore and Tokyo. The benefits of TOD involve variety of mobility choices, increased public safety, increased transit ridership, reduction of private vehicle miles travelled, increased savings for households, reduction of air pollution and energy consumption rates, conservation of land resources and open space, reduction of infrastructure costs, contribution to an increase in provision of affordable housing and contribution to economic development. Research has also specifically focused on the relationship between transit and commercial land and housing values. In general, such it is suggested that although singular measures, such as transit based housing or transit adjacent employment centres, are not influential enough in isolation, TOD can be more effective when it includes a mixture of uses and is supported by coordinated policy measures (Knowles, 2012; Hess and Lombardi, 2004).

Nonetheless, despite the fact that the economic, social and climate change case for limiting car dependency and urban sprawl is strong, there are potential negative trade-offs related to industry sectors that are traditionally highly dependent on the BAU urbanization model. More specifically, business models and key business actors in the automotive, construction and real estate sectors have proven resistant to change to date. In addition, strong consumer preferences relating to car ownership and suburban lifestyles remain. Switching urban patterns in many existing cities are high, particularly in urban areas that have already developed low density and car oriented housing. Finally, a range of institutional and process barriers also exist. Policy integration across urban planning, design and transport planning is often compromised by inflexible governance structures (Rode et al, 2014).

3.3.2.3. Land use and urban form of megacities in developing countries

The megacities of the developed and the developing world mainly differ in terms of primacy, levels of monocentricity, population densities, roadway designs, and geographic locations of the poor. Although it is considered that the concept of single centred cities is becoming less relevant with the growth of megacities, as they are rapidly developing as polycentric urban agglomerations, often absorbing other smaller cities in the process, lack of planning and separation of activities significant deteriorate accessibility and quality levels (Banister, 2011; Cervero, 2013).

Megacities of the developing world tend to have more primacy with big cities having disproportionately higher numbers of inhabitants as well as high paying jobs. The concentration of national wealth in capital cities such as Jakarta, Lagos or Dakar also means concentration of private vehicles and transport infrastructure. In addition, megacities serve as a gateway for international linkages and are the often the prime receivers of funding for infrastructure improvements. In a self-reinforcing circle,

the concentration of capital in megacities has attracted foreign and local investments that produced more jobs that continue to attract more workers from rural areas. Besides primacy, many developing cities have a monocentric urban form. In many African and South American cities for example, a third or more of formal jobs are concentrated in the urban core, considerably above what is found in most American and European metropolitan areas. Large concentrations of population, employment, economic activity and services inevitably lead to high traffic densities and comparatively longer trips by public transport (Cervero, 2013).

High primacy and monocentricity mean economies that accrue from concentration and agglomeration can quickly become diseconomies. While urban agglomerations yield economic benefits by allowing job specialisation, efficient market transactions and knowledge spillovers, if concentrated growth is not well planned then over the time these benefits erode. Agglomeration diseconomies can be expressed in the form of lost labour productivity from traffic congestion, worsening air pollution that threatens public health, and an overall decline in the quality of urban life. For example, overconcentration of activities has been blamed for Beijing's deteriorating traffic conditions and environmental pollution. The lack of distinct suburban clusters of mixed land uses has undermined the ability to introduce cost effective, high capacity transit services, leading to high car use and vehicle kilometres travelled per capita (Cervero, 2013).

Cities in developing countries are generally more than twice as dense as those in Europe and five times as dense as in bigger countries like the United States and Australia. Within developing countries urban densities vary considerably. Densities in Asia and African cities are considerable higher than in Latin America. Dhaka is by far the world's most densely populated city with nearly 35,000 inhabitants per km². However, despite the fact that developing countries are comparatively denser than the developed ones, their density gradients have been flattening at a faster rate. The historically dense developing world big cities are now mimicking the sprawling patterns of their developed countries as the levels of motorization increase, following the increase in income levels, and eliminate the need to live in tight quarters in order to be close to everyday activities. The link between rising wealth and decentralized growth is more pronounced in Asian megacities, which are more rapidly motorizing and spreading outward (Cervero, 2013).

Except for population growth, class segregation and poverty can also stretch the boundaries of a city. In Greater Cairo and Mexico City, sprawl is fuelled mostly by informal housing and slums² while in the outskirts of Mumbai and Delhi new towns and employment sub centres are occupying once rural land. *Favelas* (slums) mark the peripheries of most Latin American cities as places of last resort. However, in many cases, housing policies have exacerbated the isolation of the poorest groups from employment and the lack of coordination between land use and transport planning. For example, low cost and isolated housing projects in the outskirts of Mexico City were built and either left unoccupied or abandoned between 2006 and 2009 because of their poor access to jobs, schools and social activities. In addition, the World Bank estimates that limitations on building densities in Bangalore have led to urban sprawl which causes welfare losses of 2 - 3% of household income. Finally, it is considered that the sprawl of Chinese megacities is partly induced by local government policies that allow municipalities to buy land at low prices, add infrastructure and services and then lease it to developers at much lower prices (Rode et al, 2014; Cervero, 2013).

² According to the definition of UN-HABITAT, a slum household is "a group of individuals living under the same roof in an urban area who lack one or more of the following:

1. Durable housing of a permanent nature that protects against extreme climate conditions,
2. Sufficient living space which means not more than three people sharing the same room,
3. Easy access to safe water in sufficient amounts at an affordable price,
4. Access to adequate sanitation in the form of a private or public toilet shared by a reasonable number of people, and
5. Security of tenure that prevents forced evictions" (UN-HABITAT, 2006, pg. 1).

3.4. Mode Availability and Shares

There is a great variety in the mobility patterns encountered in different cities across the world, primarily in terms of mode choice and trip lengths. This is the case even among cities of similar levels of wealth, indicating that socioeconomic factors are only one among several determining factors. The differences in contemporary urban mobility are largely determined by the relationship between land use and transport. At the same time, this relationship is not isolated from broader trends within and across different urban transport modes. Most significantly the rapidly accelerating global levels of motorization in the last five decades and the substantial shift away from non-motorized transport (Rode et al, 2014).

In the analysis provided here, three main categories of urban travel are differentiated: private motorized, public and non-motorized transport. For each mode the current trends are examined both in developed and developing contexts. Finally, measures focused on each mode are analysed and it is explained how current unsustainable modal splits can change in order to achieve sustainable urban mobility.

3.4.1. Private motorized transport

3.4.1.1. Private motorized transport in megacities in developed countries

Over the past 50 years, private motorized transport has grown rapidly in cities around the world. Between 1960 and 2010, the number of registered cars worldwide increased more than sevenfold, from nearly 100 million to over 700 million, while the number of registered trucks and buses increased more than tenfold, from nearly 30 million to over 300 million. By 2010, the total number of registered motor vehicles (excluding two-wheelers) in the world was equal to 1 billion. In absolute terms and in spite of the stabilizing growth rates in private vehicles, developed countries still have the highest number of passenger cars per 1000 inhabitants (Rode et al, 2014).

However, as urban networks reach saturation and the contribution of automobile to the deteriorating quality of urban life becomes clear, restrictive policies for vehicles become more popular. Despite the global trend towards increasing motorization, new and alternative patterns of transport planning have emerged in recent years, and several cities have increased their share of public and non-motorized transport and reduced car ownership. For example, between 2000 and 2010 levels of car ownership in New York, London and Berlin have been declining. There is evidence that shows that although the correlation between wealth and car ownership at a country level is very clear, there is a less clear relationships for cities above a wealth level of 20,000 USD/capita (Rode et al, 2014).

Fiscal policies

Various policy measures have been implemented in developed countries in order to reduce the use and the impacts of motorization. To begin with, effective fiscal policy is considered a key tool for delivering equitable and sustainable urban mobility. Fiscal instruments are used widely in the transport sector in order to manage the total transport demand, shift users from private cars to public and non-motorized transport, improve the performance of sustainable modes and collect the necessary funds in order to shift cities away from carbon and resource intensive mobility patterns.

The rationale of fiscal policies is to internalize the external costs of transport (congestion, environmental costs and accidents). In relation to private motorized vehicles, fiscal policies can be applied to vehicle purchase, circulation and use. Vehicle purchase taxes and circulation charges such as registration or road tax can be applied differentially to meet a range of policy objectives, and may be used to influence both aggregate demand for vehicle ownership and vehicle choice. Fiscal policies can also be targeted at improving overall fuel efficiency and emissions standards, and key performance drivers such as vehicle size and weight, engine size, engine technology and fuel type (Rode et al, 2014).

However, the single most important fiscal instrument related to vehicle use is fuel charging. Transport fuel taxation has historically been a key part of government fiscal policy due to its characteristics as a stable, dependable revenue source that is easily administered, and typically has progressive characteristics. In addition, it is also now widely recognized as a key mechanism to facilitate the internalization of external costs imposed by vehicle use, manage total transport demand, influence vehicle and modal choice, and promote urban densification. However, direct subsidies continue to be issued by many governments, facilitating the widespread use of automobile and rendering other modes financially non-viable (Rode et al, 2014).

Except for measures that apply at national level, city specific measures for managing vehicle use include road pricing, parking charges and other user fees. For example, Singapore, London and Stockholm have successfully implemented congestion charging schemes, leading to a reduction in emissions and congestion while generating increased revenues for transport investment. To be most effective, fiscal instruments need to be designed and implemented at a system level, and coordinated with institutional and regulatory measures. For example, simulations of policy combinations involving increasing car operating costs by 75 percent and decreasing public transport fares by 50 percent for seven European cities, supported by improved land use policies and improvements in public transport functioning, have demonstrated clear synergy effects of coordinating private vehicle and public transport pricing policies (Rode et al, 2014).

Alternative technologies

The role of technology is also important and it has the potential to improve the efficiency of transport operations, reduce the impact of automobile use and promote behavioural change. Technological change is expected to play an increasingly significant role in the reduction of greenhouse gas emissions. Technology based mobility innovations in cities may include the introduction of new technology, the innovative use of existing technology and infrastructure or a combination of both. Regulatory interventions such as emission or fuel consumption standards have been proved highly effective in triggering substantial technological innovation. In many instances, they have also increased the global competitiveness of vehicle manufacturers that were exposed to more stringent regulation. In terms of vehicle technology, innovations in engine and fuel technologies, digitisation and materials have the potential to significantly improve the efficiency of motorized vehicles in cities (Rode et al, 2014).

A summary of the most common alternative fuels and vehicle technologies is provided in Table 3.

Table 3: Summary of common alternative fuels and vehicle technologies

Description	Advantages	Disadvantages
Internal combustion engine vehicles can be modified to use bio fuels which are liquid transport fuels produced from recycled vegetable oils or starch and sugar plants.	<ul style="list-style-type: none"> • As the plants grow, they take up CO₂, which is then released back into the atmosphere when the fuel is burned • Political interest is growing and the sugar industry is well placed to benefit from 'carbon finance' 	<ul style="list-style-type: none"> • Additional energy input is required to process the fuel • Energy yields vary with crop. For example, yields from rapeseed and wheat are an order of magnitude lower than sugar cane • Increases in world population will place more demand on food production than bio fuel from agricultural land • Bio fuels are more expensive than conventional fuels and they need to be heavily subsidised

<p>Internal combustion engine vehicles can alternatively be modified to use gaseous fuels such as Auto gas or Liquid Petroleum Gas (stored in compressed or liquefied form).</p>	<ul style="list-style-type: none"> • One of the most inexpensive fuels available • CO₂ emissions can be reduced by around 30 percent • Potential to extract the gas from landfill or water/sewage treatment 	<ul style="list-style-type: none"> • Most gaseous fuels are still derived from fossil fuels
<p>Fuel cell electric vehicles make use of hydrogen, the most abundant element in the universe. Most hydrogen is presently formed from the steam reformation of methane, a process by which the hydrogen atoms are separated from the carbon atoms along with emissions of CO₂. Reformation can take place either on a vehicle using a portable reformer or could be installed as part of a hydrogen infrastructure allowing vehicles to refuel with pure hydrogen.</p>	<ul style="list-style-type: none"> • A high quality energy carrier which can be readily converted into electricity • Hydrogen from electrolysis is a sustainable fuel where the only emission is pure water, addressing not only greenhouse gas emissions but also air and noise pollution • Hydrogen has the greatest potential emission reductions of any alternative fuel • Proven popular with niche applications such as the urban bus market 	<ul style="list-style-type: none"> • Does not occur naturally and needs to be liberated from chemical compounds • Additional energy is required for electrolysis • Electrolysis is currently not very efficient and just 51 percent of the energy is actually utilised after losses. • Although hydrogen is light, it is bulky making it expensive to transport, store and distribute • Requires a specialist infrastructure
<p>Battery powered electric vehicles that also use fuel cells to convert chemical energy into electrical energy, where the electricity producing reactants are supplied from an external source.</p>	<ul style="list-style-type: none"> • Zero emissions at source • Electric motors increase efficiency by 20 percent by using a direct connection to the wheels and therefore use no power when the car is at rest or coasting • Additional energy production can be derived from regenerative braking • 90 percent efficient compared to 25 percent of traditional internal combustion engines • Fuel cells are continually improving, e.g. low cost lithium ion batteries 	<ul style="list-style-type: none"> • The size of the fuel cells adds to the weight of the vehicle and constrains the performance of the vehicle in terms of maximum speeds and the distance vehicles can travel before requiring recharging • No storage system is capable of providing driving ranges comparable to those of conventional vehicles • The source of energy used for recharging is unlikely to be zero carbon unless it is produced from renewables or nuclear
<p>Hybrid electric vehicles provide an intermittent step between the internal combustion engine and the electric motor. An energy management system is used to optimise the fuel economy of both engines because electric and combustion engines work better under different driving situations.</p>	<ul style="list-style-type: none"> • Provides the advantages of electric propulsion without the need for fuel cells. Electricity is created with on board generators or recovered from braking • An intermittent technology that can easily be adopted 	<ul style="list-style-type: none"> • Technology still reliant on the internal combustion engine • Expensive, although grants are often available to help with the purchase but these rarely cover the higher costs involved

Source: Chapman, 2007

It is noted however, that the contribution of technological innovation to urban sustainability through changes in the use of automobile has also been widely criticized. Technological innovation is often undermined by the increased use of cars while diesel engines continue to increase their market share. Ultimately, the take-up of alternative fuels is hampered by oil prices. Whilst oil remains affordable, alternative fuels are viewed as expensive and unnecessary, often requiring government subsidies. At the same time, estimates from the IPCC suggest that even with current technologies, carbon emissions per vehicle kilometer could be reduced by 30 – 50 percent between 2010 and 2030 through energy efficiency and performance improvements. In addition, transport policies that have been widely supporting technological innovation for vehicles and fuels as they only cause a minor disruption to the current unsustainable mobility practices and sustain current market forces. Therefore, beyond simply introducing cutting edge technologies to cities, it is the rate of innovatively adopting and scaling technologies, combined with a broader sociotechnical transition, which determines whether or not development pathways can be sustainably transformed (Chapman, 2007; Schwanen et al, 2011; Rode et al, 2014).

3.4.1.2. Private motorized transport in megacities in developing countries

While car ownership levels are approaching saturation in developed economies, motorization continues to grow in developing countries. By 2050, the number of motor vehicles worldwide is projected to reach 2.6 billion, the majority of which is expected to be found in developing countries, especially China, India and other Asian countries. In some rapidly emerging economies like India, the number of trucks, cars and motor scooters added to city streets each year is growing at more than 20 percent annually (Cervero, 2013).

The combination of rapid motorization, rising incomes, urban sprawl, undeveloped road systems and spatial mismatches have given a rise to the world's worst traffic conditions in cities of the developing world. Time losses from traffic congestion account for 2 percent of the GDP in Europe and 2-5 percent in Asia while the externalities of traffic congestion in Metro Manila, Dakar and Abidjan have been estimated at nearly 5 percent of those cities' GDPs (Cervero, 2013).

Income inequality plays a significant role in changes in motorization levels. Although a positive relationship between inequality and car ownership is currently observed, it can inverse as countries develop and overall incomes rise. In poor countries with unequal distribution of wealth, as income grows the poor may still not be able to reach a certain minimum level of income that is necessary to buy and maintain a car. However, in countries with more evenly distributed income levels and larger middle income class, benefits accrue broadly across the population of commuters, pushing the bulk of the middle class into cars. For example, low income countries with high levels of inequality such as Bolivia have higher car ownership levels than more equal low income countries such as the Philippines. However, for middle income countries this trend changes and more equal countries such as Russia have higher car ownership levels than middle income, unequal countries such as Colombia (Kutzbach, 2010).

Although vehicle ownership rates in developing nations are low compared to wealthy ones, they lead to far worse traffic congestion and air pollution due to the lack of appropriate regulation, infrastructure and traffic management. There are nine cars per 1000 people in China, compared with 700 per 1000 in the United States and 500 per 1000 in Western Europe. In addition, extreme congestion conditions are common despite the modal share of private vehicles. For example, in China, 50 percent of all urban trips are made by public transport and another 40 percent are made by walking and cycling. In Delhi, only 5 percent of total trips are taken by car, while 15 percent are by motorcycle, 42 percent on public transport, and 39 percent by walking (Ng and Schipper, 2005; Badami et al., 2004).

Particularly in Asian megacities, rapid motorization is mainly characterized by an increase in number of motorcycles and scooters, which are the dominant modes of transport. Besides deteriorating congestion, they can be exceedingly loud, contribute to traffic accidents, take over sidewalks, and

when powered by two stroke engines, they have significantly worse tailpipe emissions than private cars or a four stroke engine. The rapid increase of the number of motorcycles in Asia is mainly triggered by the unreliable public transport system. This opportunity is well taken by finance companies as with a small amount of money as down payment, people can already have a motorcycle on the same day. This leads to further low demand for public transport and NMT (Cervero, 2013).

Motorization is raising environmental justice concerns also because of the growing international trade of old second hand vehicles from developed to developing countries. In many African countries, import liberalization policies from the 1990s made it easier and cheaper for households to buy second hand vehicles shipped across the Mediterranean Sea from Europe, ending up in big cities like Dakar and Lagos. Restrictive regulations on the circulation of old vehicles and the import of old vehicles are gradually being introduced in various countries in order to control their impacts on air quality and safety. For example, Senegal banned the import of vehicles older than five years in 2001 in an effort to improve the safety and air quality levels, especially in urban areas. However, such regulations are not always successful, as import restrictions are not always enforced and very old continue to circulate especially when they are based in rural areas (Diakhate, 2007; Cervero, 2013).

Policy interventions aiming to reduce congestion in megacities have often been focused only on cars and have failed as they lack a global perspective of the problem. An example of such policies is the even odd days driving scheme applied in Latin America cities, such as Mexico City, Lima and Bogota, according to which, vehicles with license plates ending in odd numbers cannot be operated on certain days, and vehicles with even numbers cannot operate on other days. In the medium term, this measure spurred travellers to purchase second, alternate day cars in order to be able to drive every day of the week. The failure of automobile focused policies can also be attributed to the fact that cars are primarily owned by high income citizens who can afford to pay additional costs in order to continue driving and are unlikely to shift to other modes. On the other hand, success stories like that of transport oriented development in Curitiba, Brazil involve coordinated, proactive action and strong political leadership and citizen engagement even before the explosion of middle class motorization (Kutzbach, 2011).

Different regulatory measures have been applied in many Chinese cities that have started to limit the total number of privately owned vehicles through restrictions on the number of license plates issued per month, with Shanghai beginning to control the growth of private vehicle registrations as early as 1994 which is one of the reasons behind the city's considerably lower vehicle stock compared to Beijing (Rode et al, 2014).

Best practice case study: Transport Oriented Development and Public Transport Planning in Hong Kong and Singapore: Lessons on integration, regulation and car ownership restriction

Singapore and Hong Kong are both very successful examples of TOD, which was mainly driven by the lack of appropriate land for development. Although none of the OIC megacities is constrained in terms of space in the same way Hong Kong and Singapore are, the cities still provide valuable lessons on integrated planning, car ownership restrictions and regulation of different modes. The primary difference between the two cities is the level of public participation on operations. The comparison with Tokyo, the world's biggest megacity and a pioneer in TOD, provides valuable lessons on the long terms impacts of TOD and public transport oriented planning.

For further information see **Appendix A4-Transport Oriented Development and Public Transport Planning in Hong Kong and Singapore: Lessons on integration, regulation and car ownership restriction**

3.4.2. Public transport

3.4.2.1. Public transport of megacities in developed countries

Despite the significantly different modal shares of public transport in different megacities of the developed world (93 percent in Hong Kong, compared to only 12 percent in Los Angeles) it is considered that the systems are already well developed in terms of quality. The policies that are employed in public transport cities oriented like London are focused on employing Information and Communications Technology (ICT) in order to make transport systems smarter, on providing specific improvements that will improve the quality of service and customer satisfaction, and on reducing the environmental impacts of public transport vehicles.

The majority of developed world's megacities have multimodal public transport systems. Although multimodality offers improved services and geographical coverage, it requires ticketing integration in order to offer a convenient passenger experience and lower costs. In addition, integration between different operators is also a key and more challenging issue for the transport authorities of the developed world megacities. Although cities like Tokyo have proven that high public transport shares can be achieved without any integration, other cities like London and New York have adopted integrated or partially integrated ticketing in order to offer seamless trips to their passengers and lower costs. The case of London shows the challenges of integrating different modes and operators and the importance of having a single organization managing the transport operations in a city. London is one of the very few cities in the UK that have the authority to manage all operations in the city. Transport for London (TfL) is responsible for all land and river transport in the city of London. TfL signs concessionary agreements with operators and therefore requires same standards of service for all services running in the city, such as ticketing and fare standards and real time information equipment on buses. An integrated ticketing system using electronic ticketing technology (the Oyster Card) was first launched in 2003 and is being continuously upgraded with new features.

Another major challenge for the public transport systems of the megacities of the developed world is the lack of capacity, particularly during peak hours. Extremely crowded services during peak hours are the norm in Tokyo, New York and London. Various efforts to manage capacity and two areas of contemporary technological innovation have made a significant contribution to the public transport sector: digitization and electrification. Over the last decade ICT has, for example, considerably changed ticketing for public transport with contactless payment through smart cards. 90 % of bus passengers and 75 % of subway passengers use smart cards to board buses, subways or taxis in Seoul, offering convenience and reduced travel costs (Rode et al, 2014).

ICT also facilitates the management of public transport capacity by improving the quality of services or reducing the need to travel by providing the opportunity to work, shop or perform other activities from home. In addition, the wide availability of open and big data further allow for crowd sourced information to update network maps, offer real time transport information and improve service quality. The most important recent enabler for enhancing mobility systems in cities for individual users has been a combination of smart phone technologies and geopositioning systems. Smart phone penetration has reached 72% in the United States, 71% in China and 49% in Thailand. Today, well over 70% of Londoners regularly use smart phone travel applications and more than 40 million travel information requests by smart phones are registered every month in Sydney (Rode et al, 2014).

However, efforts to manage capacity and reduce the need to travel alone may not always be sufficient to meet the demand levels of growing megacities. In these cases, additional infrastructure to improve capacity comes at very high costs. Additional capacity of road infrastructure is very expensive due to high costs of land in urban and metropolitan areas, while underground or overground projects are expensive due to the level of technological expertise they require. A recent example of such an expansion is the Crossrail project in London. Crossrail is an underground train connecting central London to the South East of England, serving major employment areas in central London. Crossrail will run over 100km and will have 40 stations dramatically improving the quality of transport in London and increasing the capacity of the network by 10%. Crossrail is currently the biggest

construction project in Europe and it is expected that the central section of Crossrail will start operating in 2018 followed by a phased introduction of services along the rest of the Crossrail route over several months (Crossrail, 2015).

3.4.2.2. Public transport of megacities in developing countries

Today, in the megacities of the developing world, the large concentrations of population and the lack of available funds make it very difficult for local governments to respond to the growing demand. This leads to dangerously overcrowded public transport which is primarily buses moving slowly and inefficiently within the extreme traffic conditions. This section provides an overview of how public transport in developing countries has evolved, the current issues regarding the management and regulation of the formal and informal sector and the newest trends in public transport provision.

In most developing countries, public transport of the post-colonial period operated as a national monopoly while in socialist economies, nationally owned public sector monopolies were also the rule. Today, in most countries the monopoly systems have collapsed and have been replaced by smaller, privately owned companies operating under permissions granted by the municipal authorities. China and a few major cities in India and Eastern Europe are exceptions where traditional public operators dominate. Despite the differences in the way the public transport system evolved in each country, there are many common characteristics in the processes of public transport decline. In many cases, governments have attempted to use the public transport industry as an instrument of social policy by simultaneously constraining fare levels and structures, and by guaranteeing favourable wages and working conditions to employees. Eventually, the mounting deficits and the absence of a secure fiscal basis for subsidy resulted in the deterioration of maintenance, service reliability and operating capacity (World Bank, 2002).

According to the World Bank (2002) the replacement of public sector monopolies with well managed competitive regimes can be of great benefit to the poor of the developing world cities. Examples from the industrialised world (such as in London, Copenhagen and Stockholm) show that competition can drop the costs per unit of output while maintaining the service levels. It is crucial to choose a competitive regime appropriate to the objectives of the procuring authority, the nature of the system being managed (particularly in terms of size and number of modes), the potential strength of competition in the supply market, and the administrative capability of the procuring authority. It is also important to make sure that the competition model that is adopted is well adapted to the local circumstances. Reforms to existing systems may take time and require progressive refinement as well as key institutional requirements. Political supervision of public transport separated from professional management and restructuring of existing institutions in a form conducive to competition are critical in order to succeed (World Bank, 2002).

The lack of adequate regulation and management structures leads to the inevitable emergence of informal transport, also referred as Paratransit, which aims to cover the gap of provision and offer more flexible and affordable options against the fixed route gridlocked formal public transport. Informal services can be those operating without appropriate licenses, permits provide collective ride services to the public or registration papers from public authorities. They are usually minibuses, vans, taxis, station wagons, three-wheelers, and motorcycles that operate illicitly. However, this does not mean that they are always operating illegally, as in many countries the entry to the public transport sector is effectively free, with operators subject only to the general rules of the road and law of the land. Informal services are not always operating completely independently since many informal sector operators are members of bars or associations (Cervero and Golub, 2007; World Bank, 2002; Cervero, 2013).

Paratransit modal shares generally rise as per capita incomes fall but they can perform different roles. In Africa informal services are dominant mode of public transport for the poor, as they can substitute the failed formal public transport provision without need for subsidies. In East and South Asia, and to some extent in Latin America, Paratransit complements the formal sector, providing differentiated services in identified niche markets as it responds quickly to shifting market demands resulting from

rapid urbanization. In other parts of Latin America, it increasingly competes directly with the traditional suppliers either by duplicating franchised services or by quality differentiation (World Bank, 2002; Cervero and Golub, 2007).

There are a number of common characteristics typical of Paratransit services, although not necessarily applicable in all cases. To begin with, the vehicles operated are typically small including motorcycles, as it is easier to finance and because controls over small vehicles are more lax, even in situations where the entry of large vehicles to the public transport market is strictly controlled. In addition, in the absence of official licensing, operators often fail to meet the official requirements of driver and vehicle standards and they are not properly insured. The vehicles used are also often very simple, including in many cases non-motorized vehicles. Finally, Paratransit often operates outside the tax system or benefits from favourable treatment of the non-corporate sector. It may also have an advantage in competition with public transport operators, with costs inflated by minimum wage regulations, strict working hour requirements, neglect, and corruption (Cervero and Golub, 2007; World Bank, 2002).

Despite the fact that the informal transport sector is seen as a nuisance by national and municipal transport authorities, it provides significant benefits to urban populations. Paratransit is an important entry point to urban employment. For example, in many Asian cities, it is estimated that over 15% of the population is dependent directly or indirectly on the informal transport sector for their livelihood. In Dhaka, this proportion had been estimated at over 25%. The services the sector offers are also valuable. Except for being the mode of transport of the poor, provided by the poor, it can also provide high-quality services to wealthier citizens. Manila is a megacity where both services are provided as there is a “down market” of Jeepneys but also an “up market” of FX mini vans. Finally, Paratransit services offer high levels of responsiveness to customers’ needs by providing access to poor areas, direct routing, speed and flexibility of service (World Bank, 2002; Cervero and Golub, 2007).

Despite their advantages, paratransit operations also cause significant problems in urban environments. The main negative characteristics of informal transport are the dangerous on road behaviour of the drivers, the pollution and congestion caused by the vehicles and the fact that they undermine the formal services. In addition, scheduling is often erratic, with high frequencies and overlapping services during peak hours and low or absent services during off peak hours. It is also common that when operators are wholly dependent on ridership and often have to fight for waiting passengers at bus stops and in terminals. Paratransit vehicles are often involved in accidents as drivers can stop almost anywhere to board passengers and they lack appropriate training, they allow inappropriate loadings, and the vehicles are poorly maintained. These defects are frequently exploited by vested interests. For example, police and other public officials may take advantage of the quasi-legal nature of the sector to supplement their incomes (World Bank, 2002; Cervero and Golub, 2007).

Problems related to illegal transport provision are not always very high in the social priority list as megacities in the developing world are faced with pressing problems related to housing, child hunger, and crime. Nonetheless, there are various examples of efforts made by local authorities in megacities to regulate Paratransit services, with different levels of success. It is suggested that, given the importance of Paratransit both as an income generator and as a service provider to the poor, attempting to eliminate it by administrative action could generate significant unrest. For example, when in 1999 the authorities of Sao Paulo tried to control the informal public transport sector, roads were blocked and 24 formal sector large vehicles were destroyed in a period of three months. Governments should examine why the informal sector exists, and then try to identify a regulatory and administrative framework within which the potential of the sector can be mobilised and developed (World Bank, 2002; Cervero and Golub, 2007).

A number of different approaches have been adopted to overcome the problems associated with paratransit by providing the informal operators with security in terms of field of operation and future revenues in order to ensure their commitment of capital and quality of service on their side. Several countries allow free access in certain specialised markets such as the local feeder buses in Seoul and

the air conditioned services in Dhaka. However, this approach has not been particularly successful as it tends to be limited to niche markets. The most common practice in the bus sector has been found in the form of medium-term route franchise contract preferably competitively tendered. Franchising is often combined with giving the operators the freedom to establish association in order to be able to provide high frequency services on routes requiring a large number of vehicles. In addition, in order to avoid the emergence of cartels, local authorities in Buenos Aires ensured that route franchises granted to specific associations overlapped, so that there was a degree of competition on the road. However, it is note that the ultimate objective of regulation should not be to maintain a highly fragmented bus industry but to encourage structures on which competition can be based (World Bank, 2002).

Despite the pronounced financing and management problems, public transport conditions in developing countries have been improving steadily in the recent years. The emergence of the Bus Rapid System (BRT) in Curitiba, Brazil in 1974 and introduction of TransMillenio, the BRT system of Bogota, Colombia in the late 1990s, have led the way for many cities across the developing world to adopt this revolutionary mode. Currently, BRT investments are found in 160 cities worldwide and at least as many cities are at various stages of planning, designing or investing in new systems. According to the Institute for Transportation and Development Policy (ITDP) that specialises in BRT practice, on average, BRT systems can be built in a fraction of the time of light rail, and BRT can cost 30 times less to construct and 3 times less to operate. The main advantage of BRT is that it offers high quality, reliable and quick transport for low income groups. Most BRT projects are pro-poor and trying to improve the accessibility levels of previously excluded groups. Megacities offer the additional advantage of high levels of demand to support the operations of mass transit system (ITDP, 2015; Cervero, 2013).

However, this does not always make a significant difference to the traffic conditions as even when the system is operating over capacity, the users are often previous public transport users who shifted from traditional buses to the BRT. For example, TransJakarta, the BRT system of Jakarta, Indonesia has not alleviated the congestion in the city, despite the yearly increase in ridership. Almost 70% of the riders were former commuters on the regular bus system and only 14% used a private car. In addition, the bus system was only built to accommodate only two-thirds of the total demand, resulting in heavy crowding. Logistical issues, involving the design of the boarding ramps and buses as well as the lack of feeder buses, also hamper the effectiveness of this system (Hook and Ernst, 2005).

High-end bus rapid transit's main advantage over comparable modes like light rail and metro rail are its routing flexibility and cost (and implementation speed) advantages. BRT allows for far more routing flexibility than rail because of buses' fundamental nature. Unlike trains, buses can jump on and off their "tracks" (busways), thus combining feeder and line-haul functions in one vehicle. For example, a bus can pick up suburban commuters in their neighbourhoods, enter a busway leading into an urban downtown, then leave the busway and circulate on downtown streets. This trip would otherwise require two transfers (suburban commuters driving or taking a feeder bus to a suburban rail station, travelling to the downtown, then transferring to a city bus, metro rail system, or taxi) (Tri-State Transportation Campaign, 2015).

Furthermore, BRT can generally be constructed at less cost than rail systems. The average capital costs are \$7-55 million per mile for BRT systems using busways compared to \$12.4-118.8 million per mile for light rail (Tri-State Transportation Campaign, 2015).

Compared to rail, BRT may have to face the problem of image. In some communities, buses are viewed negatively as dirty, slow, or only for people without other transportation options (depending on the quality of existing bus service, these perceptions may be justified). In these places, "selling" BRT may require a branding campaign which clearly separates BRT from traditional bus service. Of course, in the long run it is a BRT system's quality of service which will separate it from regular bus service (Tri-State Transportation Campaign, 2015).

BRT's other disadvantage is that it has less carrying capacity than metro and commuter rail; it has comparable capacity to light rail. Whether higher-capacity modes can be cost-justified depends on the land use patterns of a given area. In suburban areas like the Hudson Valley, ridership on a flexible BRT system will likely be higher than on a fixed-route light or commuter rail system, even if commuter rail can theoretically carry more passengers (Tri-State Transportation Campaign, 2015).

The largest articulated BRT buses still carry fewer passengers than individual light and heavy rail trains, so to provide the same amount of service as a rail system, a BRT system may have higher labour needs but provide more frequent service. For example, a light rail system may run a 500-passenger train every 10 minutes, while a BRT system may run a 200-passenger bus every four minutes to provide the same amount of service (Tri-State Transportation Campaign, 2015).

Lower-end BRT using on-street bus lanes and/or signal priority should be considered as a replacement for (and an upgrade from) high-volume regular bus routes. The advantages are self-evident: faster travel and increased ridership. BRT conversions may face political opposition if a parking or traffic lane is taken for buses, so planners should ensure that a BRT conversion will indeed result in noticeable improvements (Tri-State Transportation Campaign, 2015).

While some critics have argued that bus rapid transit is less energy efficient than rail transit, the available evidence is mixed. A study of German cities estimated that bus transit was 4 times as energy efficient as car travel, while light and metro rail was 2.5 times as efficient as car travel (per passenger-kilometre). By contrast, a U.S. study found that the average train trip was 8.4% more efficient than the average bus trip, and 16.3% more efficient than the average automobile trip (Tri-State Transportation Campaign, 2015).

The large discrepancies in existing studies may exist because transit energy efficiency depends on many variables, including the level of congestion in an area, how heavily used a transit system is, and the differences between various bus and train models. For example, a significant portion of New York City's public bus fleet is diesel-electric hybrid. Because both rail and bus transit are more fuel-efficient than cars, the relevant question is not which mode is theoretically more efficient but which mode or combination of modes will best divert automobile users to transit (Tri-State Transportation Campaign, 2015).

Best practice case study: Public Transport, Land Use Planning and Social Innovationthe case of Curitiba, Brazil

Curitiba is a leading example and a pioneer in BRT systems. Many of the OIC megacities examined in this report already have a BRT system and others are examining the option of adopting one. The lessons to be learned from Curitiba are not only related to the benefits of the system itself but also to the wider urban, social and transport strategies adopted in the city. Curitiba has proven that public transport can be the backbone of all operations in a city, not only transport. From social accessibility and green spaces to economic growth, Curitiba provides valuable lessons for cities of all sizes and economic status.

For further information see **Appendix A2-Public Transport, Land Use Planning and Social Innovation, the case of Curitiba, Brazil**

3.4.3. Non-motorized transport (NMT)

3.4.3.1. NMT of megacities in developed countries

The two main modes of NMT, walking and cycling, provide significant environmental benefits for the urban environment and also are a very good form of physical exercise. NMT has been recognized in many cities across the world as the best opportunity to reduce private vehicle use in the urban

environment. Walking and cycling are the most efficient and sustainable means of making short trips, as they do not generate air pollution, greenhouse gases, or noise pollution. It is generally accepted that the number of pedestrians and cyclist in the cities of the developed world depends on the extent to which people are invited to walk or cycle and is not generated by necessity. In many cities, walking and cycling maintain high modal shares, regardless of the topographical and weather conditions. Integration between different modes and equal rights for all road users to safely choose the mode they wish, provide an essential base for the success of transport policies (Gehl, 2010).

In terms of walking, research has shown that it is highly dependent of the urban design, the connectivity of pedestrian routes, the obstacles encountered on their way, the interaction with the crowd and other modes, and even the quality of the pavements. The architectural characteristics of a city play a significant role in improving the pedestrian experience. At the same time, the interaction of pedestrians with other modes at pedestrian crossings, exit of stations and shared spaces needs to be carefully planned in order to cater for the free movement of slower modes. Stairs and steps, multi stage pedestrian crossings, underpasses and footbridges are generally considered among the most uninviting pedestrian features (Gehl, 2010).

The distance that pedestrians are most commonly willing to walk is 500m. The majority of the city centres in the developed world are covering an area of one square kilometre which means that a walk of a kilometre or less will bring pedestrians to most of the centres of a city. Megacities have corresponding patterns, as they are divided into numerous centres and districts. The acceptable walking distance does not change because the city is larger.

Although cycling can be considered a rapid form of walking as an experience in the urban environment, it requires higher level of design and planning integration than walking. This is the reason why, in developed and car dominated cities, cycling modal shares range between 1 and 2% is dominated by cycling enthusiasts, mostly male and young. This is the reason why there are few examples of cycling cities, primarily concentrated in Europe. For example, Copenhagen is an example of a city with a longstanding cycling tradition. During the oil crisis of the 1970s, Copenhagen adopted a clearly defined cycling approach in transport planning and kept car traffic at low levels ever since. Key actions that Copenhagen and other cycling cities have taken include building an extensive and seamless network of dedicated cycling lanes, and integration of cycling with other modes such as trains, subways and even taxis with dedicated spaces for bikes on trains or vehicles, and parking spaces at stations and terminal points. Safety is also a prerequisite for the widespread take up of cycling, especially at intersections, where cyclists interact with other traffic. Intersections in Copenhagen have special lights signals for bikes, which typically give a green light to bicycle traffic six seconds before cars.

Bicycle sharing programmes are also widespread in many cities and megacities of the developed world. There are different levels of take up depending on the cycling culture of each city. In traditionally cycling cities, cycle ownership is already high and therefore sharing schemes are targeted to new cyclists, visitors or tourists. On the other hand, in cities like Paris, where the cycling is not so widespread, shared bikes are mostly used by locals and the schemes make part of efforts to build and reinforce the cycling culture of citizens.

Other efforts to promote both walking and cycling in cities include educational campaigns in schools and open streets only for walking and cycling on Sundays. The latter is in fact not limited to developed world cities as the idea of closing streets to traffic once a week has been popular in Latin American cities for years. An example of a megacity that has recently made coordinated efforts to increase the share of cycling is New York City, which planned in 2007 the construction of 3,000km of cycling lanes in all five of its boroughs. The city also introduced 'summer streets' dedicated to NMT on Saturdays during the summer months. It is expected that, in the future, concerns about sustainability will lead more developed world megacities to increase their efforts to develop stronger cycling cultures (Gehl, 2010).

Best practice case study: Cycling in the Netherlands: Lessons learned from integrated environmental, urban and transport planning

The Netherlands is probably the leading country in planning for cycling and integrating cycling policies in wider transport strategies. The OIC megacities can borrow from the Netherlands low cost infrastructure, safety, and promotion policies that can be adapted to the local physical and socio-cultural environment. The comparison with Rio de Janeiro proves that best practice can be shared with big success. In the case of cycling, integration and consistency in planning across years and different local governments are probably the biggest success factors. As promoting NMT does not entirely depend on infrastructure (for example, Amsterdam has a lower total length of dedicated cycle lanes than Santiago, Chile), political commitment and public support can provide a sufficient basis for building strong cycling cultures.

For more information on see **Appendix A2 - Cycling in the Netherlands: Lessons Learned from Integrated Environmental, Urban and Transport Planning**

3.4.3.2. NMT of megacities in developing countries

In the developing world megacities, non-motorized modes are often associated with poverty. Although in many developing countries cycling is also considered a leisure activity, particularly for the middle class, there are large parts of the population that rely completely on NMT for their mobility. Walking is very often the only mode of transport for the very poor. The accessibility levels and the quality of walking and cycling environment are significantly reduced by increasing motorization that is taking over the footways and deteriorates air quality and safety in megacities. Official planning for NMT is often completely absent, which means that even efforts to improve other modes are failing to achieve their full potential as it becomes increasingly difficult to undertake connecting walking or cycling trips in the cities. In addition, the forms of NMT in developing world megacities are not limited only to walking and cycling but also include animal and human drawn vehicles and various forms of non-motorized rickshaws and taxis. This usually creates a varied mix of modes on the streets which reduces the efficiency of the traffic and also proves that planning should cater for non-motorized modes to the same extent as for motorized.

Historically, developing cities often had a richer diversity of land uses and a more walkable urban environment than their developed counterparts. Lax or non-existent land use regulations have favoured an organic pattern of mixed land use in many developing cities. However, studies have shown that the influence of dense and mixed land uses on residents' mobility patterns is not as strong as the design attributes of a neighbourhood, such as street connectivity and sidewalk provision. Expanded, improved and upgraded pathways and streets are often important parts of slum upgrading programmes. It is also suggested that smaller city blocks can also encourage foot travel in developing cities. In Ahmedabad, the modal share of walking trips for neighbourhoods with an average block size of 4 hectares was 13 percent, compared to 36 percent for otherwise similar neighbourhoods with an average block size of 1.2 hectares. Another study found that in Shanghai, residents who lived in areas with smaller blocks and denser road networks averaged around half the car ownership levels as those living in more car oriented, superblock districts (Cervero, 2013).

In addition, NMT is critical for the economic functioning of developing world cities and particularly for the urban poor as walking and cycling are often the only modes of transport they can afford. In African cities, a third of all trips are walking trips while in places like Dakar and Douala this share is much higher, over 60 percent. Cycling often represents a trade up from walking. In many of the developing countries only middle income households can afford bicycles. Unlike in developed countries, walking and cycling are less often associated with pleasure or exercise. In total, NMT accounts for between 40 and 60 percent of all trips in several major cities while in poorer cities in Africa this proportion is even higher. Modal share studies in developing countries have shown that NMT is embedded in the mobility patterns of people across all ages as its share of each age cohort correlates closely with its share in total mobility (World Bank, 2002).

Despite the fact that the traditional functions and shape of the cities in the developing world could have favoured NMT oriented transport and land use planning policies, the political attitudes towards pedestrians and cyclists have been neglectful or even negative. Pedestrian space is continuously being eroded. Footways either do not exist or they are occupied by street vendors, parked cars, motorcycles, and bicycles. Even in cities like Dakar, where walking has a high modal share, the lack of pedestrian infrastructure and the poorly connected streets make it difficult to undertake long walking trips. As city authorities find it difficult to manage and control street market, pedestrian and cycling activities, the trend has been to eliminate them altogether, rather than taking a functional approach to road hierarchy, whereby the functions of some roads could be for pedestrians and market activities and not for fast flowing motor vehicle traffic. In addition, policies introducing reductions in the number of non-motorized vehicles and movement restrictions have often been adopted as viable solutions to reduce traffic congestion and the consumption of fuel. For example, restrictions on NMT were one of the main initiatives taken in 2002 by the government of Bangladesh in order to improve air quality in Dhaka (World Bank, 2002; Alam and Rabbani, 2007; Diakhate, 2007; Cervero, 2013).

Various complex reasons can be identified behind the lack of official interest in planning for NMT. To begin with, there is often a lack of interest by engineers who favour the dealing with more technically challenging road and bridge design. At the same time, there is often lack of transport planning and design skills in order to apply large scale NMT solutions appropriate for the large volumes of NMT trips in developing world megacities. Local initiative to promote NMT may also be limited by the lack of funding from central governments. In addition, it is often difficult for the police to focus the enforcement of NMT routes and on the lack of respect of cyclists for traffic regulations. Finally, car and motorcycle users seem to have a vested interest in reducing the nuisance caused by slow moving NMT (World Bank, 2002).

On the other hand, there are also major limitations that prevent citizens from the choosing or continue using NMT. Safety and security concerns and air pollution caused by motorized transport are the most important reasons that render NMT non-viable in many of the megacities of the developing world. As a result, people shift to public or private motorized transport or become less mobile, a choice that not only has significant impacts on the economies of households but also on the economies of agglomerations.

Sociocultural conventions are also an important factor affecting NMT use. Walking is in most cases not associated with status as, regardless of their income, everyone walks for short trips or for the last leg of multimodal trips. On the other hand, cycling is often associated with poverty, while the car is a status symbol. For example, results from a study carried out in Cairo showed that a considerable number of Egyptians, especially academics and students, approved of cycling in theory but would not choose to switch to it, partially because of the social stigma. In accordance to social norms, cycling can be acceptable for youth and leisure but not for commuting or as a conscious choice of transport mode. Gender specific norms and conventions also pose restrictions to use of NMT, particularly by women. Cycling is often culturally unacceptable for women as the exposure of the female body by moving is considered inappropriate. In addition, women who cycle may often face verbal and physical harassment. It is noted however, that women are usually taking more complex and shorter trips than men, and they could benefit from the flexibility and reliability offered by cycling (Peters, 2002; Aichinger and Reinbacher, 2010).

In most developing countries NMT has developed spontaneously and remains largely outside the normal processes of transport planning. Provision for NMT, when constructed, seems to be retrofitted to existing infrastructure, and to concentrate on minimising the disturbance that it causes to the flow of motorized traffic. This often results in the construction of expensive and often inconvenient infrastructure for NMT, such as open pedestrian footbridges for crossing busy roads. In this case, it is generally considered best practice that in order to retrofit NMT in what was originally designed for motorized transport, it is necessary to also modify the existing elements. For example, some level of traffic calming and reduction in speed differentiation between motorized and non-motorized traffic is necessary when a new cycle lane is introduced on an existing road (World Bank, 2002).

Integration of NMT with urban design and other modes is considered essential for the success of urban transport strategies. The ability to take seamless and efficient trips in the urban environment is heavily dependent on NMT and particularly on walking as most trips involve at least a short leg carried out on foot. In addition, similar to policies aimed at promoting public transport, those promoting NMT should focus on showing that NMT is for all citizens, regardless of their economic status. Because of the nature and the scale of non-motorized trips, the involvement of civil society in promoting NMT and reclaiming the road space from cars is considered to be a critical success factor. User and stakeholder participation can improve decisions by exploiting local knowledge and desires, and spotting and solving potential problems, as well as by smoothing the execution of public sector interventions, especially when accessibility and safety problems are urgent (World Bank, 2002).

3.5. Freight and Servicing

3.5.1. Introduction

Today's megacities have traditionally been centres of trade and continue to concentrate a great amount of trade activity, both national and international. Both in developed and the developing world, megacities are regional, national and international multimodal trade hubs. As cities grow, their economic activities and consumption patterns typically become larger, more intense and more complex. As one outcome of the urban development process, more goods need to be delivered into cities to satisfy consumption needs of growing urban populations. Megacities have made some successful efforts to decouple economic growth from passenger transport but they seem to lag behind in the goods transport sector. At the same time, even though urban freight vehicles make up a small share of all vehicle traffic, they generate a disproportionate share of several externalities, such as congestion on local streets and highways, infrastructure damage, pollution, greenhouse gases, and noise (Blanco, 2014).

3.5.2. Freight and servicing of megacities in developed countries

Based on data from developed urban areas, a city generates about 300 to 400 truck trips per 1000 people per day, and each person consumes about 30 to 50 tons of goods every year. This translates into increased freight activity and increased use of road space and infrastructure. Urban freight takes up 10-35 percent of the total distance travelled on city streets and 3-5 percent of urban land. Sustainable urban planning poses limitations to traditional urban freight operations, which means that there is a need for significant changes in the urban logistics sector (Blanco, 2014).

First, the densification of urban centres, focus on public transport and the reduction of road and parking areas is in conflict with the traditional approach to urban freight that it makes economic sense to consolidate goods and multiple operations and goods in one large area and make deliveries with large capacity vehicles. As urban density increases and road networks are constrained, logistics facilities decentralize. Urban logistics centres move further away from the cores of the cities. In Paris, parcel and express transport companies, on average, located their terminals 6.8 miles farther away from their geographic centroid in 2010 than in 1975, while businesses and shops have only moved 1.8 miles away during the same period while consumers and products continue to live inside the urban areas (Blanco, 2014).

Second, it is extremely difficult to find uniform regulatory solutions for urban freight as there is a huge diversity in the urban freight needs from one economic sector to another and across urban areas. Such diversity also poses difficulties to identifying common technologies or transferring knowledge between metropolitan areas. Combined with a fragmentation of the actors often involved in policy making in cities and metropolitan areas, such as planning agencies, port operators or transit authorities, decision making crosses multiple jurisdictional barriers. Finally, the urban freight sector is only the last (or first) mile of a much larger supply chain that expands beyond the borders of the urban area, into regional, national and global economies. This larger geographical span makes supply

chains flexible to adapt to various policies and therefore increases the uncertainty of long term impacts on the city and commencement to urban plans (Blanco, 2014).

Successful strategies on megacities of the developed world show that in order to shape an effective and efficient urban freight strategy it is necessary to take into account all the levels of the urban freight system, starting from the delivery and pick up, to the routes and distribution network and facilities available, the urban logistics system and the actors involved, the urban economy, and finally to the national and international supply chains. A more comprehensive framework of the urban freight system is needed to further understand why policies are more or less effective, but most importantly, to adapt them to a wider set of cities (Blanco, 2014).

For example, off hour deliveries, traffic regulations and port gate pricing, tackle the delivery and pick up operations. They focus on influencing the interaction between the driver and the customer. The interventions are simple (e.g. establishing loading/unloading zone) but due to the large amount of actors affected they require extensive communication. For example, TfL continuously creates pamphlets and guides to educate and influence delivery and pick up activities (Blanco, 2014).

Low emission zones (LEZ) and road pricing, directly affect last mile operations³. They often face resistance since they require the redesign of distribution networks from all affected private actors, contracts between them and start involving managers that do not have direct interaction with the urban context beyond its market potential. Their outcome is uncertain and they are slower to design and implement (Blanco, 2014).

Voluntary programs, at the city or at ports and airports, aim at engaging multiple stakeholders operating in an urban area, and drive change in hundreds of logistics systems without affecting the urban economy. They are often precursors to specific policies (such as LEZ) and try to recognize the diversity of the supply chains involved. They require long term commitment from all actors and require strong institutional support and public private partnerships (Blanco, 2014).

It is important to highlight that some of the more commonly discussed policies such as restrictive traffic and parking regulations, although effective to certain degrees, have proven difficult to scale due to the complexity of strict enforcement, but most importantly, because cities have no control over the demand of pickups and deliveries. Ultimately, shippers, drivers and customers, find a way to circumvent the restriction by other means with worse consequences (e.g. use of private vehicles, double parking). Another popular academic recommendation is consolidation and integrated city logistics planning. These aims at reducing truck traffic by combining pickups and deliveries from various companies serving the same area. Due to the multiple actors required these are often successful at small scale, at the private level or as part of larger voluntary programs (Blanco, 2014).

Best practice case study: Sustainable urban freight operations, better air quality and safety in London

London is a leading example in sustainable freight operations from where many lessons can be learned and applied in OIC megacities, regardless of the differences in their wider urban environment. London's success lies in its integrated approach between freight, safety and traffic management along with the enhanced public participation. It shows that when economic benefits are clearly communicated to the operators it then becomes easier for local authorities to engage them in making their operations more sustainable and safer.

For more information on see **Appendix A1-** Sustainable Urban Freight Operations, Better Air Quality and Safety in London

³The execution and coordination of the routing and the delivery/pick up across a city is often referred to as "last mile" operation (Blanco, 2014).

3.5.3. Freight and servicing of megacities in developing countries

Dense city areas in developing countries have limited or no space for road capacity expansion, as the land uses have developed organically over time and are potentially incompatible with logistics demands. In addition, disorganized population growth has created considerable challenges for the free flow of vehicle, people and the distribution of goods into and out of these cities. Thus, urban freight is often seen as a nuisance from the public perspective. Authorities, often fail in their urban planning processes because they lack the appropriate planning knowledge and tools for such a network but also because they do not consider every actor's viewpoint and focus only on regulatory rules or urban mobility or companies (Vieira et al, 2015; Blanco, 2014).

In developing world megacities, the goods distribution system has become increasingly complex because of increases in demand, government regulations, traffic congestion, high frequency deliveries in lighter vehicles, environmental issues, and deliveries in unsafe areas. All actors involved in the logistics sector want to work more efficiently and maintain their competitiveness but their capacities and knowledge of the local traffic patterns, safety issues, street network and regulations differ significantly. The actors directly involved in the logistics chain, such as shippers, logistics service providers and carriers, located inside or outside megacities have different perceptions related to regulations and issues in the movement of goods. The involvement of other, unofficial private actors further complicates any effort to promote collaboration and coordination as well as monitoring of logistics (Vieira et al, 2015).

Freight movements contribute to the deteriorating traffic conditions in the megacities of the developing world. In most countries, the freight sector lacks basic infrastructure, such as freight terminals, warehousing, loading and unloading areas, freight forwarding centres, and other logistical needs. There are few developing world megacities that plan their logistics activities, thus a dysfunctional arrangement of goods transport is the norm. Often, in the absence of peripheral routes or bypasses, heavy goods vehicles pass through the core of cities, contributing to the poor quality of roads as heavier vehicles pose significantly more pressure to pavements than cars. In turn, poor quality road surfaces slow trucks more than lighter vehicles. The limited data availability in terms of origins and destinations of transported goods puts additional barriers to planning freight movements. For example, in Lagos, Nigeria, despite the large volumes of transported goods in the city, there is no documented information related to the final destination of goods but only to the next destination for each logistics provider (Cervero, 2013; Olayinka Somuyiwa, 2010).

Cities in the developing world face the same challenges in dealing with urban freight as cities elsewhere, but differ significantly in terms of population and area growth, density and economic disparities. Thus, besides the obvious implications to urban freight movement in these developing cities (more congestion, less infrastructure, more informality), these unique characteristics create a salient emerging property for urban freight. There is a large share of small, owner operated retail outlets that provide goods and services in urban areas in developing countries. These small stores represent a much larger share of consumer product goods, more than 40% in Latin America and Asia. In Mexico City, for example, there are over 100,000 small stores, or an average of 200 people per store. Unlike modern retail channels in North America and Europe, these stores are family owned and operated, cash based, with very limited product assortment and shelf space, a small geographical market area and with lack of processes and technology, besides a personal mobile phone. Their servicing requires small vehicles, frequent deliveries due to the small volume and lack of shelf and storage space. There are no widespread studies, but it is not uncommon for a single small store, of less than 20-30 square meters, to receive over 30 deliveries per week. These levels of logistics activities make the prominence of urban freight in developing cities even larger than cities in high income countries (Blanco, 2014).

The majority of the measures described in the previous section, were developed and implemented in high income urban cities. Most of them are still applicable in cities and port cities in the developing world. Voluntary programs, developing of local planning freight policies, efficiency standards and

transfer directly. For port cities, improving port operations using port appointment systems, gate pricing and voluntary emission reduction programs for oceans and vessels are sensible strategies (Blanco, 2014).

Other policies are less effective due to the unique nature of the developing urban cities. For instance, off hour deliveries require changes in operation hours for shippers, drivers and receivers. The large number of small stores makes this very complex or with very limited impact as they have a single owner that will very unlikely be willing to receive shipments at night, not to mention the risks in moving freight in poor neighbourhoods. Road pricing is also difficult to implement. There is a lot of informality in the transportation sector that makes these solutions much harder to deploy, and politically even more challenging (Blanco, 2014).

There are also some good examples of innovative solutions that illustrate the potential of improving freight in very complex urban environments. For example, the Mumbai Dabbawalas are a cooperative of delivery of home prepared meals in India. They are well known in their field of logistics for achieving high levels of accuracy in their deliveries despite working with low education workforce, minimal management and no technology. From an urban freight perspective, their success is due to leveraging the public infrastructure in Mumbai. Every morning, lunch boxes are collected by bicycle and foot and transported, via multiple transfer points, using the public rail transport. The Dabbawalas' logistics system involves 25 km of public transport and 10 km of footwork with multiple transfer points. Since the majority of the journey involves public transport, the timing of the Dabbawalas is dependent on Mumbai's suburban rail network. The Dabbawalas use the rail network very effectively by employing simple, straight routes, mostly north south, and limit sorting to a few central points (Blanco, 2014).

3.6. Road Safety

3.6.1. Introduction

In 2010, road accidents were estimated to account for 1.3 million deaths per year, an increase of 46% over the previous two decades, and a further 78.2 million non-fatal injuries requiring medical care. In addition, global projections show an upward trend in total deaths and injuries, both predicted to double by 2030. It is also estimated that almost 50% of fatal road accidents and 75% of those leading to injuries take place in an urban environment. In high income countries, most of those killed in road crashes are occupants of four wheeled motor vehicles; in low and middle income countries, most fatalities are among pedestrians or cyclists (Rode et al, 2014).

Along with the human cost, the economic impact of traffic accidents involves the loss of human capital, hospitalisation, and material costs is also very high. The total cost of traffic accidents for 2010 is estimated at US\$1,855 billion, or approximately 3% of the global GDP. Low and middle income countries are experiencing even greater economic loss, approximately 5% of their GDP (Rode et al, 2014).

Describing global road death and injury as a "major public health problem with a broad range of social and economic consequences which, if unaddressed, may affect the sustainable development of countries and hinder progress towards the Millennium Development Goals" the UN General Assembly proclaimed the UN Decade of Action for Road Safety 2011-2020 in a landmark Resolution cosponsored by 100 countries. Officially launched on 11 May 2011, the Decade of Action has the official goal of stabilising and then reducing global road traffic fatalities by 2020. Among the countries that participated in the agreement are many OIC members as well as Egypt, Nigeria, Pakistan, Bangladesh, Indonesia and Turkey where six out of the seven the megacities of this study belong. Senegal also participated in the agreement.

3.6.2. Road safety of megacities in developed countries

In terms of the comparison of the ratio between road deaths and vehicles, the developed countries have better values than developing countries. However, road traffic injuries remain very relevant to high income countries as well. The local authorities in developed countries play a key role in reducing road casualties through their statutory functions and their local influence. Furthermore, they make specific provision for vulnerable road user groups, encourage safer road user behaviour and enforce traffic laws. Currently, the top performers globally with regard to road safety are the Netherlands, Sweden and United Kingdom.

A lesson learned from developed countries with advanced road safety is that comprehensive and clear legislation, enforced with appropriate penalties and accompanied by public awareness campaigns, has been shown to be a critical factor in reducing road traffic injuries and deaths associated with speed, drink driving, and the non-use of occupant protection measures (helmets, seat belts, and child restraints). City visions focused on traffic safety are prominent in the agendas of these cities. For example, New York City launched the 'Vision Zero' in 2014, arguing that traffic crashes can no longer be considered mere "accidents," but rather as preventable incidents that can be systematically addressed. This Vision Zero Action Plan is New York City's foundation for ending traffic deaths and injuries on its streets. The plan involves improved street design, regulations and also public participation (nyc.gov, 2015).

Pedestrians, cyclists and motorcyclists continue to be the most vulnerable users in developed countries. Pedestrians are among the road users most vulnerable to traffic injury. It has become highly challenging, especially for older and young people, to cope with the complex, sometimes hostile, traffic conditions that characterize today's cities and towns. Pedestrians suffer severe trauma from falls in public spaces and in traffic collisions while crossing streets. The magnitude of the consequences of falls is known to be underestimated. Older people have an elevated risk of severe injury and death from both falls and traffic collisions. Lowering motorized traffic speeds reduces the frequency and severity of crashes, especially those involving pedestrians. Reducing speed also contributes to smoother traffic flow, and enhances in many ways the liveability and sustainability of cities (ITF, 2014).

The case of cycling is particularly interesting. Many local authorities in developed world megacities are struggling to reduce accidents involving cyclists. Examples of interventions include speed management acts as "hidden infrastructure" protecting cyclists, training and awareness raising among drivers, and improved intersection design taking into visibility, predictability and speed reduction. Authorities seeking to improve cyclists' safety are trying to reorient policy focus on improving the inherent safety of the traffic system, not simply securing cyclists in an inherently unsafe system. However, evidence from Denmark shows that the risk of accidents and actual accidents fall drastically when more people cycle. Car drivers pay a lot more attention on bicycles as their number increases on the streets. In addition, bicycle helmet laws have been widely controversial. Opponents of helmet legislation claim that people will use bicycles less if they are required to wear a helmet, and thus miss out on the health benefits and enjoyment that may be derived from cycling. Others suggest that potential safety initiatives (for example, separate bicycle paths and lower speed limits) may be passed over in favour of helmet legislation (ITF, 2014; Gehl, 2010; Macpherson and Spinks, 2008).

3.6.3. Road safety of megacities in developing countries

Almost 85% of fatalities due to road accidents occur in low and middle income countries. India ranks number one with 110,000 people killed every year, followed by China where 87,000 people killed every year. In spite of various global efforts made to improve the road safety in developing countries, road accidents, fatalities and injuries are not reducing. Among the main reasons behind this are the limited institutional framework coverage and financial capacity as well as appropriate training of both responsible authorities and drivers. According to older data, Uganda and Pakistan spent 0.09 USD per capita (or 0.02% of GDP/capita) and 0.07 USD per capita (or 0.015% of GDP/capita) respectively on

road safety in 1998. Although this situation has improved since then, especially with the participation in the UN Decade of Action for Road Safety 2011-2020, public spending of developing countries on road safety remain remarkably low compared to those of the developed ones (Bishai et al, 2003; Institute of Road Traffic Education, 2009).

More specifically most developing countries have yet to adopt a National Road Safety Plan. This is often accompanied by inadequate accident data collection procedures and poor post-crash management. The lack of information on the current road safety status, causes and consequences at a country and city level further hinders the development of targets and plans for further action. In addition, the roles and responsibilities for traffic management agencies and the police are often not clearly defined. Traffic legislation is also not updated regularly, not covering the needs of NMT and does not follow modern common practices such as common examination standards for obtaining driving licences. This leads to poor law enforcement on the side of the police and reckless driving. Finally, the condition of the vehicles is also contributing to the accident rates, while at the same time poor technical control facilities and regulations do not encourage any change.

Evidence from India shows that road traffic fatalities have been increasing at about 8% annually for the last ten years and show no signs of decreasing. Accidents involving pedestrians, bicyclists, and other non motorizts in urban areas account for about 60% of all fatalities in urban areas, substantially more than in most high income countries. Motorcyclists represent a large portion of urban fatalities (about 25%). However, a partial shift of motorcyclists to small cars due to income increase is also concerning the Indian authorities, because although small cars provide more protection to the occupants, they are expected to be more harmful than motorcycles to pedestrians, bicyclists, and other motorcyclists unless vehicle fronts are designed to be more forgiving. In addition, the involvement of trucks and buses in fatal crashes is all the more frequent. Several studies indicate that the involvement of trucks in fatal crashes is greater than would be expected based only on their exposure (Mohan et al, 2009).

Other reasons contributing to road accidents in India are related to night time driving. The lack of concentration and control of road users who are driving under the influence of alcohol, the low visibility and fatigue of truck drivers have a significant contribution to road fatalities. Finally, a large proportion of fatalities on divided highways are from head on collisions caused by drivers driving on the opposite direction. One study found that such crashes accounted for 19% of all fatalities on four lane, divided highways (Mohan et al, 2009).

3.7. Institutions and Organizational structure

3.7.1. Introduction

Urban transport governance remains a challenging area for both developed and developing world cities. The development and implementation of transport policies requires a combination of institutional structures and synergies to be in place in order to succeed. The concentration of all operations and planning under a single transport authority for a city is considered a key action to ensure the delivery of a sustainable transport strategy. This transport authority needs to be able to develop a transport strategy for a city, ensure that the necessary synergies with other sectors and authorities are in place, monitor the implementation of the plan, evaluate its success and adapt it according to the changing needs of the city. In addition, the participation of all relevant stakeholders, such as the public, private operators and local authorities, needs to be secured in order to deliver equal access opportunities, service levels and economic benefits.

3.7.2. Institutions and organizational structure in developed world megacities

In most developed world megacities, the city wide transport authorities have been in place for years and have developed their structure so that they manage most operations in the city and interactions with other authorities such as land use planning and environment. However, in many cases, there is still no framework in place to determine the responsibilities and role of private operators, particularly

for buses. This often means that operators provide services of different standards and fares, affecting the overall customer experience. In addition, when the private sector is not operating based on a common framework, there is often lack of balance in provision, with services available and even overlapping on profitable routes and low or no availability on least profitable routes and areas. The example of TfL proves how important it is to limit the levels of deregulation of the transport sector, in order to provide higher levels of services. London is one of the very few cities in the United Kingdom, where bus services are not entirely privatised, with TfL defining vehicle and operation standards and managing the concessions of services in a competitive environment. As a result, unlike other cities in the UK, it has been easy for TfL to establish fare structures and a ticketing system that spans across most all modes in the city, and wide coverage real time information. In the case of London, central management is crucial for better providing coordination of services, complimentary of modes and seamless multimodal travel for all passengers.

Except for managing transport operations and the development of strategies, monitoring and evaluation are also very important, in order to assess the successes and failures of programmes during their implementation. Although monitoring and evaluation procedures are not always followed as they should, or even neglected in some cases following the implementation of a plan or a project, efforts to ensure that assessment is taking place are increasing. There are still significant limitations in the sharing of lessons learnt from the successes and the failures of schemes between authorities of different megacities in the developed world. Pre-existing political agendas or limited willingness to adapt policies to local conditions are still obstacles to sharing best practices.

Finally, one of the future challenges for transport authorities in the developed world cities and megacities is the increasing involvement of the private sector in the provision of transport services, mostly through internet applications. The rise of peer-to-peer innovation, where people offer services to their peers such as lifts, groceries shopping and running errands, is challenging the structure of traditional governance systems. For example, the rise of internet taxi services such as Uber, changes the geographies of cities as people now are able to access more rapidly and easily areas that they may otherwise not visit, such as busy nightlife areas where taxis are difficult to find. Such services change the levels of availability of mobility in the city, stretch the operating hours of services and long standing urban standards such as car ownership. It is expected that car ownership levels will drop even in traditional car dominated countries such as the United States which has a direct impact on parking standards for housing, focus of infrastructure and location of new development. Should this social and capital transformation be successful, transport authorities will need to adapt their strategies and standards in order to adapt to the changing markets and demands.

3.7.3. Institutions and organization in developing world megacities

The institutional structure of transport planning authorities in developing world megacities is usually less clear than that of the developed ones. The fragmentation of responsibilities is a key issue causing problems and inconsistencies among different authorities and organizations responsible for different aspects of transport and spatial planning. This is often the reason why cities and megacities in particular megacities of the developing world lack a global vision which in turn enhances the freedom of organizational authorities and the private sector to act without collaborating. The lack of control over the activity of the private sector in particular, leads to economic losses for both local authorities and operators themselves as competition is uncontrolled and in many cases unfair.

However, it should be noted that private public transport operators are often the first to respond to the needs of the population where there is new demand or lack of provision by the local authorities. In addition, monitoring and evaluation are a very big challenge for the authorities of the developing world megacities. The size and interconnected challenges in the urban environment require a robust database for the management for the collection of the necessary information to be used for monitoring. However, the lack of monitoring mechanisms and consistent data collection is a significant barrier to understanding the quality and quantity of transport problems in the city. As a consequence, the evaluation of policies and projects is becoming extremely difficult to conduct. Except for the

difficulty to assess the impacts of projects and policies, it is also becoming difficult to understand the synergies and clashes between them, which hinders the effective shaping of future actions.

Last but not least, one of the major problems of the transport sector in the developing world megacities is the focus on short term impact, prestigious or highly profitable projects. Concepts such as “cities are engines of economic growth” and the concept of linking economic well-being with GDP growth have had a major impact on national and urban policies in many cities and megacities of the developing world. The increasing involvement of international corporations to the building and maintenance of infrastructure and the type of infrastructure that has been built has weakened the economies of developing countries and marginalised even further the poor who have limited capacity to respond to such interventions. Mega infrastructure projects for megacities have traditionally lacked a multimodal planning approach, favoured private cars and dislocated or separated poor communities (Hasan, 2009).

3.8. Urban Transport Infrastructure Financing

3.8.1. Introduction

As transport demand increases with the rapid increase in population and per capita income of megacities, so does the need for expansion in transport infrastructure capacity. As stressed in the previous sections, it is necessary to focus on mass transit and demand management as well as in building a stable institutional framework that manages the transport system. Nevertheless, even when other issues, such as environmental and community impacts of new infrastructure, are managed, finding adequate sources of finance continues to figure prominently in both the developing and developed worlds. Infrastructure financing is particularly difficult because of the separation of road infrastructure from operations and because of the multiple objectives that public authorities are pursuing in urban transport policy (Zegras, 2003).

The capacity of cities and megacities’ plan and fund their own infrastructure, as well as the sources of their funding, vary across the world regardless of their level of wealth. While city governments tend to lead on small and medium scale public infrastructure initiatives – such as public space improvements, cycle paths, footpaths and smaller roads – large scale infrastructure tends to be controlled by state and national governments, often requiring substantial external investments. Both highway infrastructure and operations and rail-based transport are the most centralised transport subsectors, mainly led by national government. On the other hand, the main difference between developed and developing countries is the consistency of financial arrangements within the overall urban strategies. In the case of developed countries, this consistency means that both taxation income and private investments can be secured to a certain extent. On the other hand, in developing countries, the lack of consistent financial arrangements means that funding sources and models need to be employed on an individual project basis, often undermining the cohesion of urban strategies (UCL Cities, 2014; World Bank, 2002).

3.8.2. Urban transport infrastructure financing in developed world megacities

Developed countries benefit from existing funding mechanisms and regulations which allow them to create highly profitable opportunities for private sector investments and capture the full benefits of new infrastructure. Since the 1970s, in Organization for Economic Cooperation and Development (OECD) countries, privatisation and public sector expenditure constraints have given rise to a substantial reduction in public sector investment and to an alteration of the respective importance of the private and the public sectors in infrastructure investment. At the same time, privatisation of a number of public enterprises has taken place, and a number of new private infrastructure investments have been realised (Short and Kopp, 2005; Debande, 2002).

In order to stimulate investment, public authorities have sought to involve the private sector in the creation of new infrastructures. Various structures can be used. For example in concession schemes the recourse to private capital for projects are undertaken at the initiative of the public authorities, but the private sector is in charge of providing the capital assets as well as the services. With

privatisation, in contrast, the ownership rights of the assets are transferred to the private sector, the public sector retaining a regulatory role in some sectors. In a contracting out schemes, the private sector is only contractually responsible for providing services, and not for capital assets.

The trend to privatise is strengthened by technological innovations in the collection of user fees. In this context, Public Private Partnerships (PPPs) emerging as one institutional structure, in which the public authorities deal with network or environmental externalities, demand uncertainty, and administrative costs associated with the project. On the private side, if infrastructure privatisation is combined with deregulation or liberalisation of market entry, competition in terms of the provision of services may increase, as may the market risks associated with the project. Among the benefits of such partnerships is that the private investor will search for a balance between cost, financial return, and risk. The introduction of full lifetime costing of the asset is another advantage of having recourse to the private sector. Indeed, a concession scheme favours optimisation of the trade-off between the standards to which facilities are constructed and the cost of maintenance during their lifetime. The lifetime costing approach ensures that the overall costs of an asset are minimised throughout its lifetime as it is maintained at the required standards. It is associated with the shift of the public sector's focus to output specification in private concessions.

However, despite the elaborate funding mechanisms, cities and megacities do not always prioritise projects and infrastructure that supports sustainable urban transport and development and long term benefits. For example, it is estimated that the external costs of urban sprawl are in the area of \$400 billion USD per year in the United States. Best practice towards sustainable urban development involves many of the compact city investment projects within the reach of city governments, who can leverage national or private funds to finance initial capital investments. In this case, private finance can be mobilised through real estate developer charges and fees, property or value capture taxes, loans, green bonds and carbon finance. This allows monetisation of the positive externalities of public transport investment and can be particularly important in overcoming funding gaps for infrastructure that supports higher levels of urban density. For example in Hong Kong, the government's 'Rail plus Property' model captures the uplift in property values along new transit routes, ensuring efficient urban form whilst at the same time generating US\$27 billion in direct financial benefits for the Hong Kong government since its inception in the 1970s. Land value capture is also applied in several other Asian cities including Delhi and Tokyo (Rode et al, 2014).

3.8.3. Urban transport infrastructure financing in developing world megacities

Around the world, transport sector resource allocation has perpetuated a longstanding emphasis on traditional private vehicle oriented transport projects and programs by domestic and international funders. Currently, particular in the developing world, national and international funding streams do not sufficiently recognise the importance of supporting sustainable transport projects and initiatives that will mitigate the negative global trends car ownership and use, greenhouse gas emissions, and fatalities resulting from road accidents (WRI, 2013).

Over the past few years, national governments, Multilateral Development Banks (MDBs)⁴ and Multilateral Financial Institutions (MFIs)⁵ that have begun to prioritise funding for sustainable

⁴Multilateral Development Banks are institutions that provide financial support and professional advice for economic and social development activities in developing countries. The term Multilateral Development Banks (MDBs) typically refers to the World Bank Group and four Regional Development Banks (African Development Bank, Asian Development Bank, European Bank for Reconstruction and Development, Inter-American Development Bank Group) (The World Bank, 2015).

⁵ Several other banks and funds that lend to developing countries are also identified as multilateral development institutions, and are often grouped together as other Multilateral Financial Institutions (MFIs). They differ from the MDBs in that they have a narrower ownership/membership structure and they focus on special sectors or activities.

transport projects. The commitment by the eight MDBs and MFIs (African Development Bank, Asian Development Bank, CAF – Development Bank of Latin America, European Bank for Reconstruction and Development, European Investment Bank, Inter-American Development Bank, Islamic Development Bank, World Bank) to invest \$175 billion in sustainable transportation systems over the coming decade provides an opportunity to move forward on the pressing issues currently facing the transport sector. It is a key indicator of shifting priorities, as they consider the long term impacts of climate change and recognise the public health, environmental, and economic benefits and inclusiveness of sustainable transport (WRI, 2013; Mitric, 2013).

Nonetheless, there is still much work to be done to develop national level urban transport programs and policies, clarify and track investments in sustainable transport at the MDB, MFI, national and local government levels, and leverage domestic and private finance. National governments are vital for linking their national finance programs with international finance sources to promote a shift to more sustainable transport. Three sources of financing, capital funds from national and international funds, private sector, and local, are discussed below. It is noted that the complexity of financing requires extended analysis and therefore the discussion below is only an effort to summarize the key issues related to the key sustainability and success factors (WRI, 2013).

To begin with, in order to overcome the longstanding bias towards unsustainable transport, national governments must establish strong policy frameworks that prioritise sustainable transport project and program investments along with national funding programs to implement them. The national funding programs should supplement and leverage MDB/ MFI project and policy funding, while providing incentives for local governments to plan, evaluate, and implement sustainable transport projects. The combined impact of national and international efforts for infrastructure, plan and also institutional development grows local demand for sustainable transport financing and establishes a virtuous cycle that continuously increases demand for international, domestic, and private financing for sustainable transport projects (WRI, 2013).

However, national governments or international funding alone cannot fulfil the vast infrastructure needs in the transport sector. It is key to attract private sector investment and financing by ensuring a viable regulatory and legal environment, appropriate design and structure of markets, long term incentives for private investment and protection from investment risks. PPPs have been embraced by many developing countries that have followed a more proactive approach in attracting funding, but this has been so far used primarily for financing airports and ports, rather than for sustainable urban transport used by the majority of people on a day to day basis. In the case of PPPs and concessions it is necessary that public contribution is appraised following specific principles and procedures in order to avoid committing to partnerships without clear understanding of costs and benefits. Essentially, if the private concessionaire is able to exploit consumer surplus of users of new infrastructure, the public sector should require that the value of external and nonuser benefits be sufficient to justify the required contribution (WRI, 2013; World Bank, 2002).

In addition to private sector financing, another way for national governments to leverage their own finances, and the funding received from international sources, is to tap into local funding sources and develop other innovative financing sources. National governments collect user fees and revenue from land use, vehicle, income, and fuel taxes. Governments can implement additional instruments to invest future property value increases into infrastructure improvements, like the innovative financing scheme on the Mass Transit Railway in Hong Kong. National governments also play a vital role in

Among these are The European Commission and The European Investment Bank, the International Fund for Agricultural Development, The Islamic Development Bank, The Nordic Development Fund and The Nordic Investment Bank, and The OPEC Fund for International Development (The World Bank, 2015).

correctly pricing fuel and reducing fuel subsidies. In Indonesia, for example, the government is pursuing reforms to reduce market distortion. India's planned "green surcharge" on petrol, "green cess" on personal vehicles, and "urban transport tax" on the purchase of new cars and two wheelers are also notable. Raising additional financing through local sources is an important opportunity that national governments could pursue to fund sustainable transport projects demanded by local areas. Although local taxing capabilities are very limited in many countries, it can also be an option of local funding and an opportunity to channel resources to each city's particular needs (WRI, 2013; World Bank, 2002).

Finally, in order to ensure the effectiveness of financing it is absolutely necessary to increase the effectiveness of the current decision making processes that typically fail to take into account the full economic, social, and environmental consequences of transport policies, programs, and projects. National governments can increase the effectiveness of financing decisions by following a structured process starting with needs assessment, planning and policy formulation, implementation, monitoring, and finally ex post evaluation. Financing based on performance outcomes should be a practice followed by both national governments and international funding organizations. One potential method of impact evaluation is a scorecard with mandatory and recommended outcomes, including safeguards for mitigating environmental, social, and other risks (WRI, 2013).

3.9. Health

3.9.1. Introduction

Unsustainable transport practices, particularly the intensive use of private motorized transport, have serious indirect impacts on public health. Air pollution is probably the most commonly mentioned cause of transport related health problems but the urban heat island effect, increased noise pollution and the lower activity levels are equally important. In addition, it is now widely accepted that the environmental impact of transport and therefore its impacts on health, are exacerbated in an unpredictable way by climate change. (Campbell-Lendrum and Corvalan, 2007).

Air pollution from transportation can be caused by several factors such as excessive vehicle use, age of fleet and technology used, poor maintenance of vehicles, and unavailability or improper use of appropriate fuels. Air pollution from motorized transport in cities is an increasing threat for public health in megacities, much of which is generated by motorized transport. Pollutant emissions such as NO_x and PM_{10} are the biggest concern for local air quality in urban areas as they contribute to a range of cardiovascular, pulmonary and respiratory diseases, leading to an estimated 3.2 million deaths a year across the world. For 2010, the World Bank estimated the total number of deaths due to transport related air pollution was at a minimum of 184,000 per year. Urban air pollution is estimated to cost approximately 2% of GDP in developed countries and 5% in developing countries (Rode et al, 2014).

The impacts of transport on health differ significantly between developed and developing megacities. Results suggest that some megacities like Los Angeles, New York, Osaka Kobe, Sao Paulo and Tokyo have very low excess cases in total mortality from transport related pollutants. In contrast, the approximate numbers of cases is highest in Karachi (15,000/year) characterised by a very high concentration of total suspended particles ($670 \mu\text{g}/\text{m}^3$). The highest cardiovascular mortality rates are found in Dhaka (7000/year), Beijing (5500/year), Karachi (5200/year), Cairo (5000/year) and Delhi (3500/ year). The morbidity (hospital admissions) due to Chronic Obstructive Pulmonary Disease (COPD) caused by air pollution follows the tendency of cardiovascular mortality. Dhaka and Karachi lead the rankings, having about 2100/year excess cases, while Osaka-Kobe (20/year) and Sao Paulo (50/year) are at the low end of all megacities considered (Gurjar et al, 2010).

Along with the accidents and air pollution, increasing levels of motorization also result in a reduction in the total physical activity levels. Physical inactivity and its effect on the prevalence of non-

communicable diseases, such as cardiovascular conditions, cancer and diabetes, is recognised as a leading cause of mortality worldwide, contributing to 3.2 million deaths annually. Increased use of motorized transport limits the activity levels of all users as it contributes to the reduction of overall levels of outdoor activity due to traffic and air pollution and limited accessibility to green and public spaces (Rode et al, 2014).

Heat waves in cities are exacerbated by the urban heat island effect. These result from lowered evaporative cooling, increased heat storage and sensible heat flux caused by lowered vegetation cover, increased impervious cover and complex, dark surfaces, and possibly from heat trapping by elevated levels of locally produced CO₂. Central city areas show a large heat island effect, with an increase in sensible heat up to 4°C than the surrounding rural areas. Wider urban sprawl further exacerbates the effect. For example, in southeast China, such land use patterns have been estimated to account for 0.05°C of regional warming per decade since 1978. Heat waves can cause dramatic impacts on urban health, particularly for vulnerable populations such as the elderly and low income groups. One of the most striking examples of the recent years was the extended period of record high temperatures experienced in Europe in summer 2003, which was made significantly more likely by human induced climate change. This caused excess mortality of over 35,000 people within a one to two week period in early August (Campbell-Lendrum and Corvalan, 2007).

Finally, air quality is strongly dependent on weather and is therefore sensitive to climate change. Levels of many pollutants, such as ozone, are affected by atmospheric conditions and tend to be higher on warmer days. Epidemiological evidence from developing country cities is weak, but inferences from developed countries suggest significant risks associated with increasing temperatures. Studies of 15 cities in the south eastern USA have shown that under one of the more severe scenarios of future climate change, by the 2050s, climate change can be expected to raise the average number of days in which the 8th hour⁶ ozone standard is exceeded by 60% and cause ozone related deaths to increase by 4.5% (for the impacts of transport on climate change see also section 3.10 below) (Campbell-Lendrum and Corvalan, 2007).

There is a scope for synergies between efforts to improve urban transport related problems such as congestion, and public health. Transport, as well as urban planning, affect energy consumption and associated emissions through shaping land use, modal share and the extent of the urban heat island effect. In addition, there is scope for actions at the individual, or at the municipal or national level, which have the capacity to simultaneously enhance health, reduce consumption, and provide economic benefits (Campbell-Lendrum and Corvalan, 2007).

3.9.2. Transport and health in the megacities in developed countries

Air pollution has been recognised as a problem in the developed countries since the 1950s in both Europe and North America. Motor vehicles emission standards were introduced as early as in 1966 in California. Since then, many developed countries have been making significant efforts to improve air quality and reduce air pollution caused by the transport sector by promoting sustainable transport. Europe is mostly considered as world best practice in sustainable transport as most European countries have high quality NMT infrastructures and a well-developed public transport system (Parrish et al, 2011).

Besides implementing behavioural strategies (e.g. to attract more car users to use NMT and public transport modes), European countries are currently also at the stage of promoting clean vehicle and fuel technology. Low emission vehicles become more popular in order to green the public transport fleet, i.e. electric buses and buses with high emission standards, in order to protect the health quality of the citizens especially in the urban areas. In the Netherlands for example, around 76% of the public transport bus fleet already have EEV (Enhanced Environmentally friendly Vehicle) standards, which is the highest European emission standard that corresponds to very low pollutant emissions. In terms

⁶The 8th highest hourly concentration of ozone within a year.

of cars, due to attractive fiscal policies, electric car sales in Europe increased by 77% in 2014. In the last decade, many European cities (London, Milan and others) have introduced LEZ (Low Emission Zones) in urban areas where only clean freight vehicles with diesel particulate filter are allowed to enter.

In addition, the principal air quality pollutant emissions from petrol, diesel and alternative fuel engines (carbon monoxide, oxides of nitrogen, un-burnt hydrocarbons and particulate matter) are regulated by the Euro emissions standards. Modern cars, if kept in good condition, produce only quite small quantities of the air quality pollutants, but the emissions from large numbers of cars add to a significant air quality problem. Unlike emissions of CO₂, emissions of the air quality pollutants are not directly linked to fuel consumption. Pollutant emission levels depend more on vehicle technology and the state of maintenance of the vehicle. Over the last twenty years increasingly stringent emission limits have been set at a European level, starting with the Euro1 standards in 1993. All new cars currently have to meet the Euro 5 standard which was adopted on 1st January 2011. At the same time, the European Union Ambient Air Quality Directive sets maximum permissible levels for atmospheric concentrations of pollutants thought to be harmful to human health with which governments must comply. Achieving the air quality standards for nitrogen dioxide and fine particles presents the greatest challenge, especially in urban areas and areas close to busy roads (DfT, 2015).

In terms of physical activity many campaigns in developed countries are focused on promoting the health benefits of active modes. Such campaigns are addressed to all age groups, highlighting the different benefits for different people. In megacities such as London and New York, walkability and cycling have been key issues in the healthy cities agendas. However, the impacts of current practices are still not fully recognised in many cases. More specifically, obesity is widely considered and treated as an individual problem when it is often a social problem as unsustainable lifestyles are not only related to diet but also to mobility and exercise choices of both adults and children. At the same time, the full impacts of noise pollution, especially in central areas in cities, are not fully incorporated in transport planning policies. There is evidence that noise pollution can impact the physical and mental health of city dwellers. It is suggested that current health and ecological sustainability practices should be enhanced in order to support not just the absence of diseases but also a social and physical environment that recognise the importance of active modes and enhances all modes of physical and mental well-being.

Finally, in terms of the Urban Heat Island (UHI) effect, the contribution of transport is often not fully recognised. UHI is often attributed to dense development and high densities but it is also a result of high levels of combustion in the urban areas and the dark, unreflective asphalt surfaces. The road network and the big open parking spaces contribute significantly to the increase of the urban temperatures which, in turn, can have serious impacts on the health of urban populations. Lighter colour surfaces, NMT and public transport, and planning for planting trees across streets can significantly contribute to cooling the urban environment and reducing the sensible heat (Fraker, 2010).

3.9.3. Transport and health in the megacities in developing countries

While most developed countries have put in measures to reduce vehicle emissions, in terms of fuel quality and vehicle emission reduction technologies, these measures are yet to be adopted in most cities in developing countries. Unlike developed countries that implement fuels pricing to influence the way the consumers choosing the vehicles types, many developing countries subsidise fossil fuel consumption, which hinders the acceptance of new fuel technologies. Even in the cases when there is political willingness to impose restrictions on old vehicles and emission standards, the lack of monitoring capacity as well as the necessary funds to support new standards significantly limits the success of such policies. Sao Paulo, the only megacity in Brazil, is possibly the only example of successful example of alternative fuel adoption, as the country widely supports bio fuels.

The lack of an effective policy framework and the rapid motorization levels have contributed to the hazardous levels of air pollution in many developing world megacities. Although the modal share of private cars remains lower than that of the developed world megacities, it has multiple impacts on the population's health and vulnerability, particularly in the megacities of South Asia. Over 90% of air pollution in cities in developing countries is attributed to vehicle emissions brought about by high number of older vehicles coupled with poor vehicle maintenance, inadequate infrastructure and low fuel quality. It is noted that motorized transport has a circular impact on health, physical activity, safety and eventually increasing motorization as it renders any other transport mode a non-viable solution.

There are encouraging signals that urban populations of developing countries will be active partners in positive change. Health driven environmental concerns are today most keenly felt among urban dwellers in low income countries. For example, 24% of Chinese respondents believe that the environment and climate change are the most important problem facing the world compared to less than 2% in the USA. Cities are often cosmopolitan and built around trade, increasing awareness of globalization and interconnectivity. Many cities now work together directly, both nationally and internationally, to address sustainability issues. Such partnerships are likely to grow as the common interests of urban populations in protecting the local and global environment become more apparent (Campbell-Lendrum and Corvalan, 2007).

3.10. Climate Change

3.10.1. Introduction

Climate change is one of the major global challenges, and greenhouse gas (GHG)⁷ emissions from transport are a key contributor to this. Although the Earth has experienced changing climate since the beginning of time, during the last century, anthropogenic activity has threatened significant climate change over a relatively short time period. Global warming is caused by the accumulation of key GHG in the atmosphere resulting from continuous combustion of fossil fuels and changes in land use over the 20th century. The impacts of anthropogenic activity on climate are now evident as the rate and magnitude of warming due to GHG is directly comparable to actual observed increases of temperature. The exact extent of climate change is unknown. The Emissions Scenarios report published by the IPCC in 2000, predicts that for six different emission scenarios on the increase of CO₂ emissions, global average temperatures could increase between 1.4 and 5.8°C. Furthermore, the radiative forcing experienced from CO₂ today is a result of emissions during the last 100 years. It is this inertia that means that some impacts of anthropogenic climate change may yet remain undetected and will ensure that global warming will continue for decades after stabilisation (Chapman, 2007; Nakicenovic and Swart, 2000).

The majority of the world's megacities are located on the coast or along major rivers, as they are old cities and historical centres of trade. These locations are now vulnerable to flooding caused by storms and high winds, and accentuated by global warming and rising sea levels. There are 40 million, or 10% of their total population, that are exposed to a 1 in 100 year coastal flood event, a number which is expected to rise to 150 million in 2070. However, the vulnerability levels of different cities are different. Developed world megacities are more exposed in terms of assets while developing world megacities are exposed in terms of population (Banister, 2011).

About 40% of the overall transport emissions are generated in cities, not only by passenger transport but also freight and commercial transport, aviation and maritime transport. The impact of transport on the global climate is not limited to vehicle emissions as the production and distribution of fuel from oil, a 'wells to wheels' approach, produces significant amounts of greenhouse gas in itself. For example,

⁷Gases that trap heat in the atmosphere are called greenhouse gases. The most significant greenhouse gases are water vapour (H₂O), carbon dioxide (CO₂), methane (CH₄) and nitrous oxide (N₂O).

consideration of total CO₂ emissions from an average car showed that 76% were from fuel usage whereas 9% was from manufacturing of the vehicle and a further 15% was from emissions and losses in the fuel supply system (Chapman, 2007).

All transport sectors are experiencing expansion and there is a general trend that the modes which are experiencing the most growth are also the most polluting. Aviation and motor cars are increasingly the favoured modes for passenger transport, but are also significantly the most damaging. The case is similar for freight where again aviation and road freight are both the sectors with the biggest growth and highest CO₂ emissions. There are many good examples of reductions in energy use and improved, multimodal planning as well as positive signs that sustainable urban lifestyles are being adopted by many people. However, the question remains if whether there is commitment and leadership reconsider the modern mobility patterns (Banister, 2011; Chapman, 2007).

3.10.2. Climate change of megacities in developed countries

It is considered that the development patterns that the majority of the developed world countries have followed have had a detrimental effect on climate. Although most countries have included emissions reduction targets in their national agendas, the measures that they have taken are often not sufficient to achieve the scale required. The actions at a city level are more promising as local governments have taken on a leadership role in addressing the transport problems as they relate to carbon emissions, but there is still considerable variation between cities.

Developed world megacities are more resilient than those in the developing world but still vulnerable to climate change. For example, the Thames flood barrier was built between 1974 and 1983 to prevent London from flooding as a result of high tides and sea surges for the '100 year event'. Between 1986 and 1996 the barrier was raised 27 times, but in the period between 1996 and 2006 it was raised 66 times. The costs of extreme weather phenomena for developing world megacities increase exponentially because of the high concentration of assets in these cities. The repair costs after Hurricane Sandy in New York were estimated above 30 billion USD, especially due to the extensive damages to the subway system. In addition, the impacts of disasters are inequitable. The strike of Hurricane Katrina in New Orleans, USA in 2005 showed that poorer populations were more vulnerable and therefore social inequities and poor disaster response can worsen the total toll of a natural disaster (Campbell-Lendrum and Corvalan, 2007; Forbes, 2012; Banister, 2011).

The high income cities and megacities have the opportunity to substantially reduce emissions through a combination of sustainable planning and behavioural practices, which will be the basis for a paradigm shift in transport planning (Table 4). Four key areas of actions towards this direction can be identified. These are substitution, modal shift, distance reduction and efficiency increase. Substitution of travel practically means that a trip is no longer made, as it has either been replaced by a non-travel activity or it has been substituted through technology, for example internet shopping. There is also the possibility of several activities into one longer trip instead of single journey trips. Modal shift can be supported by transport policy measures encouraging walking and cycling and developing a new transport hierarchy. Demand management is effective in restricting access and reallocating space, and making better use of existing capacity. A much wider notion of the street can be created so that it is no longer considered only as a road, but also as a space for people, green modes and public transport. Land use planning can address the physical separation of activities and build sustainable mobility into the patterns of urban form and layouts. Finally, technological innovation can increase efficiency of operations in the freight and passenger transport. Except for vehicle and fuel technology, there are substantial opportunities to use the new technologies creatively to enable sharing and match up journeys or loads to increase occupancy levels and to reduce the overall numbers of vehicles using the transport system (Banister, 2011).

Table 4: Contrasting approaches to transport planning

The conventional approach	An alternative approach
Transport planning and engineering Physical dimensions Mobility Traffic, particularly on the car	Sustainable mobility Social dimensions Accessibility People focus, either in (or on) a vehicle or on foot
Large in scale	Local in scale Street as a space All modes of transport often in a hierarchy with pedestrian and cyclist at the top and car users at the bottom
Forecasting traffic	Visioning on cities Scenario development and modelling Multi criteria analysis to take into account environmental and social concerns Travel as a valued activity as well as a derived demand Management based
Speeding up traffic Travel time minimisation Segregation of people and traffic	Slowing movement down Reasonable travel times and travel time reliability Integration of people and traffic

Source: Banister, 2011

3.10.3. Climate change of megacities in developing countries

Although both developed and developing economies are exposed to climate change, the distribution of its impacts is characterised by significant inequalities. The most vulnerable groups are the children, the elderly and the urban poor of the developing world cities, who have contributed the least to GHG emissions. The rapid economic growth and the urbanisation of developing countries mean that the cities of these countries will soon be both vulnerable to health hazards from climate change and major contributors to the problem at the same time (Campbell-Lendrum and Corvalan, 2007).

The impacts of climate change on developing world megacities are already evident. Construction patterns in many developing cities have resulted in a combination of degradation of natural protection (for example through deforestation and building on floodplains), poor quality housing built on exposed slopes and extensive ground coverage of concrete without adequate drainage. Heavy rains therefore result in intense flash floods such as those that happened in Mumbai, India in 2005. Sustainable economic development offers the opportunity for improved protection through better housing and flood protection. However, apart from upgrading protection and infrastructure to handle such events, land use planning should be used to reduce vulnerability for new development and selective relocation of existing city areas should be considered (Banister, 2011; Campbell-Lendrum and Corvalan, 2007).

The megacities of the developing world seem to be following the same path as the developed ones did in the past, with the affluent middle class buying cars as soon as they can afford to, continuing the excessive production of GHG emissions. The adoption of a carbon free vision by megacities of the developing world is expected to bring environmental, social and economic benefits. A vision adapted to each city's previous development pathways and current problems and vulnerabilities can make a significant contribution to the shift away from car based mobility which requires mass redevelopment of the existing city centres or their expansion to new areas so that the necessary capacity can be created. These practices have been proven to be extremely costly with substantial implications on social welfare, environmental quality and health. There is an opportunity for the megacities of the

developing world to continue growing, not as replicas of the cities in the West, but as models for sustainable development (Banister, 2011).

A carbon free vision needs to combine all the best practice that was described in the previous sections, both in terms of planning and governance. There should be a clear future city vision or spatial strategy that is affordable, adaptable and implementable, and this requires strong institutions and governance structures for the city. Policy effectiveness needs to be clearly explained and accepted by the full range of involved stakeholders, through their involvement in the process. Finally, the ownership of the land in the city is the key factor in the success of such a vision as for real change to take place, there needs to be direct intervention by city governments. Currently, in most cities the land is either owned and managed by low income groups or sold to developers in order to build large, unconnected and expensive superblocks. Transport should be seen as part of the new and existing developments where some of the benefits can be released through value capture. Sustainable transport and poverty alleviation should be seen as complementary issues and should be moving to the same direction (Banister, 2011).

3.11. Social Exclusion

3.11.1. Introduction

Poor transport, both in developed and developing economies, is one of the factors contributing to social exclusion. Not everyone who experiences social exclusion will necessarily have a transport problem, and not everyone with transport problems is at risk of social exclusion. For some people, transport can be a major factor limiting their opportunities, while for others, it may not be very important compared to other problems such as poor education. In many cases, car access makes a huge difference to quality of life and access to jobs, education, health care and shops (Social Exclusion Unit, 2003).

Transport related social exclusion can take different forms for different groups of a society, different societies and different modes of transport. In both developed and developing economies, the most vulnerable groups are the urban poor, the aging population, the women and the people with disabilities. The analysis provided on this section is non exhaustive and is focusing on the most common transport related social exclusion problems in the megacities of the developed and the developing world.

3.11.2. Transport related social exclusion in megacities of developed countries

Transport related social exclusion in developed world megacities is very often linked to the unequal distribution of access opportunities to employment. Economic and time based exclusion refer to the failure of the transport systems to enable employed or unemployed individuals to access the labour markets that match their professional skills. For example, the concentration of highly skilled individuals in central employment areas in London means that a very large number of the population that does not live in the central area of the city relies heavily on the reliability of the public transport network. The contribution of other factors, such as housing affordability is crucial to economic and time based exclusion (Church et al, 2000).

In terms of gender and transport related social exclusion, it is generally considered that men and women have the same access opportunities to transport in the developed world. However, a substantial part of academic research has examined whether women's access opportunities are actually able to cover their mobility needs. The modernist urban land use planning principles have been openly criticised as male oriented and unable to adequately serve an employed woman's needs. It is considered that the impact of automobile oriented transport planning and its lack of coordination with land use planning, is significantly higher on women due to their complex mobility patterns. The improvement of accessibility and mobility opportunities for women can have wider social benefits as

it has a significant impact on the quality of life and contributes to the time savings of a large, active part of the society (Hayden, 1980; Jain et al, 2011).

Efforts have been made to understand the complexity of women's travel needs in order to move forward the debates of gender and sustainable mobility. The majority of the studies on women's transport needs examine the potential of bottom up innovation by understanding their time space needs and constraints and proposing solutions that can be introduced by women as users of the transport system. For example, a study on the everyday context of transport for British women who combine parenting and part time work, showed that the solutions women find, although not necessarily innovative, were inherent in the selection of transport mode, and specific ICT related rescheduling in real-time. The 'school run' by whatever mode and despite the time constraints appeared to have an important role in the lives of this group of women, notable for the time it gives for social interaction. Thus, this suggests the issue is how to maintain this journey with their children sustainably while coordinating it with journey with work, should be the policy focus (Jain et al, 2011).

Research on the complexity women's mobility needs has also revealed flaws in widely accepted policy tools such as the implementation of High Occupancy Vehicle (HOV) lanes where cars with only two passengers or more can travel. It has been argued that, although women are more likely than men to have passengers in their cars during some parts of their journey on a daily basis, for example children on the way to school, this is not as easy in their last lap on the way to their workplace. Especially part time working women, it is less likely to have regular journey times and patterns and therefore it is not as easy as for men to arrange car sharing with other commuters (Cresswell and Uteng, 2008; Jain et al, 2011).

In terms of equal access for people with disabilities, developed world megacities have been making significant progress towards providing improved access to public transport, infrastructure and public spaces in response to strong advocacy. For example, a number of European countries have introduced legislation governing the rights of disabled people or concerning accessibility to public transport and the built environment in 2000. Legislation is supported guidance, information campaigns and training. In addition, legislation is often regionalised in order to meet the specific needs of different areas within a city, and busy urban environments in particular. Additional services, particularly door-to-door and dial-a-ride services, are often offered in order to facilitate the movement of people with mobility problems. However, it should be noted that even in high income countries, implementation has spread slowly and the overall impact still remains disappointing in many cases (Venter et al, 2002; World Bank, 2004).

Solutions for seamless access are easier to apply in newer transport systems and vehicles. For example, TFL asks their passengers to check which Tube stations provide step free access before travelling and provides detailed information and maps showing which stations are accessible. Despite the fact that all bus routes in London are served by low floor vehicles with dedicated wheelchair spaces and access ramps, only a quarter of the Tube stations have step free access. On the contrary, newer urban rail systems in London such as the tram stops and the Docklands Light Railway (DLR) offer full step free access.

It is also important to note that many transport planning authorities have recognised the fact that accessible transport is not only related to vehicles and stations. Pedestrian infrastructure throughout the cities should be focused on facilitating the movement of people with disabilities. Unobstructed and well maintained footways are a key element of accessible city. Additional features such as tactile paving and detectable warnings assisting pedestrians who are blind or visually impaired are often installed in indoor or outdoor pedestrian spaces. Other examples include audible traffic signals and signals equipped with rotating tactile indicators which facilitated the interaction of people with sight or hearing disabilities with other traffic.

Finally, the efforts to improve accessibility for the elderly population have been started to increase over the past few decade. However, specifically targeted measures and research are still limited. As

health systems improve along with the economies, it is anticipated that life expectancy levels will increase across the world and this will in turn increase the number and the proportion of the elderly population. Global ageing will put increased economic and social demands on all countries. At the same time, older people make a significant contribution to the function of a society which is often ignored as they provide significant assistance in housework and childcare for many families (Pettersson and Schmocker, 2010; WHO, 2002).

The society is aging rapidly and this has significant consequences on transport. Although older people travel less than young people in the peak hours, the elderly now travel more than the elderly in the past. As a result, the traffic will probably spread over a longer time period of the day. Ageing also demands certain requirements in a transport system in the sense that safety, reliability and accessibility criteria become more important (WHO, 2002).

The term 'active ageing' was introduced by the WHO in the late 1990s and is defined as "the process of optimizing opportunities for health, participation and security in order to enhance quality of life as people age" (WHO, 2002, p.13). WHO provides four definitions related to active ageing; autonomy, independence, quality of life and healthy life expectancy. Autonomy is defined as the ability of an older person to control and make own decisions. Independence is defined as the ability to perform daily functions. Quality of life is defined as an individual's perception of his or her position in life in the context of the culture they live, and healthy life expectancy is synonym to "disability free life expectancy" (WHO, 2002).

Research shows that transport, both as the ability and the potential to travel, is perceived as a key aspect of quality of life for older people. Mobility is a means of encouraging older people to participate in community life, enhance their social interaction and reduce isolation. In addition, provision of accessible transport for people of age with compromised mobility has a significant contribution to barrier-free living for these groups (Pettersson and Schmocker, 2010; WHO, 2002).

3.11.3. Transport related social exclusion in developing countries

Poverty reduction continues to be the key challenge in urban areas across the developing world. Almost one quarter of the world's urban population is living in informal settlements. Lower income households are disproportionately affected by the externalities generated by transport, including road accidents and air pollution. At the same time, the levels of urban inequality in megacities are exacerbated by increasing motorization and urban sprawl. Studies have identified three common impacts of increasing private vehicle use on the urban poor. First, physical barriers such as roads and bridges, or road traffic are limiting the opportunities for social interaction; second, traffic noise and road safety pose psychological barriers; and third, there are long term social impacts on physical and mental health and on economic resilience and productivity of communities whose communication with other social groups and areas is continuously disrupted (Rode et al, 2014).

The new populations migrating to the megacities of the developing world, especially from poor rural areas, are drawn by perceived chances of finding employment in the industrial or servicing sectors. Many of those people are unable to find proper housing and turn to live in slum settlements⁸. For the very poor urban populations in developing countries, the savings derived from living in informal settlements are often spent on transport to workplace, educational, medical and retail destinations. Travel can consume 25% or more of their daily wages in cities like New Delhi, Buenos Aires and Manila, and as high as 30% in Nairobi and Dar es Salaam. Low income groups also spend significant amount of their time travelling to and from work. For example, 20% of workers in Mexico City spend more than three hours travelling to and from work each day (Cervero, 2013; Faiz Rashid, 2009).

⁸Although the term informal settlement is often used instead of slum, it is considered that the former is not capturing the realities of residents living in slums. The absence of regulated housing structures does not imply that residents are living in slum conditions, or vice versa as some slum settlements, for example in Calcutta, are being regularized (Faiz Rashid, 2009).

Apart from having an impact on the urban form and the mobility patterns within a city, slums should also be examined from a social exclusion point of view. Planning for adequate levels of accessibility for slums not only facilitates the lives of the residents but also, in the long term, can contribute to alleviating the long standing social exclusion of such areas and therefore increase the overall quality of life in the megacities of the developing world. For example, in La Vega Barrio, Caracas one of Venezuela's largest and oldest informal settlements, 30 pathways along the steep hillsides of the neighbourhood were rehabilitated or built in order to improve access to jobs, schools and medical facilities, as part of a major upgrading initiative.

In terms of gender, although substantial efforts to improve equality have been made in sectors such as health and education, few attempts can be found in the transport sector. The differences in the mobility needs between men and women are grounded in the gender based division of labour within the family and the community. Despite the fact that men's traditional role is to earn the biggest part of their family's income, women perform in parallel with employment other tasks such as homemaking and childcare, which require the undertaking of shorter, more frequent and more dispersed trips during the day. Accessibility to different modes of transport is therefore very important for the quality of women's lives.

Transport systems are not gender neutral either. Inadequate transport systems can restrict women's access to education, economic opportunities and healthcare. In many developing countries, such as India, women face harassments in public transport which often leads them to stop using public transport for safety reasons. In Bangladesh, female labour (mostly garment workers) heavily relies on public transport to go to work. In many Asian megacities, women rely on various forms of cycle rickshaws for shopping and taking children to school. In recent years, this form of NMT has been banned from primary and arterial roads, in some cases like Jakarta and New Delhi across the entire city. This has had a disproportionately negative impact on the mobility of women and increased their exclusion from social activities. These countries have been attempting to include gender specific measures in public transport by providing separate space for women in vehicles.

Within the developing world, the provision of services for disabled people is still often seen as a welfare function of the state and of civil society. The human rights approach to disability, in terms of which every citizen has the right to be included in social and economic opportunities, is slowly gaining acceptance. Some developing countries, particularly in Latin America and Asia, have applied this approach to transport, taking some significant first steps towards improving the mobility and access of people with disabilities (Venter et al, 2002).

In order to improve the accessibility and mobility opportunities for disabled people, actions should focus on four key areas: policy and legislation, advocacy and planning, vehicle and infrastructure solutions, and training and awareness. In terms of legislation and policy, the United Nations' Standard Rules on the Equalization of Opportunities for Persons with Disabilities, adopted in 1994, provide an international framework within which advocates and legislators can address disability issues. Improved access and mobility are important factors in reducing poverty and can facilitate the participation of people with disabilities in economic, social and political processes. However, major obstacles remain to translate accessibility policies into the provision of inclusive transport. Inadequate monitoring and enforcement of compliance with existing accessibility legislation is widely cited as the key impediment to providing inclusive transport in developing countries. In most cases, countries have adopted inclusive policies and specific regulations regarding the accessibility of people with disabilities, which are not enforced (Venter et al, 2002; World Bank, 2004).

Advocacy and planning are key factors contributing to the recognition of the fact that access for people with mobility difficulties and disabilities is a human right. Training and awareness are closely related as they contribute to the acceptance of policy and measures by the public. Policies and measures range from providing appropriate training to public transport personnel to allowing dedicated spaces on public transport and clear messages to other passengers about how important this is. Concessions and

door to door services are also important tools that can reduce the levels of economic and geographical exclusion of people with disabilities (World Bank, 2004).

In terms of vehicle and infrastructure access, the private sector may not have sufficient incentives to implement provisions for people with disabilities. In most cases, applying Western disability standards and facilities to deliver access solutions and ensure universal access in transport systems is not affordable or realistic for the provider or for the users in low income countries. Nonetheless, it is not sufficient to ensure that everyone can enter and use basic transport services. It is equally important to apply the principles of access for all to the street environment and to the design of the buildings and other facilities that people use. In many situations low cost improvements such as pavement and footway maintenance, kerb insets at street corners, ramps to public buildings, and larger letters on bus destination signs can bring disproportionate benefits. Most interesting are those interventions which bring benefits to all passengers, creating a win-win opportunity (World Bank, 2004; Venter et al, 2002).

In terms of ageing population, the evidence coming from the developing world is even more limited. Worldwide the proportion of the population of people over the age of 60s growing faster than any other age group and it is expected that by 2050 there will be 20 billion people aged over 60, with 80% of them living in developing countries. In terms of regions, over half of the world's population above 60 lives in Asia, a share that will continue to increase. On the other hand, Europe's share as a proportion of global population over 60 will decrease the most until 2025 (WHO, 2002).

Compared to the developed world, socioeconomic development in developing countries has often not kept pace with the rapid speed of population ageing. For example, while it took France 115 years for the proportion of people above the age of 60 to increase from 7% to 14%, it will take China only 27 years to achieve the same increase. Gradual population ageing for the developed world meant that countries grew affluent before they became old, while rapid ageing for the developing world means that these countries will grow old before they accumulate substantial wealth. Rapid ageing in developing economies is accompanied by dramatic changes in structures and roles as well as labour patterns and migration. Urbanisation, smaller families and more women entering the formal labour force mean that fewer people will be available to take care of older people when they need assistance (WHO, 2002).

Official planning for the ageing population is usually absent. Older people's mobility is usually restricted and they rely heavily on their families for help. However, it should be noted that the social solidarity levels in developing world megacities are often higher than in their developed counterparts. Despite the fact that family structures are gradually changing, caring for the elderly is deeply embedded in the cultures and the traditions of many developing countries. Similarly, social solidarity is stronger between neighbours and friends. This does not mean that planning for the mobility of the elderly should be ignored because the society can cater for them. On the contrary, planning authorities can take advantage of these pre-existing social structures to improve the accessibility for socially excluded groups, through ridesharing, or task sharing programmes. Such initiatives have been proven successful in rural areas in the UK, organized or supported by local authorities.

3.12. Human Dimension of Cities

3.12.1. Introduction

There are direct connections between improvements for people in the city space and visions for achieving lively, safe sustainable and healthy cities. According to the architect Luis Kahn, the street is one of the city's first institutions and a room where people live, learn, shop, and work. The street is a powerful symbol of the public realm and provides opportunities for social interaction that no other public space can. Streets as public spaces and their contribution to urban prosperity were recognised by the United Nations with the Cities Prosperity Initiative which was established in 2012. The Cities Prosperity Initiative is a strategic policy initiative for cities that are committed to adopting a more

holistic, people centred and sustainable notions of prosperity and that are willing to deploy necessary efforts and resources to move forward in the prosperity path based on their specific local conditions (Kahn, 1971; UN, 2013a).

It is suggested that sustaining the human dimension in transport planning will in turn sustain the quality of life and culture of cities that is rooted in and shaped by their history and identity. Particularly in the context of Islamic megacities, it is very important to preserve local identities and maintain the balance among local and global values, global mobility and global consumption patterns (Kunzmann, 2004). In this part, starting from the role of streets, we examine the initiatives and efforts of developed and developing cities to incorporate the human dimension and the human participation in transport and urban planning.

3.12.2. Human dimension of developed cities

The expansion of cities in the developed world has been accompanied by changes in land use, both in terms of form as well as structure. Streets as public spaces lost their importance in terms of their share of land and their prominent role in shaping the culture and history of cities. Land allocated to streets in economically developed cities is much lower in suburban areas than in the city core. On average, most cities have more than 25% of land allocated to streets in their cores while in suburban areas it is less than 15%. In many cities, the human dimension has been neglected as street space is primarily allocated to automobile movement. On the other hand, low densities are accompanied by poor connectivity of streets in suburban areas that limits the opportunities for social interaction (UN, 2013a).

However, there is an increasing concern for the human dimension of city and transport planning that reflects a distinct and strong demand for better urban quality. A notable example is the New York City Plaza Programme which forms part of the city's effort to ensure that all New Yorkers live within a 10 minute walk from a quality open space. According to New York's Department of Transportation (NYC DOT), streets make up approximately 25% of the New York's land area and yet, outside of parks there are few places to sit, rest, socialize, and to enjoy public life. NYC DOT is currently aiming to create neighbourhood plazas throughout the City to transform underused streets into social public spaces. As part of the NYC Plaza Programme, eligible non-profit organizations can propose new plaza sites for their neighbourhoods through a competitive application process. DOT prioritizes sites that are in neighbourhoods that lack open space, and partners with community groups that commit to operate, maintain, and manage these spaces so they are vibrant pedestrian plazas. For the selected sites DOT funds the design and construction of the plaza and assists partners in developing a conceptual design appropriate to the neighbourhood, using to the community input through public visioning workshops (NYC DOT, 2015).

The creation of Times Square Plaza is probably the most high profile action that forms part of this programme. Over a six month pilot during the summer of 2009, temporary paving and street furniture were used to close the streets around Times Square, aiming to improve safety and air quality. The project proved to be a huge success and NYC DOT is now preparing to make permanent the public space enhancements that were installed as part of the pilot. In addition, the air quality around Times Square improved dramatically after the creation of the plaza. The concentrations of Nitrogen Oxide (NO) and Nitrogen Dioxide (NO₂), two pollutants closely associated with traffic, were among the highest in the city. After the conversion to a pedestrian plaza, NO pollution levels in Times Square went down by 63% while, NO₂ levels went down by 41% (Bloomberg, 2011).

Along with government initiatives, other movements and initiatives led by non-profit organizations, planners, academics and citizens that are encouraging communities to reclaim their streets, participate in civic life make a difference in the way public spaces look, function and feel. An example is the Streets as Places initiative, led by Project for Public Spaces, an international non-profit planning, design and educational organization dedicated to helping people create and sustain public spaces that build stronger communities. Streets as Places seeks to engage citizens, planners and the

transportation industry in the US to transform the design and construction of public streets into places that improve the quality of human life and the environment rather than simply move vehicles from place to place (Project for Public Spaces, no date).

3.12.3. Human dimension of developing cities

In most cities of the developing world there are not enough streets and those that exist are either not well designed or well maintained. In most city cores, less than 15% of land is allocated to streets and the situation is worse in the suburbs where less than 10% of land is allocated to streets. In the case of poor areas and slums, however, the concepts of walkability and social interaction in streets are not applicable. While in developed regions it is assumed that a walkable street is more attractive to people for various reasons, and in fact, defines the “liveability” of a street, in slum areas of many cities of the developing world walking on streets is not a choice, but a necessity due to lack of other affordable transport alternatives (UN, 2013a).

Ironically, in the cities of the developing world, where rich people tend to live in gated communities, the existence of well-planned and served streets does not imply social and cultural interactions amongst neighbours. The relatively more walkable streets in high income areas do not encourage people to use them, partly because walking is associated with poverty. Rich people will often use their cars for the shortest trips, and thus it is not unusual to see empty streets and sidewalks in high income areas (UN, 2013a).

Another common feature of housing areas with high population density and few economic resources in megacities is that outdoor space has a particularly large bearing on living conditions. Where possible, many ordinary activities are taking place outdoors, on streets, squares or other public spaces. In many regions, culture, tradition and climate have contributed to extensive outdoor life involving handcrafts, street exhibitors, street trade on sidewalks and street kitchens (Gehl, 2010). In addition, in many cities of the developing as well developed world, street vending represents an avenue for entrepreneurship. Streets are the starting point of businesses for immigrants because they are cheaper to operate than established shops. All these features of daily life are threatened daily by traffic and parking requirements. Public space is reduced and negatively affected by noise, pollution and insecurity (UN, 2013a).

Initiatives for redesigning streets as public spaces are taking place in cities in Africa, Asia and Latin America on a smaller scale. The most notable examples come from Latin America and cities like Bogota, Mexico City and Sao Paulo. Local government initiatives along with collective citizen actions are supporting design measures to enhance the pedestrian environment such as expanding sidewalks, planting trees and installing benches and other seating. All these initiatives have a common set of objectives to enhance environmental sustainability, social interaction, public health, productivity and social inclusion, all key components of urban prosperity (UN, 2013a). Examples of collective actions include the Colombian independent national initiative “La Ciudad Verde” that promotes sustainability in cities by organizing educational events, maintaining cycle lanes and pedestrian crossing and raising awareness on the benefits of cycling and the safety issues cyclists are facing (La Ciudad Verde, 2015).

4. 3 OIC Case Studies Review

4.1. Jakarta

4.1.1. Urban background

Daerah Khusus Ibukota/DKI (Capital Special Region) Jakarta, after this will be indicated as Jakarta, is the capital of Indonesia and it has 'provincial government level' status. The metropolitan area of Jakarta consists of the agglomerations of the following regencies/cities:

Table 5: List of regencies/cities in the Jakarta Metropolitan Area

Province	Regency/City
DKI Jakarta Province	North Jakarta City
	South Jakarta City
	Central Jakarta City
	East Jakarta City
	West Jakarta City
West Java Province	Bogor Regency
	Bekasi Regency
	Bogor City
	Bekasi City
	Depok City
Banten Province	Tangerang Regency
	Tangerang City
	South Tangerang City

In short, the metropolitan area is also called Jabodetabek, taken from the initial letters of the administrative units of Jakarta, Bogor, Depok, Tangerang and Bekasi. Based on the Population Census 2010, the population of the Jabodetabek Metropolitan Area was 28 million, which makes it the largest metropolitan area in South East Asia. The population of Jakarta in 2013 was 10.1 million⁹.

The annual population growth of Jakarta between 1980 and 1990 was 2.4%, and dropped to 0.2% between 1990 and 2000, which was most likely due to the success of the Family Planning Programme. Between 2000 and 2005 the population growth reached 1.1% annually. In the last decade, the population of Jakarta has been increasing by approximately 4.5% per year. Currently, the population density is more than 15,000 people/km².

4.1.2. Transport network and infrastructure

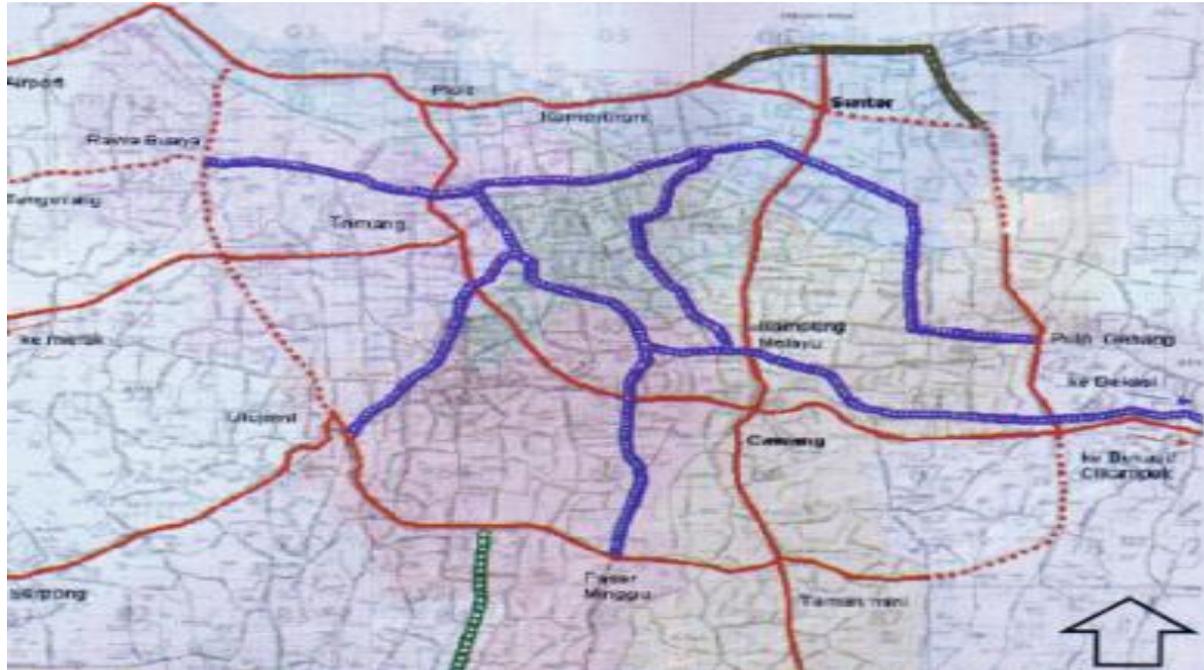
The population growth of Jakarta results in the growth of travel demand. Transport problems occur when the road network is insufficient to meet the increasing traffic demand. As an illustration, the number of registered vehicles in Jakarta increases by 11% per year, while the road capacity increases by only 1% per year. Currently, the road network in Jakarta accounts for 6.3% of the total area of Jakarta (as comparison, this number is 24% for Paris and 21% for London).

Toll roads (see Figure 11 for the existing and planned toll roads in Jakarta) have helped to relieve urban traffic congestion in the city, but internal traffic circulation is still in need of improvement: a poorly developed sub-arterial network, interference from roadside activities, and mixed traffic remain as causes of delay and reduced capacity. As one of the strategies indicated in the Transport Master Plan Jakarta¹⁰, road capacity will be increased by constructing new roads or expanding the current ones.

⁹Jakarta Transportation Agency in Figures, 2013.

¹⁰The Jakarta Transport Master Plan indicates three main strategies: (1) Public Transport Development; (2) Traffic Restriction; and (3) Road Network Capacity Increase.

Figure 2: Existing (solid line) and planned (dash line) toll-highway network

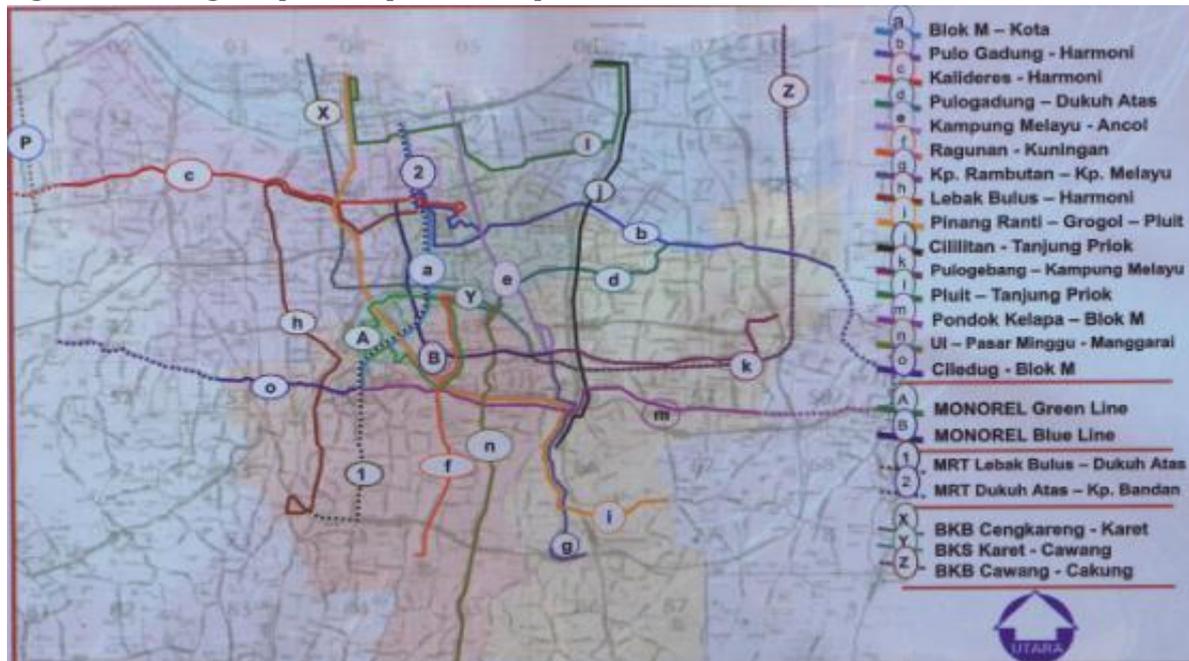


Source: Jakarta Transportation Agency in Figures, 2013

The direct result that cannot be avoided is traffic congestion, which has been a chronic problem faced in the Jabodetabek region and the situation is expected to worsen should there be no improvement of any kind made on the existing transportation system. At present, the congestion cost of Jakarta is estimated at USD 3.4 billion per year, which consists of energy waste, vehicle operational cost, time value, economic value and external environmental costs (Adiwianto, 2010). World Bank (2001) in Somuyiwa (2010) also pointed out on-the-road congestion costs in five major cities including Jakarta. Decrease in travel speed and deteriorating travel environment for pedestrians and people powered vehicles, due to the inefficiency of the entire road transport system, Jakarta experienced an average one way journey to work of about one and quarter hours or more.

In order to reduce congestion, the Government of Jakarta has developed bus rapid transit (BRT) system in Jakarta (called TransJakarta), the first high quality public transport in Jakarta and Indonesia that has been in operation since 2004. It started with one corridor in 2004, it has now 12 corridors, which make it the world's longest bus rapid transit route. By 2020, this BRT network will be complemented by a North – South Mass Rapid Transit (MRT) corridor. Figure 12 presents the existing and planned public transport network in Jakarta until 2020.

Figure 3: Existing and planned public transport network in 2020



Source: Jakarta Transportation Agency in Figures, 2013

Based on interviews with experts in Jakarta, even though the planned development of public transport network will meet its target in 2020, it will only slightly reduce the traffic congestion of Jakarta as long as demand for road space is still high. To reduce congestion, expanding transport options may need to be complemented by other initiatives like congestion pricing to discourage the use of cars and a shift towards compact and mixed-use development.

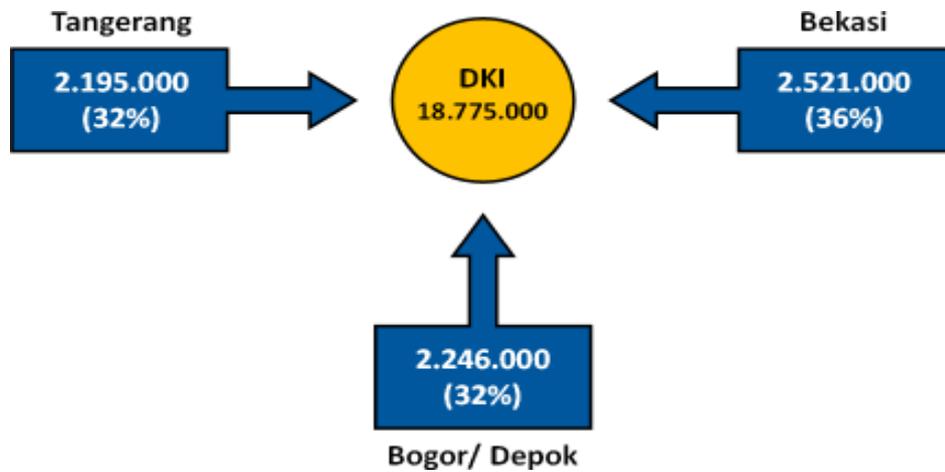
4.1.3. Land use and urban form

The urban structure of Jabodetabek is polycentric with Jakarta as the main centre for governmental and commercial activities. Tangerang and Bekasi Regencies are concentrated as industrial areas. For residential areas, many satellite cities have been developed to support Jakarta, such as Tangerang City, South Tangerang City, Depok City and Bekasi City.

This implies that suburbanization has rapidly preceded and population has spread out in Bodetabek area to seek better life quality, housing circumstance and environment and/or look for cheaper place of housing due to increasing land price in Jakarta. The population migration toward suburban areas has generated longer daily commuting trips between residence and workplace and has put much burden on the existing transport infrastructure and environment. In 2013, 25.7 million trips per day were taking place in Jabodetabek, and almost 19 million of these trips took place in the central area of Jakarta (see Figure13). These trips were performed by cars (24%), motorcycles (51%) and public transport (25%).

Since Jabodetabek's urban structure is changing rapidly and dynamically, the urban transport system serving Jakarta and the surrounding areas has not been expanded in a way that keeps pace with urban development growth. As a consequence, worsening traffic congestion, overcrowded buses and trains, and an increase in air pollution have been catalysed.

Figure 4: Daily trips in and to Jakarta in 2013



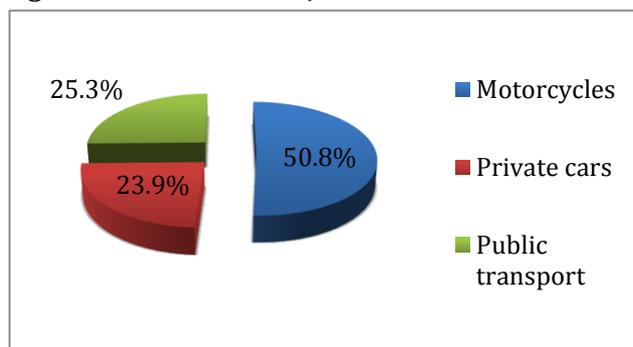
Source: Jakarta Transportation Agency in Figures, 2013

Another important issue is the nonexistence of an authority that coordinates transportation developments for Jabodetabek. The national government is currently at the stage of establishing *Otoritas Transportasi Jabodetabek* (Jabodetabek Transportation Authority) to coordinate plan, implement and monitor transportation developments in Jabodetabek. One of the tasks will be developing new trajectories for land public transport modes such as heavy rail and buses. Many experts are pessimistic about the success of this programme. There have been several attempts to form such an institution in the past, but they have failed due to the strong political tensions among provincial governments as the real authority lies with each provincial and local government in the Jabodetabek area.

4.1.4. Mode availability and shares

In 2013, there were 25.7 million trips per day in Jabodetabek and more than 50% of the trips were made by motorcycles.

Figure 5: Modal share in Jabodetabek in 2013



Source: Jakarta Transportation Agency in Figures, 2013

4.1.5. Private motorized transport

In 2013, there were 9.2 million private vehicles in Jakarta. Of these, around 3 million (33%) were cars and 6.2 million (67%) were motorcycles. This number increases by 8% on average per year. As described above, private vehicles account for 75% of the modal share in Jakarta. The high share of private vehicles is also caused by regulated and heavily subsidized fuel prices by the government. The low price of petrol has led to fuel not being valued by consumers and so widespread waste is endemic.

For many reasons, fuel subsidy is considered to be a bad policy as it appears to disproportionately favour the wealthy who have more cars, which is the case in Indonesia. However, in Indonesia, fuel price strongly affects prices of everyday goods in general. Therefore, increasing fuel price affects the poor the worst, because they barely have enough money to buy basic needs. Attempts to reduce fuel subsidy are usually met with big protests by the general population.

Motorcycles have the highest mode share of all transport modes in Jakarta, due to the following reasons:

- no proper public transport
- ease to manoeuvre through congested roads
- ease to get financed to lease a motorcycle (with a down payment of as little as USD 30)
- low operational and maintenance costs (monthly cost of motorcycles is 38% cheaper than that of using public transport)
- important for status and image

Currently, there is no policy applied with a goal to reduce the private vehicles ownership rate in Jakarta. Such policy is under the authority of the Central Government and they will not simply take the easy way out to tackle this issue. Accounting for around 7% of the country's gross domestic product, the automotive and supporting industries are one of the most important sectors in Indonesia's story of economic growth. Castrating the automotive industry also means putting millions of jobs in jeopardy.

The yearly increase of the number of private vehicles has therefore been accepted as a given situation in Jakarta. As indicated in the Transport Master Plan (2007-2020), traffic restriction has been and will be implemented to reduce the use of private vehicles and increase the use of public transport. It includes four measures, i.e.

1. Motorized vehicles restriction in certain areas or certain time, e.g. 3 in 1 (minimum 3 occupants per car) that has been implemented since 2003 (see Figure 15), and since 2014 motorcycles are forbidden in certain Central Business District areas.
2. Electronic Road Pricing, which is currently being prepared to replace the 3 in 1 strategy that has low effectiveness due to violations where car owners pay people to reach the minimum car occupancy.
3. Parking strategy: currently Jakarta does not have a concrete and strict parking strategy yet. Parking fees in Jakarta are the second lowest worldwide, which encourages people to use their cars.
4. Provision of Park and Ride facilities at public transport terminals, which has been started since the operation of TransJakarta.

Figure 6: Traffic sign before entering 3 in 1 area



Source: Consultant

4.1.5.1. Public transport

Public transport accounts for 25% of modal share in Jakarta. There are currently several types of public transport in Jakarta:

- TransJakarta: a BRT system with dedicated infrastructure on most of the routes (12 corridors);
- TransJakarta Integrated Border Transport (TIBT): feeder bus services from cities around Jakarta towards TransJakarta corridors (11 routes);
- City buses: buses with level of service that depends on traffic situation, no dedicated routes, timetable and stops, and operated with large, medium and small vehicles;
- *Kopaja* and *Metromini*: economy minibus systems that provide important services for Jakarta commuters with numerous routes throughout the city;
- Commuter Rail Line (*KRL*): a commuter light rail system that serves commuters from the surrounding cities of Jakarta.

Apart from these, there are also unofficial transport systems such as *Bajaj* (Auto rickshaw) that provides local transportation in the back streets of some parts of the city as it is not allowed to enter the arterial roads, and *Ojek* (Motorcycle taxi) that is very much used as a solution to deal with the crowded urban roads and narrow alleyways. Figure 16 presents various public transport modes that are currently available in Jakarta.

Despite various public transport services offered, the current public transport system in Jakarta cannot meet the transport demand, as a result, it has not been able to alleviate the acute traffic congestion. The number of passengers grows faster than the number of public transport vehicles. This creates uncomfortable journeys for the passengers, which makes them choose private vehicles.

TransJakarta is the only urban public transport service that offers comfort through (mostly) dedicated infrastructure, timetable and convenient stops. However, the aforementioned supply issue also degrades the level of service of TransJakarta. TransJakarta is facing the following main problems: (1) Too few buses to serve the demand which results in constant overcapacity. Currently, TransJakarta transports 350,000 passengers per day; (2) Too few gas stations for the buses; and (3) TransJakarta dedicated corridors are also used by private vehicles to avoid traffic jams.

The current target to tackle this capacity issue is to extend the fleet as soon as possible and as many as possible, to improve the bus shelters with passenger information system, and to sterilise the dedicated bus way corridors from the illegal use of other modes.

Figure 7: Public transport modes in Jakarta Clockwise (from top-left): TransJakarta, Kopaja, Metromini, Commuter Rail Line, Bajaj, Ojek



Source: Jakarta Transportation Agency in Figures, 2013

The low level of service also occurs in other public transport modes. City buses, for example, are old (operating for 30 years in general) of which some do not even have speedometers or proper brake systems causing many traffic accidents in Jakarta.

The mass transit that has seen a major change since 2013 is the KRL. Electronic ticketing system, low fares and a more comfortable journey due to the banning of sellers in the trains, has successfully attracted commuters who used to use private cars for their work journey to Jakarta.

Many parties believe that improving the level of service of the current mass transit system will not alleviate the traffic congestion of Jakarta. Therefore, the following transit systems has been planned for Jakarta:

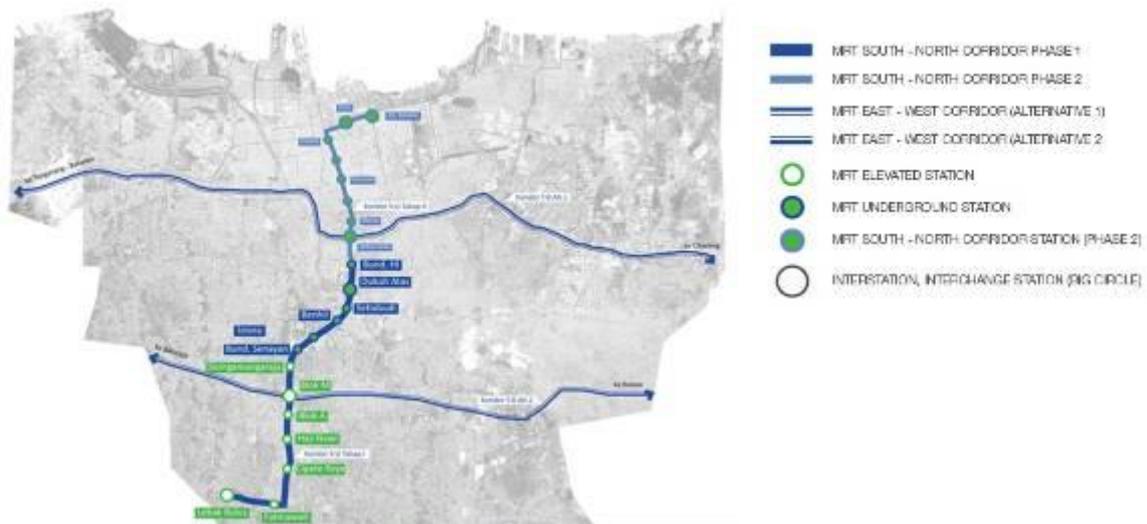
1. Mass Rapid Transit (MRT)

In 2008, a Mass Rapid Transit (MRT) project is started, where a \$1.6 billion loan agreement with the Japanese International Cooperation Agency (JICA) has been secured for funding. This flagship project will be the nation’s first modern urban railway system and it will have North-South and East-West lines.

The first MRT track (15.7 km), which is currently under construction, will connect South Jakarta and Central Jakarta with 13 (elevated and underground) stations and a capacity of 173,000 passengers per day, which is targeted to be in operation in 2018. The second track (8.1 km) from Central Jakarta to North Jakarta is targeted to be in operation in 2020. The East-West line is currently at the stage of feasibility study and is targeted to be in operation in 2027. The following figure shows the planned routes of MRT Jakarta.

Figure 8: MRT Jakarta route network

Source: MRT Jakarta, 2015



2. Light Rail Transit (LRT)

When this report is being written, the ground-breaking has been done for the two of the seven planned LRT routes (see Figure 18 for the planned routes). These routes are not indicated in both PTM and the Jakarta spatial planning documents.

Figure 9: Planned LRT routes



Source: Detik Finance, 14 July 2015

4.1.5.2. Non-motorized transport

NMT modes in Jakarta include walking and cycling. NMT policies have a low priority in the transportation development of Jakarta. Compared to road network expansion for motorized traffic, the attention given to NMT infrastructure is very minimum. Available sidewalks are mostly taken by street vendors or used for parking lots (see Figure 19). This causes pedestrians to walk on the road and share the road with motorized transport users who mostly do not respect the pedestrians as they think that the roads are provided for motorized traffic.

Well maintained sidewalks only exist in CBD areas where traffic enforcement is strong (no street vendors and on street parking allowed). The Government realizes the importance of proper NMT infrastructure as a measure to reduce the use of motorized vehicles, reduce traffic accidents and increase road capacity. Even though the Jakarta Transport Master Plan (2007) gives development directions for NMT infrastructure network and facilities (pedestrian walkways, crossing facilities, cycling infrastructure and cycle parking), until now there is no significant increase in the development of the NMT network in Jakarta. 86 km of cycle paths are planned and currently 8.6 km has been constructed. However, due to weak law enforcement, the cycle paths are also used by motorcycle users who want to avoid traffic jams especially during the rush hours, and push away the cyclists who use the paths.

Figure 10: Footways used as car parking and by street sellers



One of the reasons why the Government gives low priority to NMT is because it seems that there is no demand for the NMT network, that everybody uses their cars, motorcycles or public transport. However, public transport users are NMT users who perform their last mile on foot. Furthermore, very few people are walking or cycling because there is no proper and safe NMT infrastructure.

4.1.6. Freight and servicing

Freight transport in Jakarta relies heavily on road transport, especially freight truck movement from and to the Tanjung Priok Port in the north of Jakarta using city arterial roads. The areas around the port are heavily congested as there is no dedicated network for freight transport yet. This causes several problems such as traffic congestion in the inner city highways, inefficient use of road space, noise and air pollution, road safety and road damage. Since 2011, the Government of Jakarta has been implementing operational time restriction for freight vehicles in the city (access allowed only in the evening). Currently, a direct highway access to the Port is under construction with a goal that most of the freight vehicles will not use arterial roads and use the new highway instead.

Figure 11: Freight movement from and to Port of Tj. Priok



Source: Jakarta Transportation Agency in Figures, 2013

4.1.7. Road safety

In 2013-2014, there were on average 3,500 traffic accidents happened per year in Jakarta or around 10 cases per day. Of this, around 300 people died per year or 1.12 people died in traffic accidents every day in Jakarta. In 70% of the cases, motorcyclists were involved and they also account for 60% of the fatalities. Their behaviour on the roads (such as not obeying traffic signs, tend to do anything to escape from the traffic jam and low skill at operating a motorcycle) explains this data.

Public transport also contributes significantly to the number of traffic accidents in Jakarta. Reckless driving, haphazard stops in improper areas, and a general disregard for road rules are only a few of the driving concerns.

For car users, there are still many aspects that need to be enforced. Safety belts for drivers and the passenger in the front is obligatory, but not for other passengers. There is no regulation about child seats and about the limit of alcohol level in blood. There are regulations about penalty for traffic violence and mobile phone use in the traffic, but law enforcement is still weak.

4.1.8. Institutions and organizational structure

Several ministries of the central government and two levels of local governments in the Jakarta Metropolitan Area except for the 5 cities under DKI Jakarta Province have transport department that plays a role as Transport Authority.

In the case of road construction, jurisdiction is determined by type of roads such as national roads, provincial roads and roads under regency/city. However, all the currently operating railway lines are operated by a sole state-owned railway operator in Indonesia, PT. Kereta Api Indonesia, under the jurisdiction of the central government. In terms of buses, inter-provincial buses are licensed by the central governments, and inter-city buses are licensed by the provincial government in principle. Bus route licenses within a regency/city are issued by the regency/city government. However, buses between DKI Jakarta province and the other two provinces in the Jakarta Metropolitan Area can be licensed by the provincial governments. This significantly increases the number of stakeholders of the transportation sector.

Due to the connection between Jakarta and its peripheries, solving transport problems in Jakarta must take transport developments of the surrounding regencies and cities into account. Integrated planning is crucial. Therefore, a single transport authority for the Jakarta Metropolitan Area, which is currently still absent, needs to be formed. Until this report is written, the forming of *Otoritas Transportasi Jabodetabek/OTJ* (Jabodetabek Transportation Authority) is being discussed with the President. The establishment of this authority aims to tackle transportation problems of not only Jakarta but also other regions within Jabodetabek area. Furthermore, this authority is hoped to be able to remove administration/bureaucratic and institutional obstacles that have been hindering many attempts to create a robust transportation system.

4.1.9. Urban transport infrastructure financing

As described before, pertinent transport problems in Jakarta are mainly caused by a lack of quantity and quality of transport infrastructure that cannot cope up with the rapid motorization increase. This situation demands the Jakarta government to continuously provide transport infrastructure and facilities. According to the World Bank (2010), Indonesian government can only cover 30% of total investment need for its infrastructure program and is relying on state-owned enterprises and private investors for the rest. Therefore, extra government effort is required to enable private funding, which mainly through PPP. The Indonesian government has had a pro-PPP policy since the early 2000s. A state owned company, called *PT Sarana Multi Infrastruktur*, was established to facilitate the cooperation between the government and private parties in financing infrastructure projects in Jakarta including transportation infrastructure.

Private participation is strongly influenced by a conducive investment climate and - although improving - Indonesia is struggling to provide such an environment. The legal framework involving land acquisition has been a serious obstacle for transport infrastructure projects to materialize and makes investors hesitant to invest. Recently, steps to improve the land situation have been taken. In 2012, the government and parliament approved the new Land Acquisition Law that is regarded to speed up the land acquisition process notably as it deals with the revocation of land rights to serve public interest, puts time limits on each procedural phase and ensures safeguards for land-right holders. Both government and PPP projects on state-owned land are protected by this bill. Furthermore, to provide more assurance for private investors, the government has established the Indonesia Infrastructure Guarantee Fund (IIGF). This institution gives certain guarantees against infrastructure risks for projects under the PPP scheme.

Another obstacle is capability. Generally speaking, government bodies do not have the experienced staff needed to properly prepare infrastructure projects for tender. This includes making sure they are economically viable and are evaluating and managing the many project risks. This problem is even more serious when complex finance is involved, as in the case of a PPP. TransJakarta is one of the PPP success stories in Indonesia. The infrastructure provision of TransJakarta is fully financed by Jakarta Provincial Government, while ticketing system, bus procurement and operation are financed by private parties. Apart from PPP schemes, several transport infrastructure projects in Jakarta are funded by multilateral organizations. As discussed above, multilateral agencies and bilateral donors

have been playing an important role in financing infrastructure projects throughout the developing world as part of their commitment to sustainable transport. This is also the case for Jakarta. Jakarta MRT, for example, is largely being funded by Japan International Cooperation Agency (JICA).

4.1.10. Health

4.1.10.1. Air quality and pollution

Fast urbanization and industrialization in Indonesia have produced severe air pollution problems, predominantly in Jakarta as the economic centre. Motorized vehicles are regarded as the main sources of air pollution, and contributes to 80% of air pollution in Jakarta. Rapid increase of the vehicles does not only increase the total emission amount in proportion to the number of vehicles, but also the unit emission amount at an exponential rate by slowing down travel speed with the congestion.

Levels of particulate matter (PM₁₀), or large particle dust, carbon monoxide (CO) and nitrogen dioxide (NO₂)—which already far exceed limits set by the World Health Organization—rose by between 40% and 85% respectively in 2011.

As the most significant source of PM₁₀ emission, diesel vehicles are targeted as they account for over 80% of PM₁₀ emitted from vehicles while they provide less than 30% of total road transportation (Asri and Hidayat, 2005), and the most emitting vehicle type is truck, followed by large bus which generates 33 times and 22 times as much emission as a passenger car respectively.

Therefore, the PM₁₀ emission control on these heavy duty diesel vehicles is most effective and should be placed the highest priority on to the chronic air pollution. Meanwhile, other studies show that more than 50% of Jakartans have experienced illnesses related to air pollution. To address this issue, the Government began emissions checks in 2007 and to date only heavy duty diesel vehicles (public transport bus and truck) have to undergo regular emission tests.

Such efforts to manage and improve air quality have been hampered by poor regulations, weak enforcement, capacity and a lack of reliable information. Implementation has been marred allegedly by fraud, resulting in urban transportation with high emission levels.

4.1.10.2. Physical activity

High motorization and poor provision of NMT network in Jakarta lead to high dependency of Jakartans on motorized vehicles to perform their mobility even for a short distance. As such, there are very few physical activities involved in their regular journeys.

4.1.11. Climate Change

Jakarta is located close to the sea's edge and therefore vulnerable to rising sea levels and has constantly been at risk of flooding. Uncontrolled development of upland regions and the growing wealth of Jakarta's citizens lead to new high quality residential areas at the expense of small lakes, putting the city under permanent risk of flooding. Many environmentalists, ecologists, moralists and sociologists recount how Jakarta's rapid increase in population gives rise to a demand for housing, living space and other human necessities, without paying attention to social ethics.

Risk of global warming, rising sea levels and climate change faced by world megacities is also contributed by an unsustainable transport sector. 23% of global carbon dioxide (CO₂) emissions from fuel combustion are transport related and these are expected to increase 57% worldwide in the period 2005– 2030 (ADB, 2009). Asia counts for more than 50% of this global increase and Jakarta as a megacity in Asia, plays an important role in it. One of the measures to reduce CO₂ emissions is by shifting transport to modes with intrinsically low carbon emission per unit of transport provided. Jakarta has done this in the last decade with its TransJakarta that has demonstrated that rapid increase in ridership results in lower CO₂ emissions per passenger kilometres delivered. Even though the

development of TransJakarta is more for the reasons of solving transport problems rather than climate change as a direct objective.

The use of Compressed Natural Gas (CNG) for TransJakarta fleet also positively contributes to the environment, although the number of the buses fleet is much lower than the total number of private vehicles and other public transport buses in Jakarta that use gasoline or diesel. Use of electric vehicles in Jakarta is currently not an option yet as the electricity network and capacity do not support a smooth supply.

4.1.12. Social exclusion

4.1.12.1. Ageing population

The world trend of ageing population is not applicable for Jakarta. People in the age category of more than 65 years account only 3.5% of the total population. However, this group accounts for the highest %age number of people with mobility limitations. To date, there is no data available about the mobility pattern of this group which can explain the absence of special policies and facilities for them in the transport sector. The Government argues that there is too little demand to provide facilities for disabled people since due to cultural circumstances, they feel ashamed to go out with their wheel chair.

Only TransJakarta has been trying to provide facilities for disabled people by providing ramps at most of the stops. Some stops are equipped with lifts, but most of them are not maintained due to ownership problems. As part of the Standard Operational Procedure, officers of TransJakarta will help if there are disabled people who want to board the bus. However, these measures are not effective since there is almost no disabled people who use the bus.

Based on interviews with several experts, the problem lies in the access of disabled people from home to the public transport stops. Most sidewalks do not have ramps. Therefore, the solution to this problem is NMT policy.

4.1.12.2. Gender

An estimated 37.5% of all working age women in Indonesia are engaged in paid work in Jabodetabek. The physical separation of living areas from working areas has led to increasing travel distances with high costs in time and fares. Given the double burden of earning a living and caring for the family, the time and reliability of transport systems is very important to women. As mentioned before, KRL is the main mode used by commuters who work in Jakarta and this mode has introduced special compartments for women to reduce sexual harassment to women in public transport. This measure has also been implemented in TransJakarta especially in the articulated buses where the front part of the bus is dedicated for women.

Figure 12: A special compartment for women in the front part of Commuter Rail Line



To date, there is no data yet about the rate of sexual harassments on women in public transport. Due to cultural sensitivity as it is considered as a taboo subject, women who have experienced a sexual harassment may not have space to complain such circumstances and decide not to report it to the police (The Jakarta Post, 2014a; The Jakarta Post, 2014b).

4.1.12.3. Urban poor

It is worldwide accepted that a transport system should facilitate access of the poor to urban markets, services and economic opportunities. The low fares of KRL for example, are deliberately subsidized in order to maintain affordability of this mode for low income travellers and large sections of the middle income population who are engaged in long distance commutes to commercial and business activities in the centre of Jakarta.

In many literatures, TransJakarta as a BRT system is also argued to benefit the lower income population as it provides cheap and fast transportation. TransJakarta uses one flat fare regardless of the distance and 70% of the fare per passenger is subsidized by the Government. However, according to a research done by Wentzel (2010), the use of the BRT among low income residents is low as the BRT did not embrace low income users according to its destinations. Transport costs might also have a significant impact in the use as many low income users do not have a BRT stop within reasonable a walking distance from home.

This finding can be related to the study done by ITDP (2014), where the accessibility of residents of Kampung (urban villages with informal housings) along the main BRT routes is researched. One of the Kampung researched is Kebon Kacang. The residents could have walked to access the BRT stops of corridor 12, but their access is completely blocked by office and commercial buildings in this Financial District area. They need to make a detour to access the stops, which will be more likely done by a motorcycle due to the distance and motorcycles are restricted in this area during the day. Eventually, they choose motorcycles over public transport.

Figure 13: Situation of Kebon Kacang area



Source: Consultant

4.1.13. Human dimension

The situation of Kebon Kacang described above also occurs in several Kampung in Jakarta. The kampung is associated with informality, poverty, and the retention of rural traditions within an urban setting. Many experts argue the existence of kampungs and modern cities reflect spatial segregation and socio-economic disparities. The poor are excluded by commercial concerns, which shows that human dimension is neglected in urban planning and transport policies. If the residents of those Kampung had direct access to the BRT system, they would not be dependent on motorcycles and the Kampung streets would have less motorized traffic which eventually could create a more liveable place to live for the residents.

High-rise buildings in the CBD areas close to Kampung not only block the access of the residents to public transport, but also create a clear physical segregation between low-income and high-income areas. The consequences are increased income inequality, higher rates of unemployment and poor health services due to lack of access to job networks and transportation.

Figure 14: Kampung and the modern city of Jakarta



Source: Consultant

4.1.14. Summary of the key points of the meetings

The five meetings and several short discussions during the data collection activities in Jakarta have given deeper understanding of the transport problems, challenges and plans of Jakarta in addition to the prior knowledge of the project team. Meetings were held with representatives of the Ministry of Transportation (Legal and International Cooperation Bureau, and Department of Urban Transportation System Development), Institute for Transportation & Development Policy Indonesia, Research and Development Agency for the Ministry of Transport, Jakarta Transportation Agency (JTA), and TransJakarta.

The key points of the meetings can be summarized as follows.

Traffic congestion

The main transport problem is pertinent traffic jams that cause much longer daily journey time to work, especially for commuters from the peripheries, such as the City of Bogor, Depok, Tangerang and Bekasi. This commute journeys are unavoidable due to the role of Jakarta as the main centre for governmental and commercial activities and the role of the peripheries as settlement areas with few employment opportunities.

In the last decade, the government has been restructuring the spatial structure by shifting manufacturing activities from Jakarta to the periphery to reduce commute journeys to Jakarta. However, this dynamic and rapid change of the urban structure is not supported by a well-planned urban transport system. This situation has been worsening traffic problems in metropolitan Jakarta.

Growth of vehicles number vs road capacity

Transport problems also occur when the road network is insufficient to meet the increasing traffic demand. The development of new roads can never catch up to the growth rate of vehicle ownership. A new highway or a widened road only alleviates traffic congestion for a short period of time. After a few years, any new or widened highway fills with traffic that would not have existed if the highway had not been built, a phenomenon called induced demand. Because of induced demand, neither building new roads nor widening existing roads are viable long-term solutions to traffic congestion.

On the other hand, attempts to reduce the private vehicles ownership rate will not be an easy way out. Accounting for around 7% of the country's gross domestic product, the automotive and supporting industries are one of the most important sectors in Indonesia's story of economic growth. Castrating the automotive industry also means putting millions of jobs in jeopardy.

Weak parking strategy

Currently Jakarta does not have a concrete and strict parking strategy yet. Parking fees in Jakarta is the second lowest worldwide, which encourage people to use their cars. Furthermore, most of the on street parking locations are operated by individuals who do not properly report the parking revenue to the government, causing massive 'leak' of government's revenue from parking. Attempts to encourage these individuals to work at off street parking areas under official parking companies failed, due to much less income that they will receive.

Figure 15: A new parking meter in Jakarta



In January 2015, the government of Jakarta launched a parking meter system to reduce the revenue leak. At the time preparing this report, there is no information yet about the effectiveness of this system to achieve this goal. However, the low parking fare (\$0.15 per hour for motorcycles and \$0.35 per hour for cars) still encourages people to use their private vehicles.

Public transport, poverty alleviation and gender issue

Besides alleviating congestion, a good public transport system is also believed by the interviewees as a tool to reduce poverty and to facilitate access of the poor to urban markets, services and economic opportunities. The one flat fare of TransJakarta (\$0.15 in the off-peak hours and \$0.26 in the peak hours) and the low fares of KRL (\$0.15 for the first 25 km and \$0.08 for the next 10 km) are deliberately subsidized in order to maintain affordability of this mode for low income travellers and large sections of the middle income population who are engaged in commercial and business activities in the centre of Jakarta.

Furthermore, TransJakarta and KRL are also the only public transport modes in Jakarta that accommodate the special needs of women. Special compartments for women in TransJakarta articulated buses and in KRL have been introduced in the last years to reduce sexual harassment to women in public transport.

Neglected non-motorized transport (NMT) modes

NMT policies have a low priority in the transportation development of Jakarta. Compared to road network expansion for motorized traffic, the attention given to NMT infrastructure is very minimum. Available footpaths are mostly taken by street vendors or used for parking lots, causes pedestrian to walk on the road and share the road with motorized transport users.

Even though the Jakarta Transport Master Plan (2007) gives development directions for NMT infrastructure network and facilities (pedestrian walkways, crossing facilities, cycling infrastructure and cycle parking), until now there is no significant increase in the development of NMT network in Jakarta. 86 km of cycle paths are planned and currently 8.6 km has been constructed. However, due to weak law enforcement, the cycle paths are also used by motorcycle users who want to avoid traffic jam especially during the rush hours, push away the cyclists who use the paths.

Weak law enforcement

Traffic law enforcement in Jakarta is very weak, mainly caused by a corrupted bureaucracy. Small amount of traffic fine that can be given directly to the traffic polices discourages drivers to obey the traffic rules, worsening traffic jams and causing many road accidents. Many drivers do not possess a driving license that makes their driving skill questionable. The driving license service is notorious for corruption, with applicants wanting to skip the administrative process often bribing police officer through middlemen.

Roles coordination of different institutions

The various meetings held also strengthen the prior assumption of the team concerning coordination issues among different governmental institutions. Many policies of the Central Government are often contradictory with the policies of the lower governmental levels. One of the latest examples is the Low Cost Green Car (LCGC) program launched by the Ministry of Industry to increase the automotive and supporting industries in Indonesia. The tax incentives applied to this program has increased the affordability of the middle income class to purchase (more) cars, which eventually encourage more people to use private cars on the Jakarta's already congested roads. This issue is considered to add more burdens to the lower institutional levels, such as Jakarta Transportation Agency and TransJakarta, who have been working on reducing traffic congestions in Jakarta.

Another example brought up in the meetings is the misuse of the TransJakarta bus way corridors. According to JTA and TransJakarta, the bus way corridors may only be used by TransJakarta buses and should be kept from other transport modes. However, in practice, the Traffic Police allows private vehicles to use the corridors, especially when the corridors are not being used by TransJakarta buses; to relieve the over congested roads during the peak hours.

Absence of Jabodetabek Transport Authority

Despite its complication, there is no one authority that coordinates transportation developments for Jabodetabek. Currently, the real authority lies with each provincial and local government in the Jabodetabek area. An establishment of such institution to coordinate plan, implement and monitor transportation developments in Jabodetabek (the so called Jabodetabek Transport Authority/JTA) is currently under discussion even though such attempts in the past has failed due to the strong political tensions among provincial governments as the real authority.

4.1.15. Planning documents currently adopted by Jakarta

During the site visit, several planning documents related to the transportation of Jakarta were collected. The national, urban and transport strategies adopted for Jakarta can be summarized as follows.

Presidential Decree 48/2014 about adjustments of Presidential Decree 32/2011 about Master Plan of Acceleration and Expansion of Indonesia Economic Development

This national planning document determines a strategic direction in the acceleration and expansion of Indonesia's economic development for the period of 2011 – 2025. This presidential decree recognises the Jabodetabek area as one of the main Indonesia's development potentials that controls 60% of national export-import activities. The decree also recognises the challenges that come along with it, and that the main challenge is severe traffic congestion caused by lack of road capacity to accommodate the vehicles traffic. In order to address this challenge, the following strategies are determined:

- a. spreading some business activities to outside Jakarta to reduce the travel quantity between business centres in Jabodetabek;
- b. developing non-road mass transport system for commute journeys;
- c. developing intermodal mass transport network that accessible for business and government activities;
- d. developing efficient logistic network from industrial centres in peripheries and improving access to Tanjung Priok Seaport and Soekarno Hatta Airport;
- e. establishing a transport authority at the national level;
- f. improving Soekarno Hatta Airport and Tanjung Priok Seaport;
- g. improving rail-based mass transit network from peripheries to and inside DKI Jakarta;
- h. developing road-based mass rapid transit (MRT) network;
- i. Improving road network.

DKI Jakarta Local Regulation 1/2012 about Spatial Planning 2030

The DKI Jakarta Spatial Planning 2030 contains macro policies of the Province of Jakarta and the cities/regencies in the metropolitan area. Several strategies related to transportation system are:

- a. developing an activity hub at mass public transport nodes through the Transit Oriented Development (TOD) concept;
- b. developing a mass public transport system as the backbone of the transport system by developing road-based and rail-based mass transit and providing feeder transport integrated with the mass transit system, in order to achieve a target of 60% public transport mode share and of 35 km/hour average traffic speed;
- c. increasing road space to mitigate the severe traffic congestion and developing hierarchical road networks to increase accessibility, followed by sound traffic management and traffic restriction at certain activity areas;
- d. providing safe and comfortable pedestrian and cycling routes, ensure the integration with public transport system, and taking disable people needs into account;

- e. improving parking system by gradually removing on street parking to increase the comfort of road users (especially pedestrians) and to ease road congestion, promoting off street parking and park and ride system;
- f. developing an effective and efficient freight transport system by providing freight terminals to support industrial estates and export-import activities;
- g. improving the integration of water, air, and land transport systems;
- h. integrating local, regional, national, and international transport systems;
- i. developing international-scale port infrastructure.

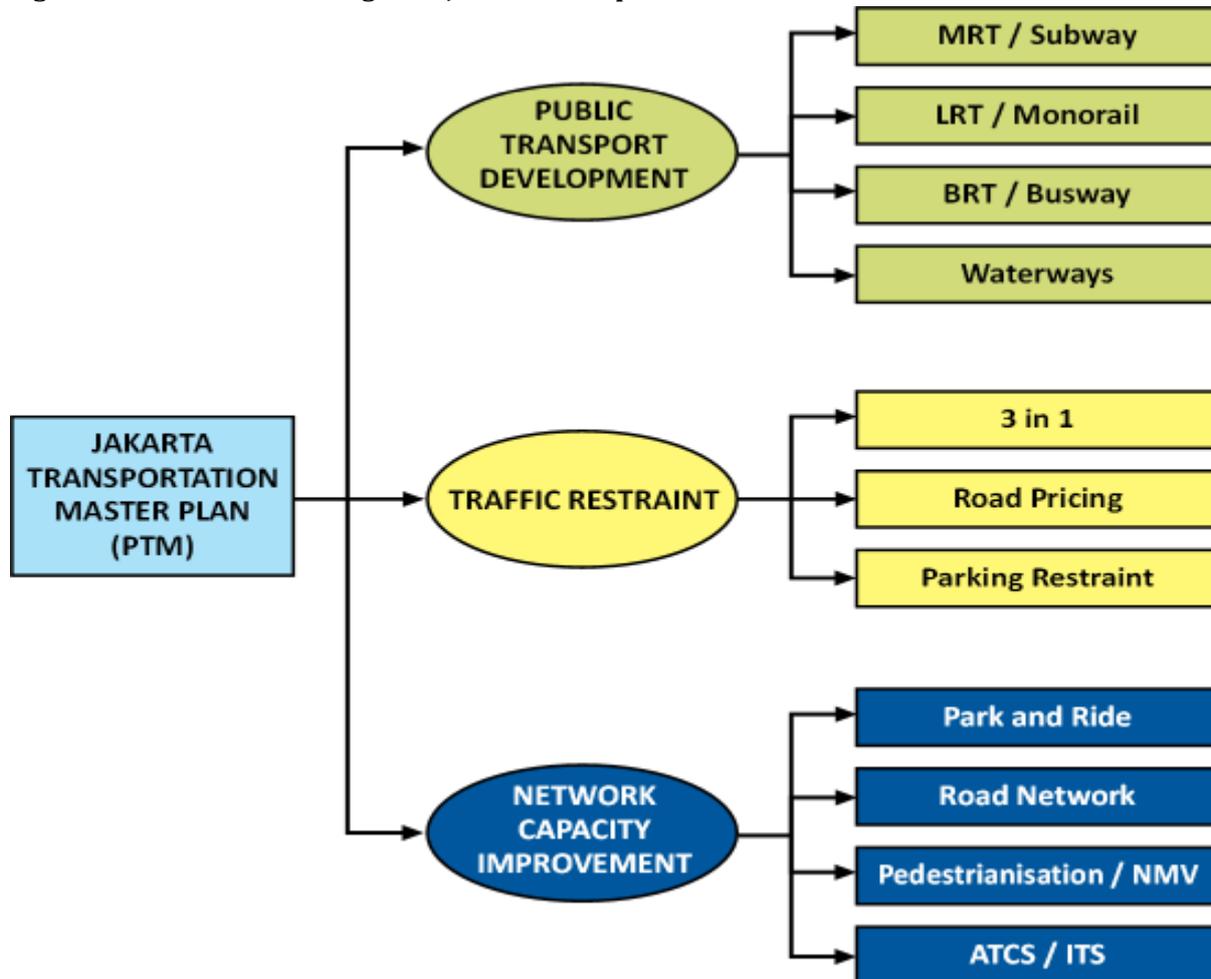
Jakarta Transportation Master Plan 2007-2020

Jakarta Transportation Master Plan, or mostly called *Pola Transportasi Makro (PTM)*, outlines the general direction of transportation development and synchronises transport plans of each city and regency in Jabodetabek. PTM recognises the complexity of transport problems in Jakarta in terms of quality and quantity, and that a careful planning is needed in order to anticipate the increase of transport demand in the future. Transport problems of Jakarta are reflected by severe and persisted traffic congestion on almost all arterial roads, low quality public transport, and non-optimal and un-integrated supporting system (bus terminals, train stations, seaport, airport, and road and toll-road network).

Therefore, three main strategies (shown in the figure below) were developed in PTM to address these problems:

- 1) Public transport development, which focuses on:
 - a. Improving rail-based mass transit by starting the construction of MRT, revitalising KRL and planning rail service to the airport.
 - b. Developing Light Rail Transit (LRT) and monorail; LRT is currently at the initial stage of construction while monorail plan is in the meantime already cancelled.
 - c. Improving Transjakarta busway by finishing the planned 15 corridors (12 corridors are currently in operation), operating busway feeders, operating Transjakarta Integrated Border Transport, and managing other road based public transport modes.
 - d. Improving waterways to be used as transport mode integrated with road-based public transport modes.
- 2) Traffic restraint, which focuses on:
 - a. Motorized vehicles restriction, by implementing among others, 3 in 1 policy (minimum 3 occupants per car) in certain areas and at certain time and forbidding motorcycles to entering Central Business District areas.
 - b. Electronic Road Pricing, a congestion charge applied to private vehicles on certain roads at certain time which currently being prepared to replace the 3 in 1 policy.
 - c. Parking restraint.
- 3) Road network capacity extension, which focuses on:
 - a. Provision of Park and Ride facilities at public transport nodes.
 - b. Extending road network capacity by extending the current network and constructing flyover and underpasses.
 - c. Promoting pedestrianisation/non-motorized vehicles by providing pedestrian walkways.
 - d. Automatic Traffic Control System (ATCS) and Intelligent Transportation System (ITS) to integrate road traffic and BRT system effectively and efficiently.

Figure 16: Three main strategies in Jakarta Transportation Master Plan



Source: Edited from: Presentation of TransJakarta Management Body in UN Forum on Climate Change Mitigation, 2010

In terms of institutional aspect, PTM also stresses the need for improving the coordination between provinces, cities and regencies in Jabodetabek to improve transportation management and integration by forming a Jabodetabek Transport Authority.

4.1.16. Discussion of the current situation of Jakarta

The spatial planning document was developed by taking into account the higher-level strategic directions in the Master Plan of Acceleration and Expansion of Indonesia Economic Development, while the main transport plan document of Jakarta (PTM) was developed consistently with the spatial planning document.

Looking at the current situation, several strategies has been or being implemented, such as:

- the construction of MRT track;
- extending TransJakarta corridors and the feeder modes;
- implementing motorized vehicles restriction policy at certain time to ease road congestions at Central Business District areas;
- implementing ERP;
- providing Park and Ride facilities at public transport nodes;
- extending road network capacity;
- providing cycling network..

While other strategies are yet to be implemented, such as:

- parking regulation;

- providing pedestrian walkways;
- providing ATCS and ITS to integrate road traffic and BRT system effectively and efficiently;
- establishing Jabodetabek Transport Authority.

The three afore-mentioned planning documents recognise the same main challenge faced by Jakarta, i.e. severe traffic congestion. The plans and strategies to address this challenge, outlined by those documents, are very comprehensive and integrated, taking all modes and road users into consideration. However, there is one strategy that still needs to be strengthened in order to promote the shift towards sustainable transport: parking regulation. In both spatial planning and transport master plan documents, the parking strategy is only intended to reduce on street parking by promoting off street parking in order to maximise road capacity and to ease congestion. This strategy might be able to accomplish the aim of reducing congestion, but it does not target the real problem, which is high motorized traffic. The effectiveness of a strong parking strategy has been proven worldwide to reduce private vehicle use and to promote more sustainable modes (see § 4.2.16).

Despite the strategies that have been developed to achieve an ideal situation for transport system in Jakarta and despite the strategies that have been implemented to date, there is no significant result yet in reducing traffic congestion in Jakarta. It is most likely that the real challenge lies in the mechanism of implementing the strategies. So far, the planning documents offer solutions only from the supply side. In other words, reactive solutions, which has been proven worldwide as an ineffective approach.

Jakarta needs a multi-sectoral approach that includes supply, demand, institutional, legal and spatial planning in a simultaneous and comprehensive way. However, such an ideal approach will always be challenged by technical, physical, legal, institutional and financial constraints. The lessons learnt from developed countries show that institutional reform that leads to regulation and governance reform is needed to solve transport problems. This includes a clear vision, commitment, consistency and leadership from the decision makers in creating a sustainable city.

If this approach is translated to the situation in Jakarta, the following issues can be pointed out:

1. Ineffective and inefficient coordination among different institutions
Indonesia's bureaucracy is known to be long and complicated. This hampers a smooth coordination between institutions and different governmental levels which is needed to implement effective and efficient transport solutions. One example is the different institutions responsible in the BRT system. TransJakarta company is responsible for the operation and Jakarta Transportation Agency is responsible for trajectory and routes. Meanwhile, pedestrian bridge as access to the busway shelters and the road along the busway corridors are under the authority of the Department of Public Works. Problems arise when these different institutions are not on the same page when it comes to a commitment to improve the level of service of TransJakarta.
2. Incorrect paradigm of mobility needs and congestion
In all planning documents discussed above, provision of a proper public transport system has been pointed out as the first solution to tackle the congestion problem of Jakarta. While public transport is a transport mode that needs to be provided by the government to address mobility needs, regardless congestion problems. To address congestion then private vehicles need to be restricted/reduced. Switching this paradigm reflects the same right of using roads between private vehicle drivers and those who depend on public transport.
3. Missing link with housing policies
In the planning documents, housing policies for Jakarta are hardly targeted and linked with transportation policies. The 20 million day population and 11 million night population of Jakarta illustrates a long travel distance performed by commuters who cannot afford the exceptionally high housing price in Jakarta. Besides the policies of accommodating the commuters' journeys,

the government should also find solutions to provide affordable housing to meet the housing needs and eventually reduce the travel needs and promote NMT modes.

4.1.17. SWOT analysis

Based on the analysis of current situations, planning documents, field observations and interview with the stakeholders described above, the following SWOT analysis for Jakarta can be summarized.

Table 6: SWOT Jakarta

<p>Strengths</p> <ul style="list-style-type: none"> • Political and economic capital • Large population • Centre of agglomeration area • Government's willingness to invest in the transport sector 	<p>Weaknesses</p> <ul style="list-style-type: none"> • Pertinent traffic jams • Poor public transport system, especially to connect the peripheral areas and the centre of Jakarta. • Large area, large population and rapid growth are difficult to manage • High motorization • Low recognition of NMT policy • Shortage of electricity • Poor regulations, weak law enforcement, and lack of capacity • Low urban poor inclusion • Absence of single transport authority for the metropolitan area
<p>Opportunities</p> <ul style="list-style-type: none"> • Large population • Robust economy • Accommodates lots of economic headquarters • Attractive for investment • Many on-going transportation projects 	<p>Threats</p> <ul style="list-style-type: none"> • Insufficient transport infrastructure • Weak technology and innovation • Risk of climate change

Despite being a weakness as it is difficult to manage, the large population of Jakarta is also considered to be a strength and an opportunity. In terms of transport provision for instance, large population can be directed to create high-density areas and TOD, which in turn can create cost efficient transport provision. Large population also creates high levels of demand to support the operations of mass transit system. This is also supported by the willingness of the national the Jakarta provincial government to invest in the transport sector. This willingness is shown by the government's efforts to create a conducive environment for private investments. This can be seen in the many transportation projects that are currently taking place in Jakarta. However these still cannot cope up with the rapid motorization increase and high demand of public transport. Pertinent traffic jams are therefore unavoidable. High motorization in Jakarta is not only caused by the insufficient capacity of transport infrastructure and facilities, but also the fuel subsidy policy and the weak parking regulation that encourage the use of private motorized vehicles.

Weak law enforcement and lack of institutional capacity are the main weaknesses that need to overcome. The non-existence of a transport authority for the Jakarta Metropolitan Area is one example of low institutional capacity. The absence of such institution creates no clarity of the responsibilities and role between Jakarta and the surrounding cities and regencies which in turn creating un-integrated transport policies for the metropolitan area.

Jakarta is also facing several threats that can influence the sustainability of its urban transport. To begin with, fuel price is heavily subsidised by the national government. Increase in the global oil price means extra financial burden that can lower the capacity of the government to invest in the transport

sector. Jakarta as the centre of the biggest agglomeration area in Indonesia and Asia is one of the strengths of Jakarta as it can attract many investments. However, it also creates a threat of high immigration from other cities that can cause uncontrolled urban sprawl. Finally, as is experienced by other megacities, Jakarta is vulnerable for the climate change risks which are not only caused by its geographical conditions but also its unsustainable transportation sector. Implementing sustainable transportation technologies, for example electric vehicles, is hindered not only by weak technology and innovation but also the electricity shortage in the whole country.

Based on the above SWOT-analysis, critical success factors for Jakarta urban transport system can be determined as follows:

1. **Establishment of Jabodetabek Transportation Authority (JTA)**
The Central Government should speed up the establishment of JTA to create an effective and efficient coordination between different governmental levels, private sectors and other institutions that play a role in the Jabodetabek transport developments.
2. **Increasing capacity building**
Transport planning is a complicated discipline as it involves various skill areas and stakeholders that should be taken into account in a simultaneous way. While there may be enough highway or construction engineers, other professional staff (such as traffic engineers, transport planners, economists, and public transport regulators) tends to be in short supply and frequently lack necessary skills. Technical support tools such as local design standards and guidelines, good practice manuals, and more sophisticated knowledge management systems also tend to be underdeveloped.
3. **Strengthening and improving TransJakarta**
In all planning documents, one can see how important TransJakarta is, not only for Jakarta but also for Jabodetabek. Despite some shortages, TransJakarta as the first nation's high quality public transport mode has shown its success in reforming public transport in Jakarta. Therefore, a commitment from the government and various institutions is needed to improve TransJakarta to a higher level to follow the cities with state of the art of BRT such as Guangzhou. Furthermore, improving other road-based public transport and integrating it with TransJakarta is also very important.
4. **Strengthening parking regulation**
There are very few areas in urban transportation that can create many benefits for the quality of live and change of mode choice as a strong parking policy. Introducing paid parking, increasing parking fees and reducing or limiting parking spaces, will "push" motorists to switch to more sustainable transport modes. At the same time, the revenues can be used to promote and develop the alternative modes such as public transport and non-motorized transport.

4.2. Cairo

4.2.1. Urban background

Egypt is a pivotal country in the Middle East, the Arab World, Africa and the Islamic World. It is the most populous country in the MENA region, with a diversified economy serving a young population and a growing middle class. In recent years Egypt has had to deal with formidable challenges: a global financial crisis in 2008 and two uprisings in 2011 and 2013. In early 2015, and after a stormy four years of political convulsions and upheavals, Egypt appears to be navigating more stable political waters. A new constitution was drafted and ratified with overwhelming majority in January 2014, and a new president - former head of the Armed Forces, Abdel Fattah El-Sisi - was sworn in, in June 2014, having won the presidential elections in May 2014. Egypt enjoys an unrivalled central geographic location, affording easy access to the 300+ million strong MENA markets and the 1+ billion-strong

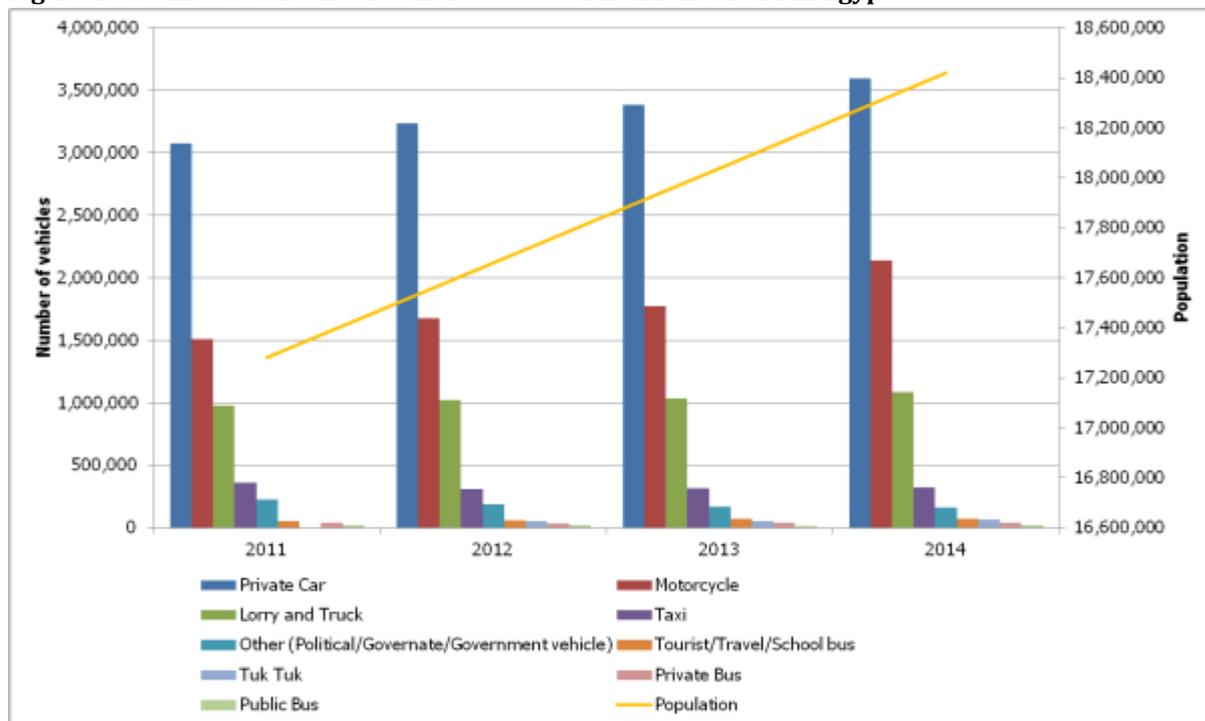
African markets. The Suez Canal further enhances this advantage, with 8% of world trade passing through the vital waterway.

The transportation sector is one of the main drivers of economic development and growth in Egypt, linking production and consumption markets. Egypt’s unique geographic location combined with an expanding infrastructure base is enhancing the country’s position as a key global logistics hub. Egypt is currently embarking on a host of transportation projects in metros and tunnels, railways, ports, and roads. The OBG’s Egypt 2014 report described the scale and scope of transportation projects in Egypt as 'breathtaking'. Despite anticipating problems to face some projects, the report concluded that 'even if only half of the targets are met the total achievements will still be among the largest in Egypt’s history.'

The Greater Cairo Region (GCR), which includes the governorates of Cairo, Giza, and Qalubiya is among the largest, fastest growing, and densest major urban agglomerations in the world. Its population is about 17 million and projected to grow by about 1.7% per year for at least the next decade. Population density exceeds 800 persons / hectare over much of the urbanized area. The GCR is the dominant metropolis of Egypt with approximately 20% of the national population and is the centre of economic, educational, medical, cultural, and governmental activity.

The CGR is also the preeminent transport centre of Egypt accommodating over 20 million motorized person trips and 7 million non-motorized trips daily. About 2/3 of all motorized trips are made by public transport, but about half of all motorized vehicles in Egypt operate in the GCR and while the current car ownership rate is quite low, it will only take a small increase to bring about a dramatic worsening of the traffic congestion that is amongst the worst in the world. The figure below summarizes licensed vehicle and Cairo population growth in the 2011 to 2014 period and Table 7 indicates the number of licensed vehicles (note data is only available for Egypt as a whole):

Figure 17: Number of licensed vehicles between 2011 and 2014 in Egypt



Source: Data from Central Agency for Public Organization and Statistics, 2014

Table 7: Number of licensed vehicles between 2011 and 2014 in Egypt

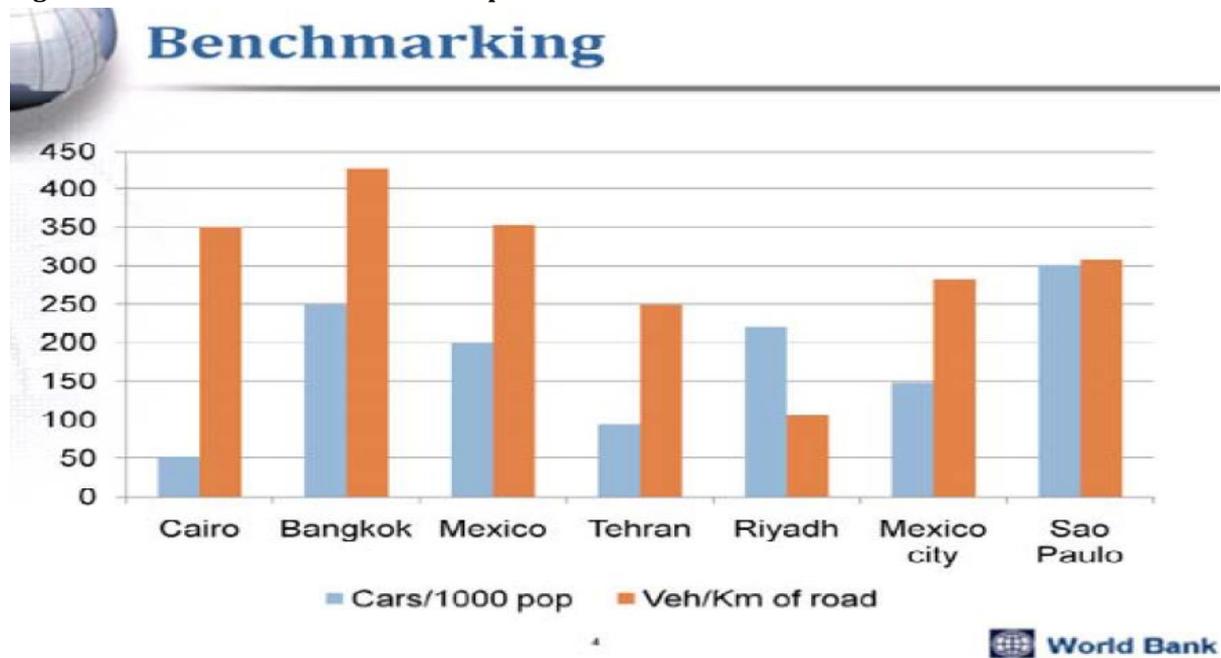
Vehicle	2014	2013	2012	2011	Difference 2011 to 2014
Private Car	3,592,822	3,380,104	3,231,513	3,074,862	+17%
Motorcycle	2,135,985	1,772,333	1,674,812	1,509,373	+42%
Lorry and Truck	1,083,938	1,033,849	1,020,378	978,731	+11%
Taxi	320,098	317,253	307,166	359,252	-11%
Other (eg Political/Governate/Government etc vehicles)	162,295	165,418	185,879	224,782	-28%
Tourist/Travel/school bus	72,255	67,849	56,139	54,924	+32%
Tuk Tuk	65,844	51,213	49,574	0	
Private Bus	38,227	36,672	31,556	36,270	+5%
Public Bus	16,494	16,420	19,417	19,104	-14%

Source: Data from Central Agency for Public Organization and Statistics, 2014

Interestingly whilst this shows a 17% increase in the number of cars licensed between 2011 and 2014, it shows the phenomenal growth in Motorcycles (42%), a significant growth in trucks (11%) a small increase in private buses but a large reduction in public buses. It also shows the phenomenal increase in Tuk Tuk's from none registered in 2011 to over 65,000 in 2014.

Increased private car ownership: low bank loans, inexpensive fuel and increased local car production/assembly has compounded the GCR traffic congestion. The figure below compares Cairo cars per 1000/population (which is relatively lower than other cities) and its vehicles/KM road which is relatively high and out of proportion with the cars by population:

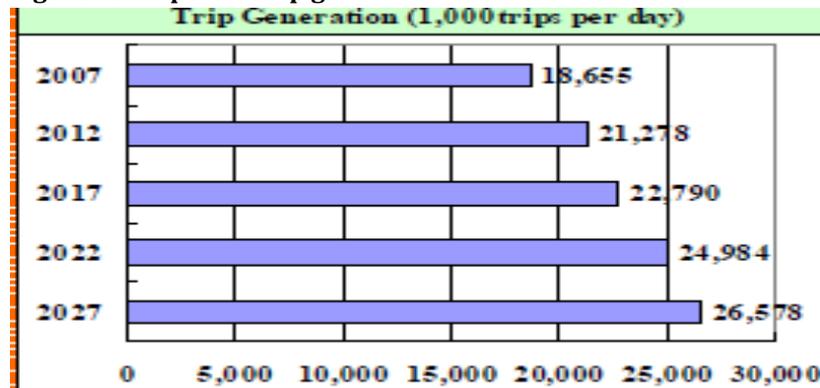
Figure 18: Number of cars in Cairo compared to other cities



Source: Slide 37 Prof Khaled El Araby International Symposium February 2013

The 2008 JICA study indicated that the population in Greater Cairo would be 24 million by 2027 with 7 million workers and 6 million students (from a base year of 2006 with 16 million population, 4.3m workers and 3.4 million students). The CREATS study indicated the following resultant trip generation increase:

Figure 19: Expected trip generation increase in Cairo



Source: slide 7 JICA Study Team June 2008 2nd Seminar

With this increase in population and resultant trip generation, the JICA study identified the need to strengthen east west transport links given the location of proposed new centres of development. Measures considered and prioritised were:

- Busways
- Rail lines
- Metro Extensions

4.2.2. Transport network and infrastructure

4.2.2.1. Introduction

While highly diversified, in terms of supply and related infrastructure and facilities, the Greater Cairo Urban Transport System suffers major inefficiencies which translate into: poor transport services especially for the low income groups captive of public transport modes and high economic, environmental and fiscal costs for the country. Demand for mobility has greatly outpaced the capacity of the public transportation system to cope. The gap has been primarily filled with private owned and operated shared taxis (informal transport) and the use of private cars. The most critical urban transport issues include:

Severe traffic congestion: Cairo is experiencing traffic congestion that places it among the worst in the world. This has serious economic consequences and contributes to deteriorating air pollution conditions. The average speed of traffic in Cairo is similar to that of other cities recognized for their severe traffic congestion (Bangkok, Mexico City, and Sao Paulo). Travel speeds in the Cairo central business district and in central Giza are typically less than 10 kph on typical business days. Yearly economic cost of traffic congestion could reach up to 4% of Egypt's GDP.

Figure 20: Typical street scene in Cairo



Source: Page 1 World Bank 10/11/06 Proposed Urban Transport Strategy

No clear functional hierarchy of roads - There is no clearly defined routes for traffic which is strategic, local, servicing nor are there any designated routes for public transport and NMT.

A lack of traffic signal control at intersections results in underutilization of intersection capacity: This situation is aggravated by a driving culture that requires drivers to give little consideration to other road users if they are to complete their travel in a reasonable amount of time. Most cities the size of Cairo have extensive centralized control of signalized intersections, a strategy that can be demonstrated to reduce travel time by about 20% as well as increasing the effective capacity of the road network *“There is an insufficient number of signalized intersections. At many intersections traffic lights are not visible because of low poles which make it difficult for drivers who are behind large buses to see them. Some traffic lights are not working properly. Currently during peak periods, almost all signalized intersections are manually controlled by traffic policemen. Manual operations are based on an assessment of spot conditions by visual observation by traffic policemen and/or information received via transceivers. However, it is rather difficult for this manual controlling technique to maintain an effective synchronization situation between intersections because it tends to result in a longer cycle length.”* (Cairo Regional Area Transportation Study, Phase II Final Report, Volume II, page 4).

Lack of road signs and road markings: If there are inadequate markings of traffic lanes, signs giving indications of traffic priority and regulations (such as “Stop” signs at intersections) and indications of how to reach destinations, drivers respond in ways that appear to minimise their own travel time, but which in practice increase travel times for all road uses. Drivers cannot be expected to follow the disciplines that make best use of available road space if there are no road marking or signs to help them. Changing from the existing “rules of the road” to others that would be more advantageous to all road users is a very long term process, but it has a relatively low financial cost and significant benefits.

Lack of facilities for pedestrians - There is a lack of appropriately designated, safe and well maintained pedestrian facilities throughout the metropolitan area. Commensurate with the lack of appropriate crossings, pedestrians are seen to be crossing streets at inappropriate locations and mingling with moving motor vehicle traffic. Moreover there are many locations where footways are blocked by signs, kiosks, construction debris, and parked cars.

Inadequate junction designs - Most road junctions in Cairo were designed when the numbers of cars and other vehicles were much lower. Simple junction designs that are suitable for low numbers of vehicles do not work well when the numbers increase to those currently experienced. Whether through lack of funding or traffic engineering skills, junction design has failed to change with the changing needs, so that most congestion results not from a lack of road capacity but a lack of junction capacity.

Lack of bus stops: One of the most common complaints against mini-bus operators is their stopping wherever a passenger wants to enter or leave the vehicle, with little no consideration of the impact of the informal stop on the flow of other vehicles. Other cities have found that the location of bus stops that provide information on the route numbers served and the places served by those routes, combined with the enforcement of their use, not only reduces impediments to the overall traffic flow, but makes the bus services more attractive to the users and more profitable to the operators.

Lack of facilities for and management of car parking: Among the greatest impediments to pedestrian movement are cars parked on footways, and so closely parked at the sides of roads that there is no space for pedestrians to cross the roads. Cars parked in inconvenient locations are also an impediment to vehicle flows and significantly reduce road capacity available for traffic. One of the reasons that cars are parked on footways and on roadways where they impede traffic is that there are few other options available.

Bus priority facilities: As in many other developing cities, initial attempts at measures to give buses priority in street and intersection capacity have not been successful. In part this is because they were not well designed, in part because other complementary measures were not taken, but most importantly, because their observance by other road users was not enforced.

Poor public passenger transport system: Cairo relies on under developed, overcrowded and unreliable passenger transport services. The main positive characteristic of these services is their low fares. However, for those services that are still operated by the public sector, this results in unsustainable subsidies, and for private services that try to compete with the heavily subsidised public services, the resulting fares are commercially unsustainable. The most obvious outcome is inadequate public transport supply and deteriorating service quality. Public buses are poorly maintained and many are out of service, while private operators are restricted to small and aging vehicles without the means to replace them. The large number of operators and the previous lack of an institutional framework to properly manage and regulate the system have led to a lack of integration among passenger transport modes, rapid development of very low quality and unsafe supply, making already unpleasant travelling conditions worse than they need be.

A high accident rate: The road transport death rate in Cairo is very high. Over 1,000 people die each year in motor vehicle accidents in GCR, more than half of them pedestrians, and over 4,000 are injured. Except Teheran, these rates are by far higher than what has been recorded in other mega cities of the world (World Bank, 2006).

Air and noise pollution: Mobile source air pollution in Cairo is serious both with regard to particulate matter as well as noxious chemicals. Noise levels are high and aggravated by very old large proportion of the car and taxi fleet. Vehicle inspections that should limit exhaust gas pollution are mostly ineffective (World Bank 2006).

Institutional weaknesses and fragmentation: Like many other cities experiencing rapid population growth and even faster motor vehicle growth, Cairo suffers from highly fragmented, largely uncoordinated and inadequately staffed institutions to deal with urban transport problems of this magnitude. The GCTRA (as described in section 4.3.7.1 below) is the first attempt to address this.

Inadequate financial arrangements: Up until the March 2015 Invest In The Future conference (as described in section 4.3.8 below) overlaying all of the above problems are inadequate financial arrangements leading to under investment in transport facilities, especially in public transport capacity which suffers major shortages; inadequate cost recovery and consequent excessive subsidies for urban transport public; highly subsidized pricing of gasoline and diesel fuels which favour less efficient private transportation (private cars and small taxis); and little participation of formal private sector in financing and/or managing urban transportation infrastructure and services. There is a lack of proper infrastructure capacity to accommodate increased traffic demands. The proposed large investments are unlikely to keep up with traffic congestion. The current focus is on single infrastructure investments or technology driven approaches and this appears to be taking place without an integrated view on broader requirements for successful intervention. The pressing need is to find solutions to pending day-to-day problems whilst adequately addressing the long term sustainable development needs of the transport sector.

Affordability. Affordability is the ability to use public transport without significantly affecting the capacity to make other expenditures of importance under normal living conditions. By keeping all its public transport fares very low, Cairo has been one of the most successful cities in making its public transport services affordable, but this has come at a high cost in terms of subsidies, transportation time, pollution and lack of investment in improved services. It is now questionable whether keeping all fares low but enduring the consequences of poor quality and inadequate quantity is the best way of making services affordable to low income groups. Inadequate and congested urban transport is damaging to the city economy and harms both rich and poor. But the simplistic solution of controlling fares at low levels for all passengers, is inequitable because it leads to a progressive decline in the quality and quantity of all public transport services and ineffective because it will tend to generate more congesting car traffic. Rather the objective of making public transport affordable can be achieved by a more poverty focused policy.

Lack of inter-sectoral co-ordination (harmonization of policies, institutional co-operation) and limited institutional capacity to effectively adopt, implement and further develop comprehensive transport programs

Shortage of sustainable transport models and new approaches tested in Egypt to gain experience, reduce the risks and build the confidence of the targeted stakeholders. Negative experiences with some early experiments such as the introduction of separated bus lanes in Cairo in late 1970's and 1998 or with trolley busses in 1970's;

Possible public perception, social and cultural barriers and occasionally conflicting interest between the different key stakeholders;

Inadequate emphasis on integrating sustainable transport planning with urban planning of new cities and on promotion of non-motorized transport in middle size provincial cities.

Conflicting land use/sustainable development challenges within the historical zones in Cairo to serve the whole components and activities of the city socially, economically and environmentally as well as to maintain/reduce the impact on the environment.

4.2.3. Land use and urban form

4.2.3.1. Introduction

Cairo is dense and for most part compact within the built-up area. Key land use and urban form issues are:

- Trips are relatively short - 50% of the population live within 15Km of the Ramses Square/Downtown Cairo
- Informal areas represent 39% of the Greater Cairo built up area and 17% of the Greater Cairo gross area. They contain 63% of the total urban population in 2008 (around 11 million of Greater Cairo 17.3 million inhabitants).
- Historical Cairo occupies significant portions in the central core.
- New Cities in desert areas occupy 2.2 times the current Cairo built-up area and house only less than 5% of population (800,000 inhabitants). Average daily commuting times are more than 60 minutes particularly to new cities.
- The countries' pivotal urban functions for economic and social activities are predominately accumulated in GCR. The number of Public Institutions in GCR = 22% of the national total. The total number of buildings in GCR = 40% of the national total. Total in movements of Licensed Vehicles = 42% of the national total. The Higher Educational function = 50% of the national total.
- Non-uniform distribution of urban populations: Low income housing is away from job opportunities and high income housing is away from business opportunities.

Informal settlements: Close to 65% of inhabitants of GCR are living in informal settlements. Informal areas absorb additional population and generate most jobs, economic activities and services. They are mostly good locations close to urban boundary and more than 55% of vehicle trips are minibus trips in informal housing areas. The image below shows an example Cairo Informal area:

Figure 21: Informal housing area in Cairo



Source: Consultant

New Cities in the Greater Cairo Area 25 new cities are proposed in Egypt, 5 of these are in the Cairo region and 3 to 4 are currently under design. These are huge areas with huge investments but so far uptake is slower than envisioned and there are large travel distances involved with reliance on the car in the absence of planned public transport systems (Source Prof Khaled Al Araby 2013).

Critical Urban Development Issues

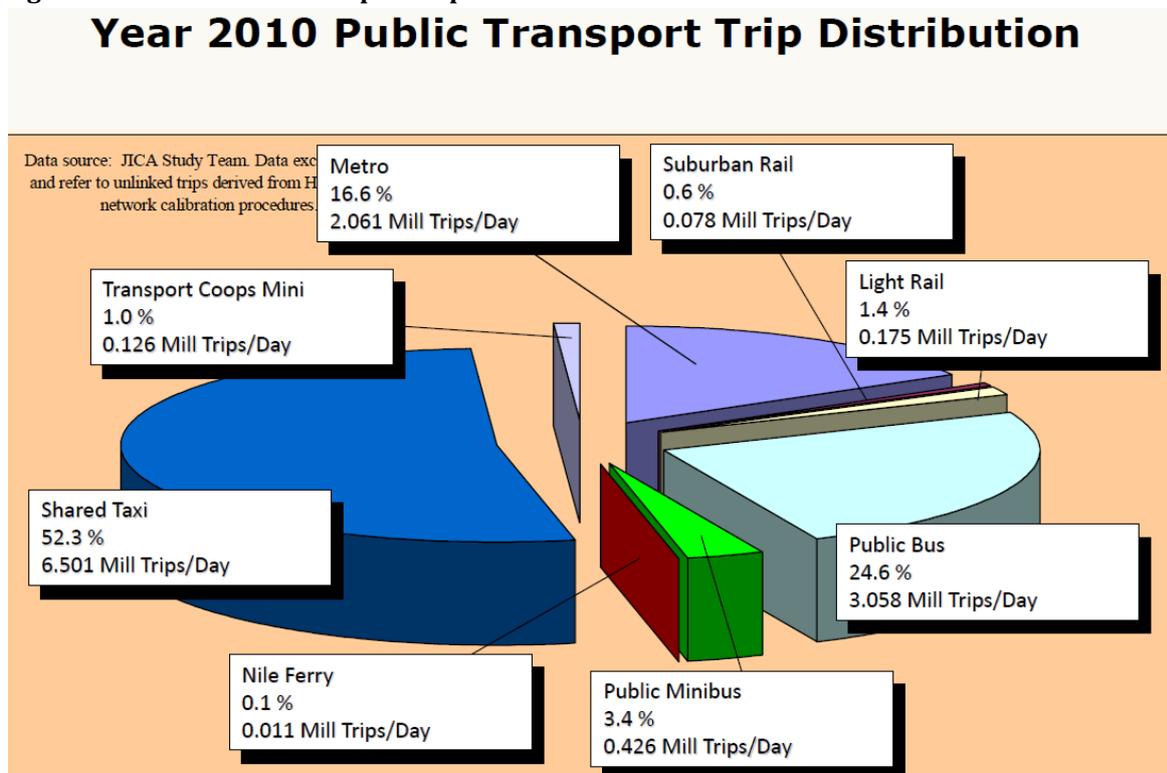
The GCR is faced with two critical urban development issues:

- How to redevelop or serve the inner city areas with an extremely high population density=217 (person/ha)?
- How functionally can the growing new communities be integrated that are physically spreading over more than 60 km distant from the metropolitan centre?

4.2.4. Mode availability and shares

Up-to-date modal share data was not made available but as shown in Figure 31 below shared taxi represents by far the largest share of public transport trips (over half of all public transport trips) with public bus the second largest share.

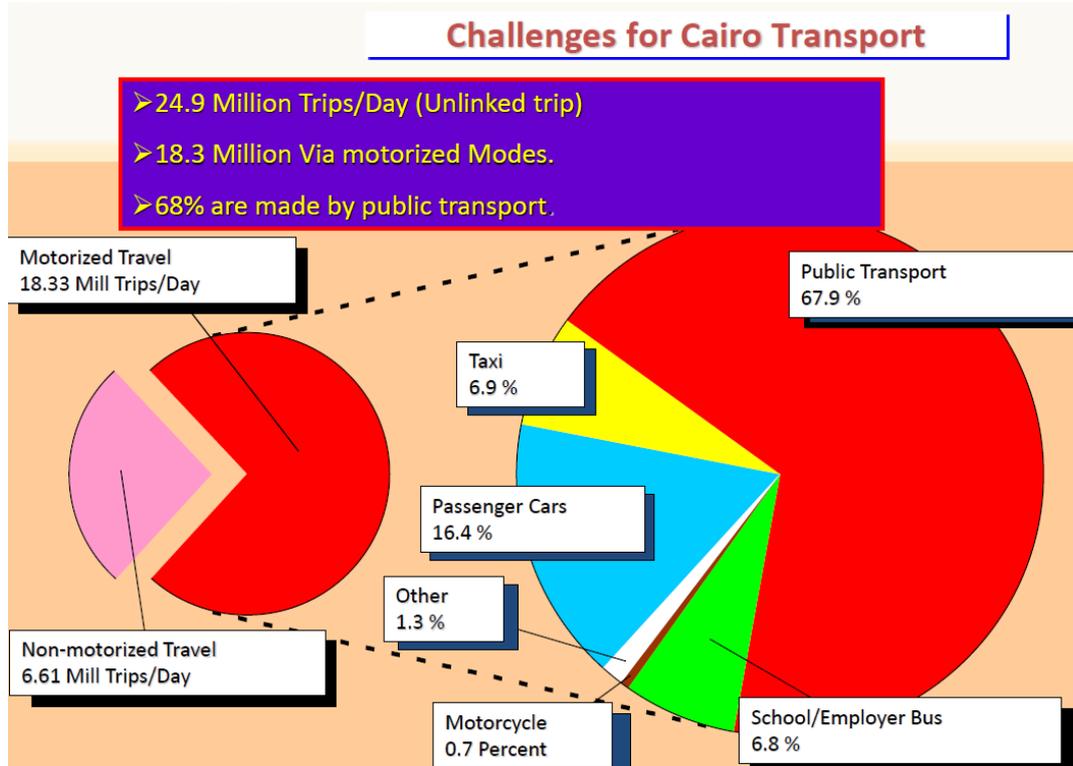
Figure 22: 2010 Public Transport trip distribution



Source: Slide 24 Prof Khaled El Araby International Symposium February 2013

As shown in Figure 32 below one of the key transport challenges is that 73% of all trips are made by motorized vehicles of which 68% are by public transport.

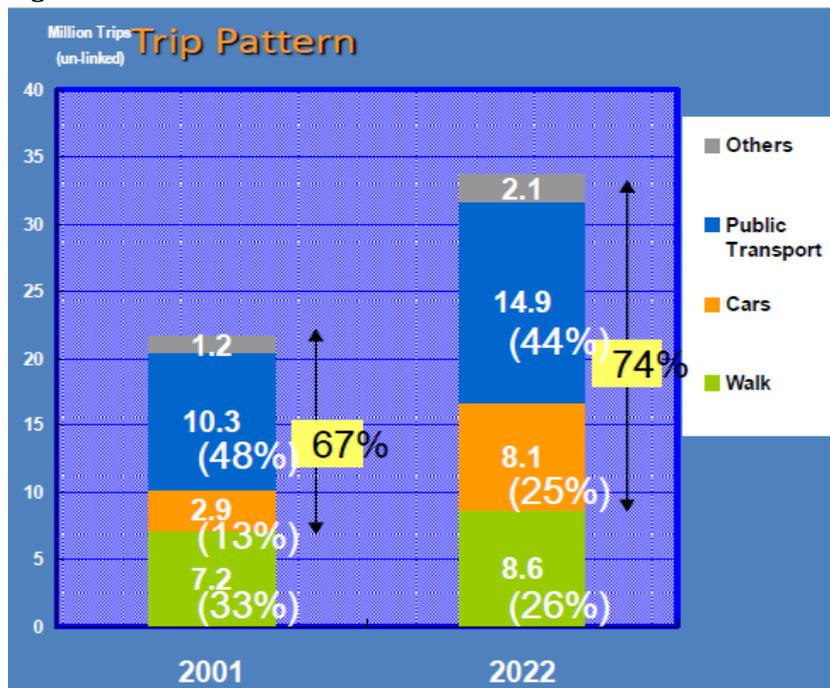
Figure 23: Challenges for transport in Cairo



Source: Slide 23 Prof Khaled El Araby International Symposium February 2013

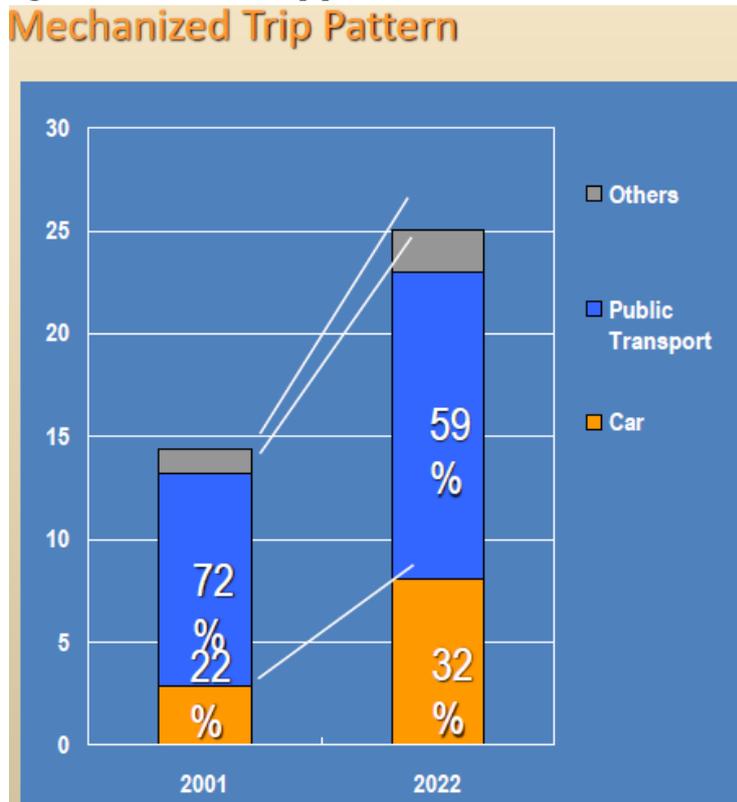
As shown in Figures 33 and 34 below the share of public transport and walk is predicted to reduce and the share of cars is predicted to increase by 2022.

Figure 24: Modal shares in Cairo 2022



Source: Slide 22 Prof Khaled El Araby International Symposium February 2013

Figure 25: Motorized trip patterns in Cairo 2022



Source: Slide 24 Prof Khaled El Araby International Symposium February 2013

4.2.4.1. Buses/trams

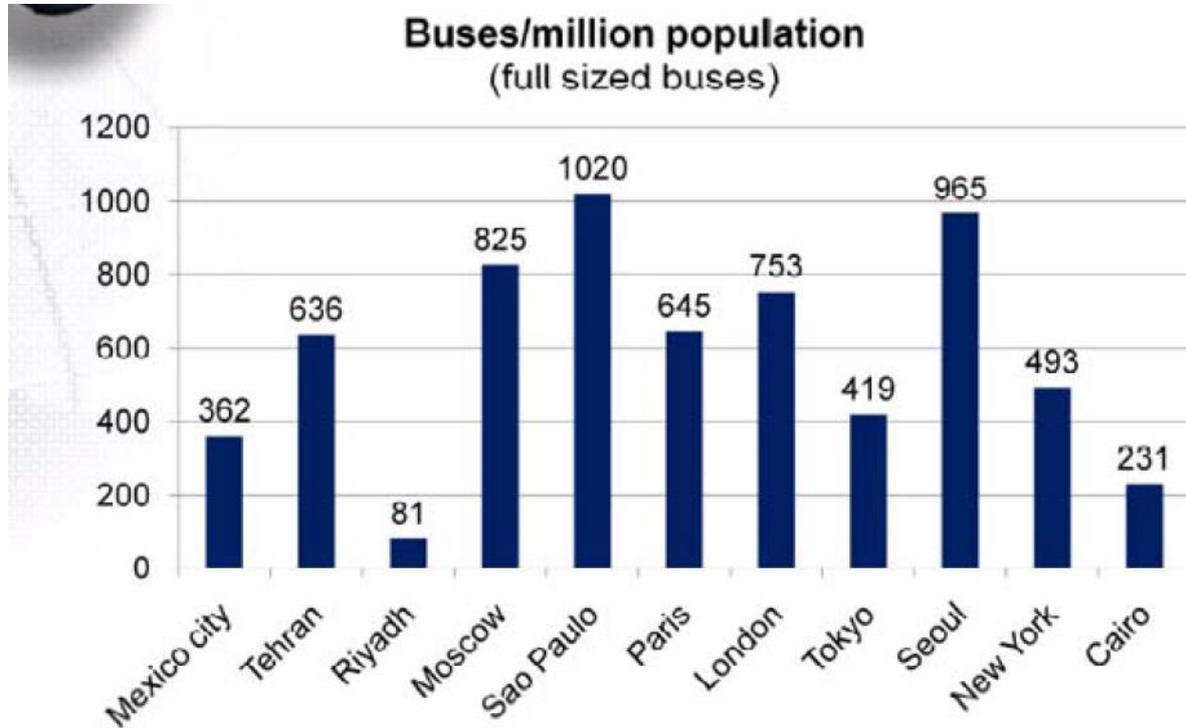
Failures to keep regular bus services updated in terms of quality and regularity has resulted in a fall in their share to just over 20% from almost 40% in only 10 years despite low fares. Similarly, tram services have been partially dismantled and remaining services, due to lack of investments and adequate maintenance, have deteriorated so far that they are of only marginal importance. These losses to public transport have been made up partially by the metro system, but mostly by shared taxis and minibuses that now account for over 50% of all public transport trips.

As a result, currently, road based public transport is provided by a large and inefficient public company (CTA), a large number of small and informal minibus operating companies, and an even larger number of individually owned minibuses and taxis. The Cairo Transport Authority (CTA) has 42,000 employees to run 4,500 buses and its sister public sector operator has 7,000 employees to run just 900 buses. This represents 9 and 8 employees per bus – easily over twice the staffing ratios for an efficient bus companies.

While minibuses now fulfil an important role in the provision of urban public transport, among the problems they bring include disproportionate contributions to traffic congestion, air pollution, and road accidents. When individual vehicles are given a license to operate on a specific route, it is impossible to control the capacity available at specific times of day – all owners want all their minibuses operating all the time to generate as much revenue as possible, even when this means that an excessive number of vehicles are operating at off-peak periods. Among those few, successful approaches to regulating minibuses have been those in which the many informal operators are brought into the formal system, and routes are allocated to small operating companies on a competitive basis, rather than licenses being given to individual vehicles to operate on a specific route. However this requires a system of route planning and allocation and subsequent regulation that until recently has been lacking in Cairo. However, the recent implementation of taxi concessions based on

competitive tendering and the award of some minibus route licenses are indications that large scale tendering and regulation of minibus routes might now be feasible. The figure below shows the relatively low number of buses in Cairo compared to other cities:

Figure 26: Buses per million of population in cities across the world (World Bank)



Source: Slide 38 Prof Khaled El Araby International Symposium February 2013

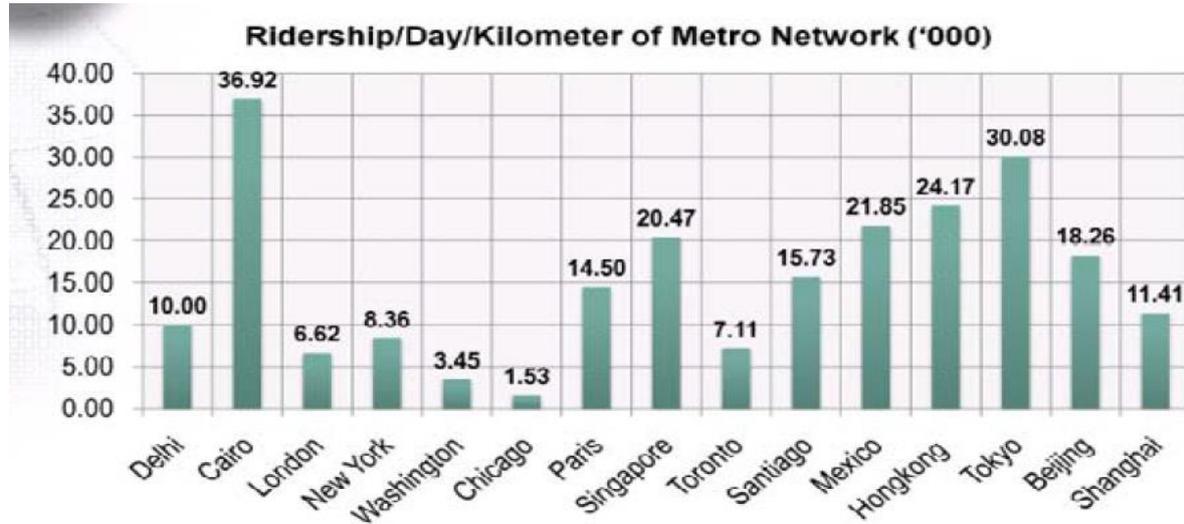
4.2.4.2. Metro

The existing mass transit system serving the GCR is very modest for an urban agglomeration of its size and population density, and expected population and economic growth:

- There are only two metro lines totalling 65km in length while similar sized mega-cities have much longer systems relative to their population:9
- The suburban rail system and tram systems are poorly developed and contribute little to system capacity. Nearly all of the mega-cities listed above also have extensive suburban rail networks;
- There are no bus priority facilities in the GCR, which are typically the lowest cost form of mass transit.

The very high patronage of the existing metro system, which currently attracts approximately 2 million passengers a day – about 20% of total passenger trips -- represents an impressive use of a relatively short system and indicates the merits of investing more in mass transit systems.

Figure 27: Metro ridership and coverage in cities across the world (World Bank)



Source: Slide 394 Prof Khaled El Araby International Symposium February 2013

4.2.5. Freight and Servicing

Data on freight specifically for the GCR was not made available and therefore data for Egypt as a whole is presented as a guide to the current situation in GCR. The freight transport system in Egypt is dominated by road transport with a share of 96%, while opportunities for more energy efficient rail and inland waterway transport are underutilized. This reliance on road freight causes congestion and accidents. Based on available data, the table below shows the increase in road freight since 1992.

Table 8: Increase in road freight since 1992

Mode/ (%)	Year	1992	2002	2005	2006
Road		92.8%	97%	95.4%	95.7%
Rail		5.4%	3%	4 %	3.5%
River		1.5%	0.4%	0.7%	0.8%

Source: Central Agency For Public Organization and Statistics

Table 9:Freight modal splits - comparison with other countries using 2005 data is as follows

Country/Modal split	Road	Rail	River
Egypt	95%	4%	0.7%
Holland	33%	5%	47%
Romania	43.4%	47.4%	9.2%
Poland	55%	44%	1%
Hungary	49.4%	44.4%	6.2%
Bulgaria	43%	52%	5%
Luxemburg	79%	14%	7%
Belgium	73.2%	14.4%	12.4%
France	81%	17%	2.1%
Germany	67%	17.5%	15.5%

Source: Central Agency For Public Organization and Statistics

Table 10:2005 published target goods transport modal shares

Mode	Year (%)			
	2007	2012	2017	2022
Road	93.6%	92.4%	92.1%	93%
Rail	5.2%	5.5%	5.4 %	4.9%
River	1.2%	2.1%	2.5%	2.1%

Source: World Bank 10/11/06 Proposed Urban Transport Strategy

As identified in section 3.4, the IITF March 2015 conference included investment in the following rail freight measures **including Ain Sokhna to Helwan (south of Cairo) Single track freight railway** - Investment in an end-to-end 140km single track rail line connecting Ain Sokhna Port with South Cairo (Helwan). The line would offer a link with the cement industrial zone in the Suez area to serve the local market or to export via Red Sea ports. Funding has been secured for Technical studies. Expected freight demand is 11.7 million tons per annum by 2022. Proposed private sector participation is a Joint Venture with Egyptian National Railways (ENR). Business development model is a Build Operate Transfer scheme for a 25-30 year period. The Freight price structure is to be market-driven and not subject to any government regulation. There is strong government support to develop the railway network (USD 10 billion investment plan for the next 10 years). Ministry of Transport guarantees the provision of rights of way to potential investors. Government policy is to gradually shift the transport of cement and feedstock from roads to cargo rail (freight cargo). It will be the first cargo dedicated line for this purpose. There is a Government commitment to provide all land and permits approvals and apply existing regulations (e.g. limits on truck load). Government will support in the negotiations of off-take agreements with cement manufacturers. Possible interconnection with existing ENR-owned rail lines. There are also potential off take agreements with cement manufacturers. The railway is to become a more competitive transportation mode due to increased local fuel prices and limited driving hours for heavy trucks (ban on daylight transportation is proposed). A potential upside is the possibility to transport petroleum products from Suez port using existing Ain Sokhna / Suez line to Greater Cairo via Helwan.

4.2.6. Road Safety

The road transport death rate in Cairo is very high. Over 1,000 people die each year in motor vehicle accidents in GCR, more than half of them pedestrians, and over 4,000 are injured. Except Teheran, these rates are by far higher than what has been recorded in other mega cities of the world. (Source World Bank 2006). In 2010 there were 7,398 fatal accidents in Egypt (where fatal is defined as died at crash of scene – this definition is different to most developed world countries definition). Of these 74% were male and 26% were female.

More detailed data on accidents specifically for the GCR was not made available and therefore data for Egypt as a whole is presented below as a guide to the current situation in GCR. The fatal rate (per 100,000) between 2001 and 2010 has increased as shown in the figure below:

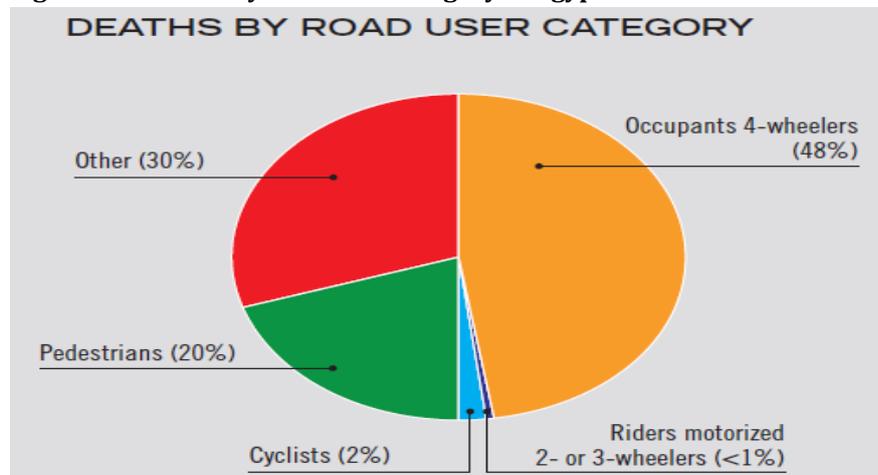
Figure 28: Trends in road traffic deaths in Egypt



Source: Page 105 UN 2010 Road Safety Report with source from Central Agency for Public Mobilisation and Statistics CAPMAS

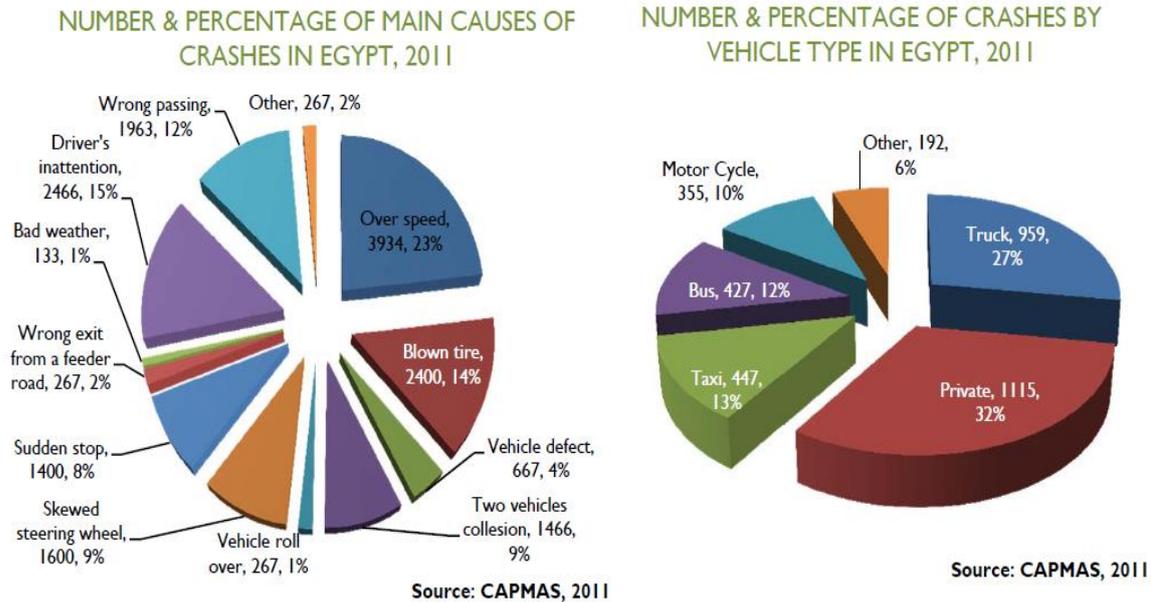
Almost half of those killed in motor vehicle crashes are occupants (passengers and drivers) of four wheeled vehicles although pedestrians make up an additional one-fifth as shown in the figure below:

Figure 29: Deaths by road user category in Egypt



Source: Page 1 WHO Road Safety in 10 countries fact sheet

Fatal accidents in 2011 were marginally lower than 2010 at 7,115 (MOHP, 2011). In addition it is estimated that in total 12,000 Egyptians lose their lives as a result of a road traffic accident with many thousands non fatality injured and some resulting in long term disability.

Figure 30: Road accident data for Egypt 2011

Source: Page 1 of WHO Egypt Road Safety Fact sheet

Data from the RS10 study (see below) indicate that on the Cairo Ring Road:

- Only 16% of drivers and 4% of passengers wear seatbelts.
- 52% of front seat passengers are child passengers, of which only 8% wear seatbelts, 2.5% use child restraint.
- 23% violate the speed limit. The top violators are large trucks, 2nd minibuses, 3rd private vehicles, 4th small trucks and 5th taxis.

The Lead Agency for road safety in Egypt is the National Council for Road Safety but there is no specific funding within the national budget for road safety. Various organizations are also involved in road safety including:

- Ministry of Health
- Traffic Police
- General Authority for Roads, Bridges and Land Transport (GARBLT)
- Egyptian Red Crescent
- Egyptian Society for Road Safety
- Union for Road Traffic Injuries
- Central Agency for Public Mobilization and Statistics (CAPMAS)
- NGOs eg NADA

The national fatality target set for 2011-2020 is 2 to 5% p/a.

In terms of road safety policies/laws it is notable that there are none in force relating to key accident risk factors including:

- New and imported cars requiring front and rear seatbelts – although there is a law requiring wearing of seatbelts in the front only).
- Wearing of motorcycle helmets for riders is in force but not for passengers.
- Child restraints
- Penalty points system for traffic offences. (Source UN)

Although there are laws on speed, blood alcohol concentration for the general population, seat-belt wearing (front) and helmet wearing (driver only), they are poorly enforced.

Unless addressed urgently, road traffic collisions will continue to increase to become one of the top leading causes of death by 2030. The WHO's *Global Status Report on Road Safety* ranked Egypt as a country with one of the highest rates of mortality due to road traffic crashes. In response, WHO Egypt is currently collaborating with national stakeholders for implementing the National Decade of Action for Road Safety 2011-2020 and the Road Safety in 10 Countries (RS10) Project where Egypt is the only country in the region to be included in the project.

The overall objective of the National Decade of Action for Road Safety in Egypt is the reduction of road fatalities injuries and disabilities by 2020. The overall objective of RS10 in Egypt is to support the Egyptian government to implement good practices to reduce deaths and injuries due to road traffic collisions. The project funded by Bloomberg Philanthropists focuses on speeding, and seat-belt wearing in both Greater Cairo "Ring Road", and Alexandria Corniche and Gamal Abdel-Nasser Road.

Key achievements so far of the RS10 project are:

- Formation of multi-sectoral working group with high level coordination and collaboration, and revitalizing the role of the National Road Safety Council as the national body for coordination of road safety activities.
- Procurement and installation of 24 speed and left-lane cameras in the Ring Road. This is the first time to install these cameras in the Middle East, with complete automation of the violation from offence to court ruling.
- Building capacity with MOHP and WHO HQ HMN (Health Metrics Network) to develop injury surveillance and vital registration systems and crash data reporting systems
- Conducted observational studies in Greater Cairo and Alexandria governorates on speed and seatbelt
- Development of social marketing and communication strategies and currently developing media campaigns.

Challenges include:

- Delays of implementation given country's political situation, especially in enforcement of road safety legislation.
- Frequent changes in leadership of main stakeholders particularly in the Ministry of Interior and MOHP.
- Communication with partners, particularly consortium partners, attributed to lack of resident representatives.

Activities to be implemented and future plans include:

- Revisions of existing road safety legislation are currently in progress and are led by National Road Safety Council.
- Enhancing enforcement of road safety legislation through speed cameras.
- Implement a targeted, visible and monitored public awareness campaign.
- Engage NGOs to advocate for the priority legislation changes.
- Continue to improve injury and fatality data systems.
- Monitor and evaluate impact of interventions.

Lessons learnt include:

- The importance and value of engaging with multiple stakeholders.
- Addressing issues through collaborative and interactive measures.
- Establishing national ownership and responsibility for problems enhances sustainable solutions.
- Perseverance for implementation despite difficult situations is vital

4.2.7. Institutions and organizational structure

4.2.7.1. GCTRA

This was set up circa 1 year ago and is responsible for:

- Transport Policy and Strategy.
- Bus concessions.
- Safety and quality.
- Parking.
- Taxis.
- Micro bus

Board Members consist of:

- The 3 Governates – Cairo, Giza and Qalyubia.
- Ministry of Housing.
- Ministry of Interior.
- Ministry of Environment.
- 3 local Egyptian experts.

GCTRA planned work activities include:

- Enforcement - to work with Ministry of Interior.
- Capacity Building within Ministries – this needs to be done an example was given of the lack of design knowledge of facilities for disabled people.
- Campaigns e.g. on Safety and a proposed campaign (awaiting President's endorsement) focused on 1 to 1 road safety activities.

Although in its early days this was considered by all met to be a positive step forward.

4.2.7.2. Integration of various authorities

It was clear from those met that up until the recent setting up of GCTRA very little cooperation took place with regard to the planning and implementation of transport projects in GCR. However, even with the existence of the GCTRA there are still a multitude of differing organizations involved with transport in GCR.

4.2.7.3. Institutional capacity building

It was clear from those met that training of staff and retaining staff is a key issue in the various organizations. The need for experts to be involved in projects was also made clear.

4.2.8. Urban transport infrastructure financing

Many of those met expressed the optimism with the Egyptian economy and political situation and this is reflected by the March 2015 Invest In The Future (IITF) conference and both the Government and overseas investment in major infrastructure projects. It is also apparent that the Government have changed/amended legislation to assist international investment and procurement routes. However, key issues arising from March Conference were:

- No feasibility studies carried out on projects - problem facing investors is that they don't have confidence in the schemes if no feasibility study work is available.
- No defined bidding process/procurement route – Direct Order, PPP, BOT? Need to know bidding process and Technical conditions.
- No calibre of staff within the Government to manage the projects – use local external experts due to insufficient funds for international experts.

- No vision - Other projects were released at the Conference without any concrete strategy – need a published strategy for investors.

A number of potential barriers to Investment were identified during the meetings including:

- Bureaucracy – the MoI are trying to address this by acting as the Investors Agent.
- Licensing issues.
- Procedural issues – these need to be simplified by for example:
 - Create a new regulatory framework and enable one authority to take the lead on a project and give them a role as a partner and not just the regulator.
 - Give the lead authority a share in the project - up to a maximum of 20% to 24%. MoH have a revenue sharing mechanism in place for the projects they lead on.
 - 6th of October City Dry Port is PPP. Other projects will be direct bidding - could have limited number of invited tenderers.

4.2.9. Health

Air and noise pollution: Mobile source air pollution in Cairo is serious both with regard to particulate matter as well as noxious chemicals. Noise levels are high and aggravated by very old large proportion of the car and taxi fleet. Vehicle inspections that should limit exhaust gas pollution are mostly ineffective. (Source World bank 2006).

Physical Activity: There are no NMT policies in place in Cairo, little if no specific provision for pedestrians and cyclists and the accident rate for pedestrians is very high. Despite this walking levels in Cairo are very high. From the site visits cycle use is almost non-existent.

4.2.10. Climate Change

The transport sector is responsible for about 28 % of the final energy consumption in Egypt and 25 % of energy related CO₂ emissions, and is the fastest growing source of CO₂ emissions in the country. The total amount of GHG emissions from the transport sector in Egypt is estimated at 29 million tons of CO₂ (UNDP Sustainable Transport Project for Egypt).

4.2.11. Social exclusion

4.2.11.1. Ageing population

To date, there was no data available about the mobility pattern of this group nor was this specifically accounted in for in the earlier Transport master plans which can explain the absence of special policies and facilities for this group in the transport sector. From the site observations and meetings no specific provision has been made for older people/disabled people. It is understood that the new Metro line construction includes for specific disabled people, provision (eg ramps, lifts etc). However, the existing Metro system has no provision and as such the new provision does little to allow disabled people to access the city centre. From the meetings there is also an issue regarding institutional capacity building on this particular issue.

4.2.11.2. Gender

No specific data was made available on travel patterns for males and females. Given the double burden of earning a living and caring for the family, the time and reliability of transport systems is very important to women. Sexual harassment of women on public transport systems was raised by those met but no data is available to substantiate this. On the public transport systems no special compartments for women are provided.

4.2.11.3. Urban poor

CTA old buses cost 1EGP to use, CTA new buses cost 2 EGP, the Metro costs 1 EGP anywhere (although during the meetings it was suggested that a zoning system could be introduced to increase revenue). National policy is now to increase gasoline prices from the current 11EGP (£0.9)/litre. Price is a key issue for truck and taxi drivers but for many others is not an issue at the moment.

Affordability is the ability to use public transport without significantly affecting the capacity to make other expenditures of importance under normal living conditions. By keeping all its public transport fares very low, Cairo has been one of the most successful cities in making its public transport services affordable, but this has come at a high cost in terms of subsidies, transportation time, pollution and lack of investment in improved services. It is now questionable whether keeping all fares low but enduring the consequences of poor quality and inadequate quantity is the best way of making services affordable to low income groups. Inadequate and congested urban transport is damaging to the city economy and harms both rich and poor. But the simplistic solution of controlling fares at low levels for all passengers, is inequitable because it leads to a progressive decline in the quality and quantity of all public transport services and ineffective because it will tend to generate more congesting car traffic. Rather the objective of making public transport affordable can be achieved by a more poverty focused policy.

4.2.12. Human dimension

Many experts argue the existence of informal settlements and modern cities reflect spatial segregation and socio-economic disparities. The poor are excluded by commercial concerns, which shows that human dimension is neglected in urban planning and transport policies. If the residents of those informal settlements had direct access to a reliable and modern public transport system they would not be dependent on for example micro buses the streets would have less motorized traffic which eventually could create a more liveable place to live for the residents. Lack of safe and direct walking routes between places where people live and where they need to work, shop etc create a clear physical segregation between low-income and high-income areas. The consequences are increased income equality, higher rates of unemployment and poor health services due to lack of access to job networks and transportation.

4.2.13. General conditions and problems observed

Detailed site visits were carried out between 18/5/15 to 21/5/15 – photographs were taken and the key conditions observed included

Chronic Traffic Congestion - throughout much of the day:

Lack of/poor facilities for pedestrians– examples are shown in the figures below:

Figure 31: Pedestrians have no crossing facilities provided on very wide roads



Source: Consultant

Figure 32: Cairo informal shared space



Source: Consultant

Mix of uses and vehicles on the roads – examples are provided on the figures below:

Figure 33: Children street sellers on the expressway



Source: Consultant

Figure 34: Donkey and Horse drawn vehicles



Source: Consultant

Figure 35: Hand drawn deliveries



Source: Consultant

Poor Driving standards/unsafe driving practices – as shown in the figures below:

Figure 36: Overloaded vehicles



Source: Consultant

Figure 37: Motorcyclists without helmets



Source: Consultant

Poor facilities for disabled people– as shown on the photograph below:

Figure 38: No dropped kerbs/ramps for disabled people to cross the roads



Source: Consultant

Poor quality of buses - as shown on the photograph below:

Figure 39: poor quality micro bus



Source: Consultant

Poor condition of bus stops - as shown on the photograph below:

Figure 40: Bus stops and bus stations of poor quality – CTA bus stop



Source: Consultant

Lack of parking control - as shown on the photograph below:

Figure 41: No Parking Controls



Source: Consultant

Poor maintenance of roads- as shown on the photograph below:

Figure 42: Road Conditions poor



Source: Consultant

Few examples of good quality public realm – good examples include:

Figure 43: Example of public square outside downtown train station.



Source: Consultant

Figure 44: Example shaded pedestrian route alongside the river



Source: Consultant

Smog in the city - as shown on the photograph below:

Figure 45: Smog



Source: Consultant

Media Coverage

During the study visit press coverage was noted on for example:

- A Fuel Smart Card (Consumption-Rationalisation measure) to be implemented by the Government on 15/6/15 primarily as a way of dealing with the black market in fuel. The Government also hoped that the measure would result in a reduction in fuel consumption and on money spent by Government on fuel subsidies (which currently equates to 13% of the state budget which in 2013/14 was 2071 billion EGP and hence circa 269 billion EGP is spent on fuel subsidies).

- Based on polls 67% of citizens believed that the situation in Egypt is moving in the right direction as a result of the March 2015 IITF conference, restoration of security and counter terrorism efforts.

4.2.14. Planning documents currently adopted by Cairo

It wasn't clear from those met whether there was in existence an approved Transport Masterplan for GCR and how this fits into the overall National Plan. In terms of the future it is clear that the strategy is to attract people away from Cairo, in particular to the triangle to the East of New Cairo/New Capital/Suez region which will have greater population in 30 to 40 years. As such this area will grow in a planned way. It was understood from the meetings that permanent committees have been built for planning/industry/commercial/transport/public engagement/safety/environment/slums and they are working together to:

- Produce Concept Plan for next 40 to 50 years.
- Masterplan for next 10 to 15 years.
- Immediate 5 year plan.

The MoH have an (unapproved) transport masterplan for Greater Cairo which includes connections to east of Cairo (New Cairo and New administration capital) upto Suez Canal and they have asked European Bank for assistance with the new masterplan. MoH have as yet to masterplan the area East of Cairo from the ring road to Suez Canal as well develop Metro/tram/BRT/monorail linkages east to for example 6th of October City and Cairo University (36 km away).

4.2.14.1. National, Urban and Transport Strategies adopted for Cairo

The 2008 Strategic Masterplan for Greater Cairo completed by JICA was the last study carried out for Greater Cairo and those met during the study visit considered that this needs to be updated. As such there is no overarching approved transport masterplan for GCR.

There are no national policies to promote walking or cycling throughout Egypt.

To address the transportation problems facing Cairo, government authorities have embarked on an ambitious new infrastructure spend program e.g. with the expansion of the metro system. However, until very recently little has been done to deal with operational, institutional or financing problems.

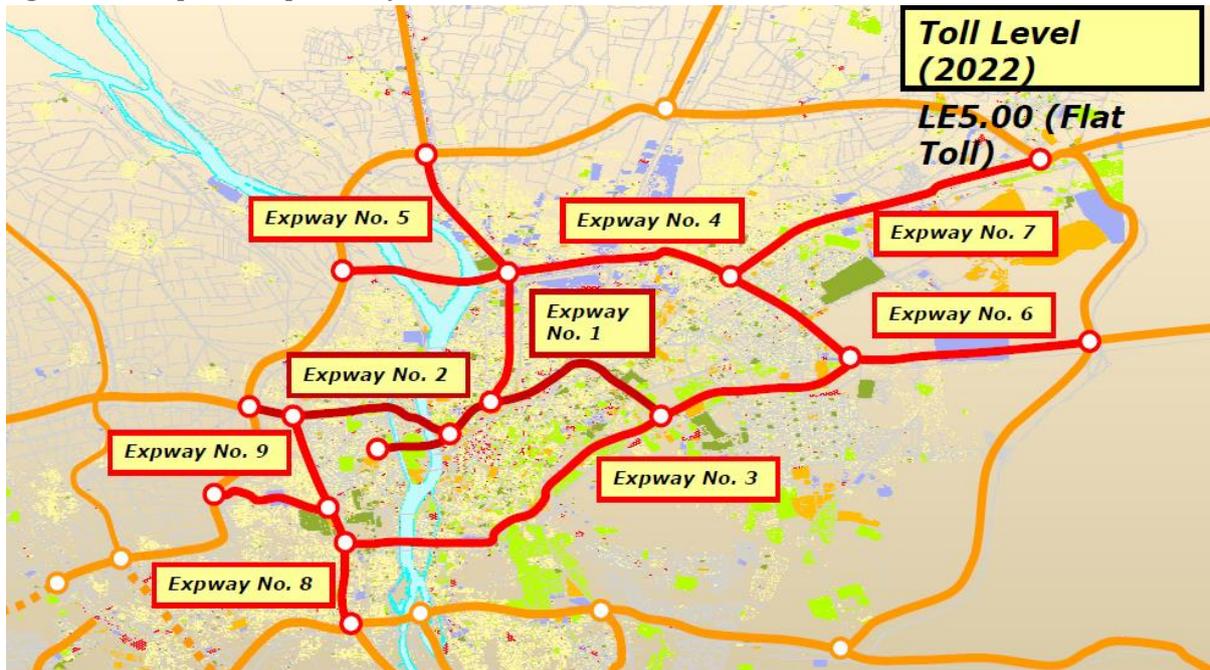
Previous transport masterplan studies include:

4.2.14.2. 2002 Urban Transportation Master Plan (TMP) - CREATS

This document was never formally adopted as the urban transport strategy of the Government of Egypt or of the three Governorates responsible for urban transport in the metropolitan area of Cairo. The Urban Master Plan envisioned Greater Cairo (GC) as a polynuclear metropolis, with transport costs minimized by the development of new commercial centres closer to residential suburbs and with a major services centre to the east of the metropolis, and new residential "settlements," construction of metro and regional rail lines, expansion of the tramway network to Giza, and construction of a new ring road.

In the period up to 2000, the population of GC increased by "only" 5 million rather than the 7 million projected in the 1982 Urban Master Plan, as there was a simultaneous reduction in birth rates and migration away from the metropolis. However, the Central Business District (CBD) of Cairo grew much faster than expected and overflowed to the west bank of the Nile, and the concept of a new services centre to the east of Cairo was abandoned. There a continued and largely uncontrolled expansion of lower class housing along the edges of the city, instead of the creation of new residential settlements. New towns were belatedly created, but had populations of about 250,000 instead of the almost 3 million projected. Given the absence of rapid and affordable public transport, these towns attracted relatively wealthy residents who had cars. The first metro line was built as proposed, and eventually the new ring road was also built. Few of the other components of the Plan were implemented.

Figure 46: Proposed expressway network

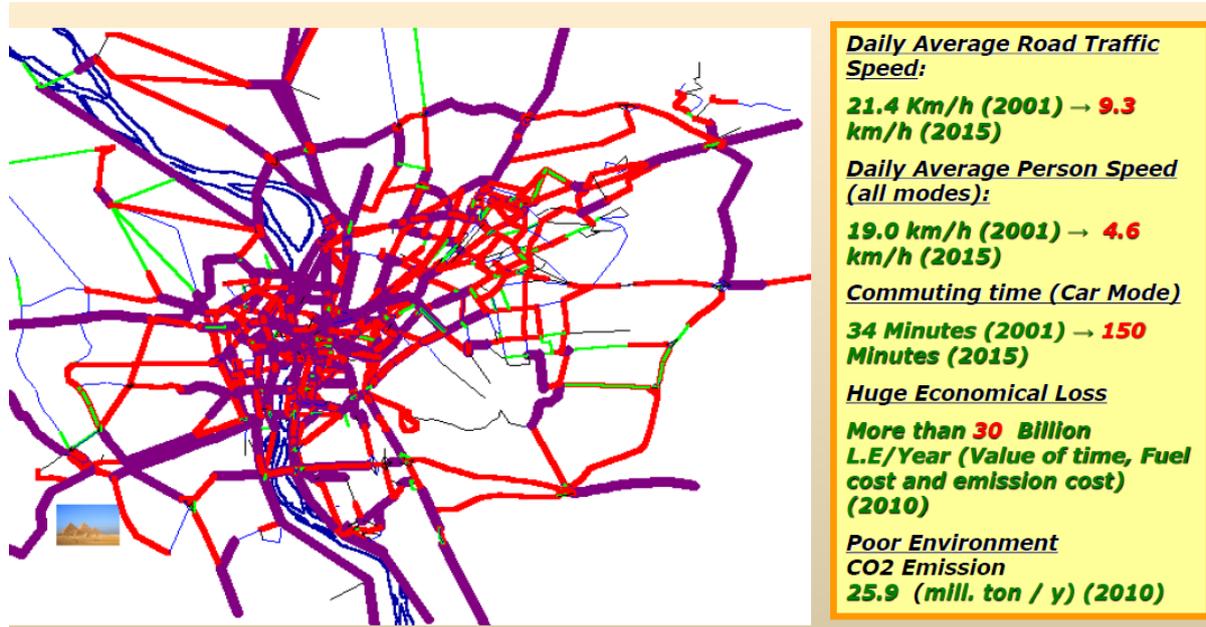


Source: Slide 54 Prof Khaled El Araby International Symposium February 2013

CREATS used a transport model - key issues from this model were:

- A TRIPS transport model was built for this.
- In 2002 average travel speed was 18 kph.
- Target year was 2022.
- Tested various scenarios (Do Nothing, Do All proposed transport measures (eg completion of all Metro lines, Urban Expressway construction, new flyovers at congested points) and then Scenarios A, B and C as options. If all projects were implemented then the target was to maintain the 2002 average speed by 2022.
- However, based on Al Azhar University recent surveys the 2015 average speed is less than 10Kph.

Figure 47: What will happen in 2015? “Do Nothing” Situation



Source: Slide 40 Prof Khaled El Araby International Symposium February 2013

4.2.14.3. 2006 Greater Cairo Urban Transport Strategy (World Bank)

Key recommendations from this study included:

- Developing and sustaining urban transportation institutions.
- Setting Decision Making Process for Selecting Priority Investments in line with realistic funding capacity in the urban transport Sector.
- Sustainable financing of urban public transport system: greater reliance on user-charges
- More efficient organization and operation of public transport services

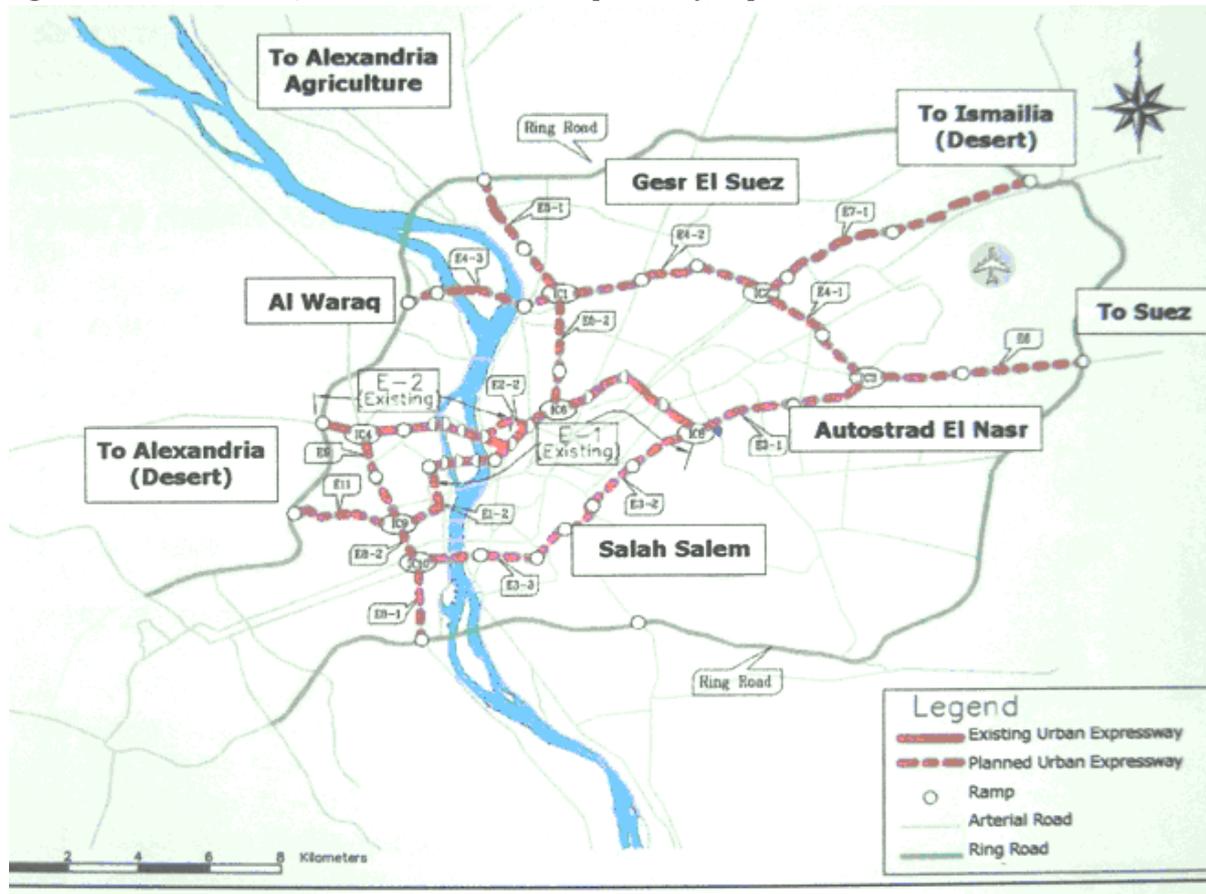
- Modernized Effective Traffic management system and Application of proactive travel demand management techniques.
- Enhanced institutional set up for stricter enforcement of traffic rules.

4.2.14.4. 2005 and 2008 Expressway studies

- 2005 PPP Study.
- 2008 Feasibility study.
- Study carried out by Pacific Consultants (now called Oriental) who built a new model called STRIC).

An extract form the JICA Cairo Urban Toll Expressway Report is shown below:

Figure 48: Extract from JICA Cairo Urban Toll Expressway Report



Source: Consultant

4.2.14.5. 2006 East of Mediterranean Sea study

- Carried out by MoT.
- Considered logistics centres/dry ports/multi modal interchange.
- Dry Port at 10th of Ramadan City proposed to link to Suez and at 6th of October City to link to Sokhna Port.
- Rail links also studied.

4.2.14.6. Cairo Vision 2050/52

Developed by General Organization for Physical Planning/MoH in 2008 and tied up with the 5 year plans (issued 2007 and 2012).

4.2.14.7. World Bank/JICA Cairo Congestion Study 2008

- PPP STRICA transport model used (since no one had access to the TRIPS 2002 CREATS model).
- Estimated travel speeds and delays.

This is the last Transport master Plan approved for Cairo but all those met agreed that this is now out of date and other studies are ongoing but are not approved.

4.2.14.8. Egypt Master Plan 2012 (MINITS)

- CUBE transport model built - was an EU capacity building programme within this study with training provided to staff at Transport Planning Authority – but these have now left.
- Covered rail, roads and marine modes.

- This considered Western Desert Corridor to Connect Alexandria to 6th of October City and a Logistics centre at 6th October of City – however a Potential Ministry of Defence conflict with regard to security issues re Sinai/Israel border.
- With the now proposed Suez proposals from the March 2015 IITF conference this study is now out of date.

4.2.14.9. World Bank Bus project - underway

- World Bank loan to buy new buses and build new bus lanes.
- 40 to 50 km long sections considered in 6 corridors.

4.2.14.10. World Bank Rail study – underway

- New locomotives and rolling stock.

4.2.14.11. Egypt Economic Development Conference (EEDC) March 2015 - Invest In The Future (IITF)

At this Conference 55 projects in the Agriculture, Housing and Utilities, Industry and manufacturing, ICT, oil, gas and Mining, Tourism Transport and Retail sectors were presented to investors. In terms of those potentially impacting on transport conditions in Greater Cairo these include:

Transport Projects

The Cairo Airport City project (“CAC”) aims at positioning Cairo as the centre of the region through a series of logistical, retail, and recreational developments including:

- Aerocity: this will be CAC’s commercial / leisure heart, and will include retail and office spaces, along with an entertainment area – this is the first project and will be a Design Build Operate and Transfer project.
- Exhibition City: a world-class exhibition centre that will host a wide range of international events
- Cargo City: will become the core distribution centre for goods and freight from Cairo international airport to Egypt’s major ports, railways and roads
- Free Trade Zone: a specialized logistics hub to complement cargo operations, with the development of specialized industries
- Airport Core: urban development’s to accommodate Cairo and CAC business / leisure visitors

Close proximity to city centre and easy access to airport terminals was sold as an advantage of Aerocity - but it can be questioned whether there is sufficient capacity in the existing and proposed transport network to accommodate this.

Nile River Bus Ferry aims at improving the Nile river bus transportation services through additional terminals and boats and better quality of services (reduced trip time and pollution) - - currently a high degree of deterioration with only 12 boats operating and outdated terminals. The project will extend existing trip routes and improve operational efficiency. Pre-feasibility studies have been carried out using EBRD funding which identified the need for 41 new boats, upgrade of 16 existing terminals and provision of 12 new terminals. The private sector will design, build and operate the Nile River Bus Ferry system, maintain the fleet and terminals through a PPP contract. Private sector remuneration (open to negotiation): fare prices, rights over commercial facilities to be developed around terminals. General Transportation Authorization in Cairo / Cairo Governorate with the collaboration of the PPP Unit will issue required licenses, provide access to existing lines and terminals.

Ain Sokhna to Helwan (south of Cairo) Single track freight railway - Investment in an end-to-end 140km single track rail line connecting Ain Sokhna Port with South Cairo (Helwan). The line would offer a link with the cement industrial zone in the Suez area to serve the local market or to export via Red Sea ports. Funding has been secured for Technical studies. ☑Expected freight demand is 11.7 million tons per annum by 2022. Proposed private sector participation is a Joint Venture with Egyptian National Railways (ENR). ☑Business development model is a Build Operate Transfer scheme for a 25-

30 year period. The Freight price structure is to be market-driven and not subject to any government regulation. There is strong government support to develop the railway network (USD 10 billion investment plan for the next 10 years). Ministry of Transport guarantees the provision of rights of way to potential investors. Government policy is to gradually shift the transport of cement and feedstock from roads to cargo rail (freight cargo). It will be the first cargo dedicated line for this purpose. There is a Government commitment to provide all land and permits approvals and apply existing regulations (e.g. limits on truck load). Government will support in the negotiations of off-take agreements with cement manufacturers. Possible interconnection with existing ENR-owned rail lines. There are also potential off take agreements with cement manufacturers. The railway is to become a more competitive transportation mode due to increased local fuel prices and limited driving hours for heavy trucks (ban on daylight transportation is proposed). A potential upside is the possibility to transport petroleum products from Suez port using existing Ain Sokhna / Suez line to Greater Cairo via Helwan.

6th October Dry Port - Located 40 km west of Cairo, 15 km from 6th of October industrial zone, adjacent to the 6th of October airport. Regulatory Body is the General Authority for Land and Dry Ports (GALDP) and the Preliminary feasibility study is complete with technical studies EBRD financed. The Business development model is a revenue sharing agreement with the Government and land lease for a 25-30 year period. Pricing will be market-driven and not subject to any government regulation. There is strong government support to develop the railway network (USD 10 billion investment plan for the next 10 years), Government commitment to provide all land (secured) and permits approvals and apply existing regulations, Preliminary protocols signed with the customs and railway authorities and with the GALDP for import and export controls.

LRT Ramses Square to Alf Maskan - Total distance of 13 km with 16 stations to be developed by revamping the existing tram line. Potential extension to Sheraton Houses near Cairo Airport. Interconnections with Metro lines 1, 2 and 3. Expected to be 180,000 passengers daily by 2027. The business development model is a Design Build Operate Transfer scheme for a 25-30 year period. Pricing will be market-driven without any government regulation. Pre-feasibility and technical studies are not yet complete. There is strong government support to develop urban transportation modes to address congestion issue. The route over existing tram line and depot location exists, All administrative approvals are already secured (including rights of way). There is increasing demand for urban transportation in Cairo due to limited existing mass transport infrastructure and rising domestic fuel prices. Demand for urban transport anticipated to reach 25 million trips per day by 2022.

BRT linking New Cairo and Rehab to Nasr City Autostrade - This is expected to handle 344,700 trips daily by 2022, and is a dual track fully segregated bus line with feeder minibuses, Distance of 31.8 km with 39 stations. The scheme provides interconnection with Metro lines 3, 4, and 10th of Ramadan LRT to be extended on Cairo-Suez road heading to prospective new governmental capital. To be developed under a Design Build Operate Transfer scheme for a 25-30 year period. Pricing will be market-driven without any government regulation - Preliminary technical studies are ongoing.

Housing projects (it should be noted that all but one of the projects are within Greater Cairo) these are promoted in recognition of need for urban expansion and decentralisation away from the congested city centre

- West Cairo City centre projects – 30,000 inhabitants plus commercial and services.
- 6th of October Oasis Mega Urban Development Project -Land owned by New Urban Communities Authority (NUCA).
- 6th of October Urban Oasis - Mixed use (housing, administrative, tourist, sports and recreation) development on land owned by NUCA.
- Marabet Equestrian and sports facilities complex - 6th of October City on land owned by NUCA consisting of villas, townhouses, horse race track, and hotel and relocated horse farm.
- Zayed Ysrtral Spark - 6th of October city on land owned by NUCA consisting of 60 floor iconic tower, mall, office park, residential units.

- Zayed Central Park - In heart of Zayed city on land owned by NUCA consisting of residential, commercial, retail, hotel, conference centre and spa.
- Sheik Zayed Integrated Residential Project within 6th of October City on land owned by NUCA consisting of residential and commercial.
- 10th of Ramadan Knowledge Village on land owned by NUCA consisting of Integrated knowledge complex encompassing a university, schools, workshops, administrative buildings and residential units.
- Mokattam Residential and Commercial Complex adjacent to Cairo Autostrade consisting of residential units, mixed use, Mall and hotel.
- Al Ismaelia Urban Revitalisation Project – Downtown Cairo.

ICT projects include:

- Maadi Technology Park - started in 2010 and completion expected 2017
- 10th of Ramadan City Tech and Science Park

Tourism projects include:

- 6th of October Touristic City in the vicinity of the Great Pyramids of Giza including commercial, administrative, cultural, sports, hospitalities, hotels and aquarium.

Also announced at the EEDC was new Capital City/Administration Capital – however we understand that progress on this has stalled subject to Government discussions with UAE investors.

In addition to various deals and MOU's between Egypt Government and private sector \$12.5bn in pledges was obtained from KSA, UAE, Kuwait and Oman.

No available information was provided in this document on whether the existing and proposed transport infrastructure has the capacity to support this level of development.

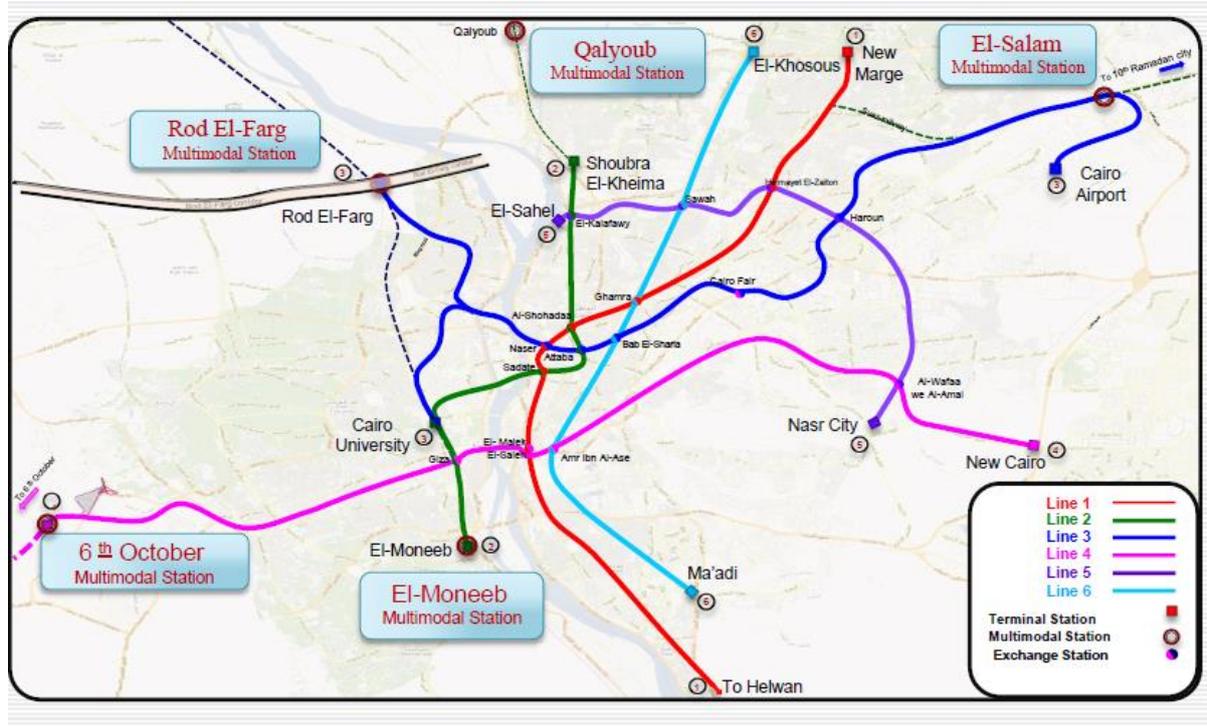
Investment Reforms

During 2014/15 various economic and fiscal reforms have been carried out/proposed by the Egyptian Government to restore confidence in the Egyptian economy locally, regionally and internationally and remove impediments to investments

Based on a review of the Plans and based on discussions with the various ministries, a summary of other current proposed planning and Transport investment in GCR includes:

Metros and Tunnels - The National Authority for Tunnels (NAT) was established in the early 1980s to deliver the first Cairo metro line. NAT's remit includes conducting technical studies of tunnels and underground projects; construction of tunnels and underground projects; and handing over the projects to the relevant authorities for operation. NAT has successfully delivered Cairo Metro Line 1 (capacity 2 million passenger/day); Cairo Metro Line 2 (capacity 1.76 million passenger/day); Al-Azhar Road Tunnel (2.65 km twin tunnels; 65,000 cars per day); and phases 1 and 2 of Cairo Metro Line 3. Since 1983 circa 83km of metro network has been completed in GCR. NAT has ambitious plans to push forward with an impressive portfolio of projects. Unlike the case with all delivered metro lines to date, where different phases of each metro line were delivered sequentially (eg phase 1 of Cairo Metro Line 2 was delivered in 1996; while phase 5 was delivered nine years later in 2005), NAT plans to go ahead with phases 3 and 4 of Cairo Metro Line 3 (CML3) in parallel (see figures below):

Figure 49: Greater Cairo Metro lines



Greater Cairo Metro lines According to the Transport Studies (Systra 1998-2000), (JICA 2000-2002) & Ministry of Housing 2010

Source: British Expertise Egypt in Transition Spring 2015

Metro Lines Intersection Stations

	Line 1	Line 2	Line 3	Line 4	Line 5	Line 6
Line 1		• Al-Shohada'a • El Sadat	• Nasser	• El Malek El Saleh	• Helmeyet El-Zaiton	• Ghamra
Line 2	• Al-Shohada'a • El Sadat		• Attaba • Cairo University	• Giza	• El - Khalafawy	
Line 3	• Nasser	• Attaba • Cairo University		• Cairo Fair	• Haroun	• Bab El-Shaaria
Line 4	• El Malek El Saleh	• Giza	• Cairo Fair		• El-Wafaa we Al-Amal	• Amr Ibn Al-Ase
Line 5	• Helmeyet El-Zaiton	• El - Khalafawy	• Haroun	• El-Wafaa we Al-Amal		• El- Sawah
Line 6	• Ghamra		• Bab El-Shaaria	• Amr Ibn Al-Ase	• El- Sawah	

Phase 3 of Line 3

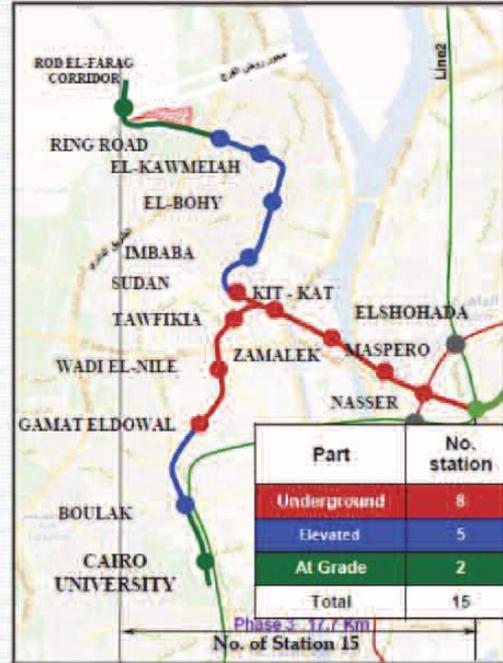
(Attaba / El Kit Kat & El Kit Kat / Imbaba & El Kit Kat / Cairo university)

Phase 3 consists of **(15)** stations with a total length of **17.7 km**.
Split as follows

Phase 3A : with a length of **4 km** and extends from Attaba to Kit Kat sation and includes **4 underground stations** "Nasser - Maspero - Zamalek - Kit Kat."

Phase 3B : with a total length of **6.6 km**
(1) Underground station (Sudan station), **(1)** At grade stations (Rod El Farag Corridor station), and **(4)** Elevated stations (Imbaba, El Bohy, El Qawmia El Arabia and Ring Road stations)

Phase 3C : with a total length of **7.2 Km**,
(3) Underground stations (Tawfikia, Wadi El Nile, and Gameat El Dwal Al Arabia stations), **(1)** At grade station (Boulak El Dakroul station), and **(1)** Elevated station (Cairo University station)



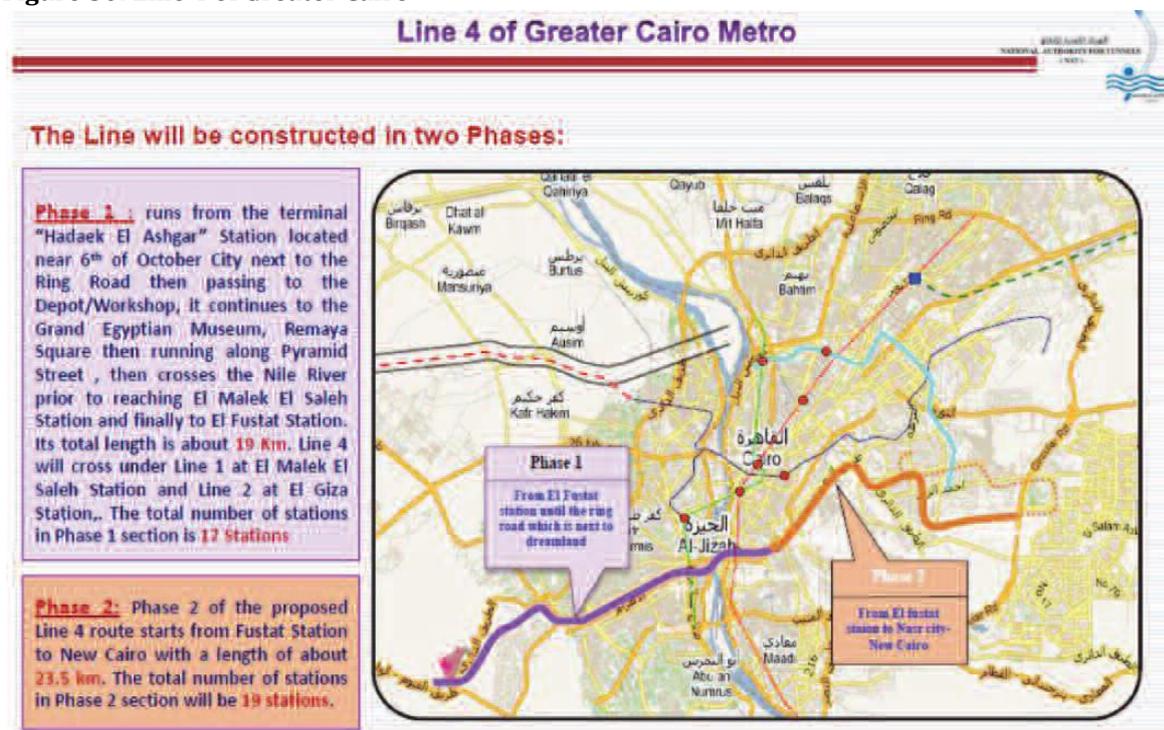
GREATER CAIRO METRO LINE No. 3 (AL THAWRA LINE) - PHASE 4



Phase 4 consists of 16 stations "Haroun – Heliopolis Square -Alf Maskan - El Shams club- El Nozhah.1 – Nozhah.2- Qobaa – Omar Ibn ELKhattab - El Salam "10th of Ramadan"- Cairo International Airport" with a total length of about 18.17 km

Phase 3 of CML3 will serve central and western Cairo, while phase 4 will connect Cairo International Airport to the capital's growing metro network. NAT commenced work on both phases 3 and 4 in 2015, and to deliver both within three years. The French company Vinci signed a contract for the underground stations for phase 4 of CML3; while the local and capable Orascom and The Arab Contractors signed contracts for the five surface stations. EIB contributed €600 million and the French Development Agency (AFD) donated €300 million for CML3, and the Egyptian treasury has recently approved circa US\$ 1 billion for rolling stock. In November 2014, NAT shortlisted 3 bidders for technical supervision services for phase 3 of CML3. Cairo Metro Line 4 (CML4) is expected to commence in 2015. Notably, CML4 will connect the new Grand Egyptian Museum and the Giza Pyramids plateau to the metro network. Japan International Cooperation Agency (JICA) is providing US\$1.2 billion loan towards the design and construction of this metro line, representing circa 50% of total cost. The Egyptian government will cover the remaining 50%.

Figure 50: Line 4 of Greater Cairo



Source: Page 11 British Expertise Egypt in Transition Spring 2015

The future projects for NAT include Cairo Metro Lines 5 and 6. CML5 is expected to run for 24 km and include 17 underground stations. Technical and feasibility studies for CML5 are expected to cost EGP 80 billion (£7 million), while the construction cost is expected to reach EGP 14 billion (£1.23 billion). CML6 is expected to run for 30 km and include 24 stations, 20 of which are underground. The studies for CML6 are expected to cost EGP 100 million (£8.8 million), while construction estimates stand at EGP 20 billion (£1.76 billion).

MoH have a proposal for a monorail from 6th of October City to Downtown Cairo.

Roads - The government estimates that US\$ 8 billion is needed to upgrade roads over the coming five to ten years. The government has started by allocating over US\$ 1 billion to upgrade the road network, and is adding 3,000km to the road network.

Railways - Egyptian railways date back to the mid-19th century. The railway network is crucial for economic growth but suffers from severe lack of investment. During the Euromoney Egypt Conference in September 2014, the co-chairman of the Egyptian National Railways (ENR) announced a US\$ 10

billion investment over 10 years to upgrade and maintain the antiquated railways network; with US\$ 2.2 billion coming from the World Bank. The investment will upgrade the rolling stock, rail infrastructure, as well as training and knowledge transfer. Egypt has ambitious plans to expand and upgrade its rail network. There are plans to connect Luxor and Hurghada by a railway line, and to build light rail to connect Cairo with its two main satellite cities: 6th October in the west and New Cairo in the east. However, the most notable railway project is the High Speed Rail (HSR) from Alexandria to Aswan. HSR is a new railway alignment dedicated for the high speed train between Alexandria and Aswan through Cairo, Assiut and Luxor. The line is planned to be built in 3 phases:

Phase 1: Cairo – Alexandria - A pre-feasibility study has been conducted by an Italian company, and indicated the following key parameters:

- Line length: 202 km
- The running speed: 300-350km/h
- Execution duration: 5 years
- Trip time: 60 minutes non-stop
- Expected passengers: from 10 to 18 million/year
- Capex estimate: US\$ 3.5 billion

Phase 2: Cairo – Luxor - The development of the tender document and TOR for the feasibility study is ongoing. The basic data of the line are:

- Line length: 680 km
- The running speed: 300-350 km/h
- Execution duration: 8 years
- Expected passengers: from 25 to 30 million/year

Phase 3: Luxor – Aswan - The development of the tender document and TOR for the feasibility study is ongoing. The basic data of the line are:

- Line length: 210 km
- The running speed: 300 -350km/h
- Expected passengers: from 25 to 30 million/year

Land use developments - Through the meetings and review of available reports it is clear that the intention is to relocate growth outside of Cairo not to extend the Greater Cairo boundary. This will be achieved by:

- New Cities - Existing (eg 6th of October, New Cairo) and proposed (eg New Administration Capital).
- New Housing (eg at Mivida, Uptown Cairo)
- New Industrial cities (eg 10th of Ramadan City which is the largest industrial zone in Egypt located 25Km from the airport).
- Aerocity proposal
- Suez proposals

Housing - There is shortage of housing particularly in the low and middle income housing market. The government announced a deal with the UAE developers Arabtec to build one million housing units, to address the chronic shortage in the low and middle income housing markets. The one million housing units will be built on 13 plots currently owned by the Egyptian Armed Forces. Among the main players in the high income housing market is the UAE developer Emaar. Emaar has three main projects in Egypt: Mivida in east Cairo, Uptown Cairo in central Cairo and Marassi on the Mediterranean coast. Emaar are looking to develop seven hotels in the Marassi project and seven high rise buildings (22 storey) in the Uptown Cairo project. Mostakbal City ('Future City') is the flagship and largest planned mixed use development in Egypt's New Cairo City. An urban community will be developed on an area of 11,000 acres, integrating residential, commercial, education, recreation, retail, and business facilities and communities. The project benefits from an advantageous location

with easy access to the Cairo-Suez motorway as well as to several key development projects and urban communities in east and north-east of Greater Cairo, including El Rehab, New Heliopolis, El Shorouk, Madinaty, Mivida and Barwa. The project is also close the new campus of the American University in Cairo, as well as the German, French and British universities in east Cairo.

Suez Canal - The aim of this project is to transform the Suez Canal region into a global hub and to ensure the long term growth of the Egyptian economy. The development of the Suez Canal region lies at the heart of Egypt's ambitious development programme, and is expected to serve as the main stimulus and engine for growth and employment.

4.2.15. Discussion of current situation and critical issues for success

4.2.15.1. Introduction

The situation has now been reached in which there is no simple solution to the wide range of urban transport problems. While addressing any one of them will bring about significant and observable improvements, the full benefits of any particular measure will not be realised unless other parallel measures are also implemented. Therefore, a holistic strategy comprising many inter-related and mutually supporting measures is now required.

Transport planning in Cairo needs to move away from a Spontaneous system to a planned system. This needs to reflect the positive aspects of Cairo including

- Economic/Business activity.
- Education, tourism and health centre.
- Urban '*buzz*'.
- Global linkages.

However, the planned transport system needs to address the negative aspects within Cairo including:

- Chronic Transport problems.
- Quality of Life: Egypt ranks 80 on the Quality of Life Index (EIU, 2007).
- Cairo although a Megacity is not a Global city (UN, 2002).

In doing so transport planning in Cairo needs to address the pitfalls that have taken place in Cairo in the past including:

- Pre-occupation with 'modern' car-based suburban living in new towns resulting from a biased transport policy where for example 11% of households own a car but cars make up 67% of total urban road traffic on average.
- Only 4% to 5% of population live in new towns.
- No public transport priority schemes exist.
- Lack of effective traffic management.
- No serious measures for restricting car movement.

There have been some successful projects implemented in Cairo. For example the 2009 GOPP report identified the success of a pedestrianisation and traffic diversion scheme in the historical area of Cairo at Al Muizz Street. The UNDP Sustainable Transport Project for Egypt has also been responsible for implementing Pilot Sustainable Transport improvements including:

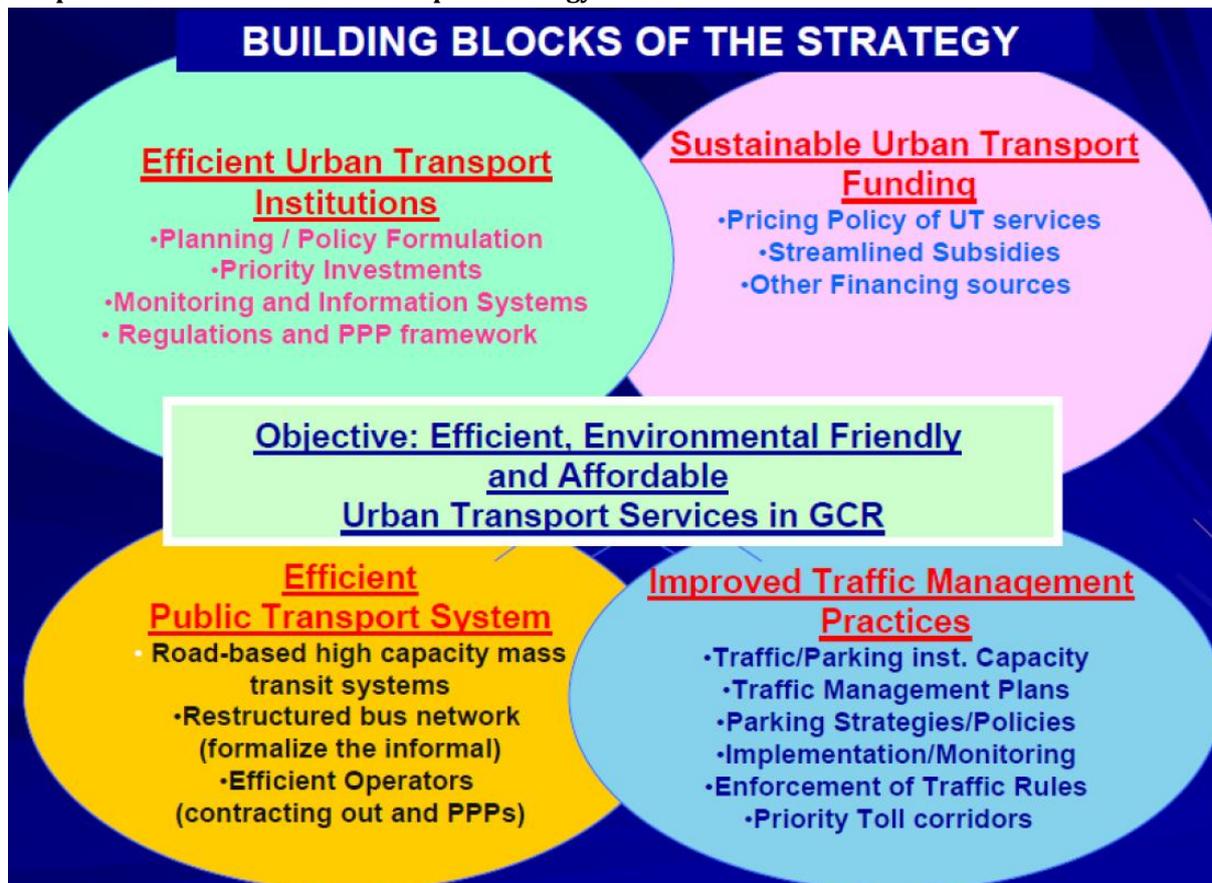
- Sheik Zayed City to 6th October City and link to Metro lines 1 and 2 with an integrated ticket.
- Improved internal 6th October City bus services.
- Proposal is to replicate these improvements at the other New Cities (10th of Ramadan, New Cairo, Badr, Oboor, Shorook with bus links to existing/proposed Metro lines.

- Feeder bus services provided Almazia and El Hegaz areas with the Sarraya El Koba Metro station and also new bus services between Maadi Metro station and surrounding Maadi residential areas with an integrated ticket.
- Improved walk and cycle measures in Fayoum and Shebin El Kom.
- Bus lane implemented on Mostaff El Nahas Corridor.
- Proposals for higher parking charges in CBD, Variable Message Parking signs and park and ride at Metro stations.
- National Policy proposed to improve energy efficiency and intermodal terminal facilities
- Awareness raising campaigns.

There is also a centre of road bus lane on Mostafa El Nahas implemented by the Cairo Governate – however it was observed that there are many conflicts with U turners. Few other implemented examples were observed or reported on in published research.

The 2009 UNDP, Cairo Sustainable Transport Report identified the following as key components of a Sustainable Transport Strategy in GCR:

Figure 51: 2009 UNDP, Cairo Sustainable Transport Report identified the following as key components of a Sustainable Transport Strategy in GCR



Going forward to solve the transport problems in GCR, an Integrated Transport Strategy for GCR should consider:

- New, high quality integrated public transport services for Cairo and its satellite cities to exert shift from private car use.
- Increase the modal share of Non-Motorized transport (NMT).

- Successful introduction of a Travel Demand Management (TDM) concept with an objective to expand it towards more aggressive measures over time to effectively discourage the use of private cars, when good quality public transport services are available.
- Improved energy efficiency of urban freight transport.
- Enhanced awareness, capacity and strengthened institutional basis to promote sustainable transport sector development
- Speed up completion of Cairo urban metro network.
- Improve roads and transport services within and serving informal areas.
- Integration of public transport modes.
- Parking management schemes.
- Congestion zones.
- Reduction of travel distances through effective land use policies.
- Improve public transport in terms of coverage and level of service.
- Make private car usage expensive.
- Provide proper space for pedestrians.
- Enforcement of traffic rules and building codes.
- Revision of transport pricing.
- Reallocation of fuel subsidies.
- Traffic demand management: flexible working hours and telecommuting.
- Continue support and development of the GCTRA with enough skills, adequate powers and funding for leading the planning, regulation and execution of key urban transport activities.

Travel Demand Management (TDM)

Whereas traffic management measures are aimed at increasing and better using the capacity of existing streets, Travel Demand Management Measures are targeted at reducing vehicle use in congested travel periods and places. Travel demand management has not so far featured as a component of a transport strategy in Cairo, which has been almost exclusively focused on attempting to satisfy demand for travel rather than to manage it. Within Cairo parking meters were introduced in 2011 using coins and pre-paid cards in CBD area – but these have now all gone. There are off street paid parking locations e.g. Tahrir Square, bus station. What is required is a CBD zonal parking system with high charges e.g. Zone 1 = 30 mins max, Zone 2 = 1 hour, Zone 3 = 2 hour. Also needed are controls on loading and unloading and for all of this to be enforced.

Even with a highly developed mass transit system, a well-developed road system, and good traffic engineering measures, traffic congestion will continue to remain a serious problem without the application of travel demand measures. There simply is not enough space for roads in central Cairo and other high density parts of the metropolitan region to accommodate all motorists who may wish to travel there in private cars at peak travel periods. Most demand management measures depend on charging for the use of scarce resources, particularly road and parking space, so as to deter the marginal road users from making their trip or by using the most efficient mode (public/private). The charging can relate to:

- car ownership;
- car parking, and
- the use of vehicles on the streets

All these demand management measures have their uses in the context of Cairo. Given the lack of parking spaces and the high costs of adding additional spaces, charging sufficiently highly for parking spaces and strictly controlling the use of unauthorised parking spaces would be among the most cost effective demand management measures. New technology has made direct charging for use of limited road space feasible and is now being considered or implemented in a rapidly increasing number of cities (as referenced in Chapter 2 Literature Review).

The 2010 World Bank report considered how effective Travel Demand Management (TDM) Measures would be in GCR - the results are summarized below:

Figure 52: Effectiveness of TDM methods

TDM Policy Options	Public Transport	Vehicle Transport	Public Transport Revenues
(1) Introduction of a common ticketing system	+ 9%	n.a	+ 5.2%
(2) Fuel Tax and Parking Charge	+ 8.4%	-10%	+ 12%
(3) Multi-polar Urban Structure	+ 2.5%	- 8%	+ 11%

Source: Slide 62 Prof Khaled El Araby International Symposium February 2013

Increasing revenues and reducing inefficiencies

Substantially more revenue is needed than has been supplied in the past for addressing the transportation problems facing the GCR. With an objective to provide cost-effective and quality urban transport services and infrastructure in a sustainable manner, funding of urban transport should be secured on a regular basis with minimum fiscal burden on Government resources. So far as possible, these additional revenues should come from transport users. This particularly applies to private cars who contribute disproportionately to traffic problems in metropolitan Cairo. Options include:

- Higher Fuel Prices.
- Wider Application of On-Street Parking Charges.
- Introducing Road User Charges.
- Public transport fares - passengers are willing to pay more than prevailing low fare levels for better quantity and quality of service.

Private sector and competition in provision of Public Transport Services.

The emergence of the private sector in providing public transport services in recent years has indicated a feasible alternative strategy to having all public transport provided by the public sector. The greater the role that can be given to the private sector in operation and investment in vehicles, the better the use that can be made on public resources in investment in infrastructure.

Enforcement

Given the lack of road space relative to the number of vehicles and the difficulties of adding more, improved enforcement of traffic laws and regulations should figure prominently in an urban transportation strategy for Cairo. There are very apparent and important gaps in enforcement including widespread disregard for parking restrictions, excessive mid-block pedestrian crossings, and disregard for traffic signals except (or even when) police are present. If traffic management and demand management strategies are accepted as priority measures to implement in metropolitan Cairo, it follows that the active supporting role of the traffic police will be essential to ensure that these schemes are adequately enforced. Enforcement includes:

- Traffic Safety. The paramount traffic enforcement activity should be aimed at reducing traffic accidents, especially those that cause serious injury or death. Particularly important will be greater emphasis in reducing pedestrian accidents which constitute a high percentage of all injury accidents, and in reducing speeding which is a primary cause of fatal accidents. To

successfully address this issue it is anticipated that training and additional vehicles and speed monitoring equipment will be required.

- Accident Statistics and Reporting. The accurate and complete compilation of accident statistics and their timely reporting is an important traffic police function which needs to be substantially improved. This information can serve as the foundation for improved traffic safety programs as well as an input for determining where and what traffic management measures should receive highest priority.
- Traffic Incidence Management. It should be recognised that traffic incidents, including accidents and vehicle breakdowns, typically are the cause of a significant proportion of travel delays or congestion in urban areas. It is therefore important to equip the traffic police with suitable equipment and training to be able to expeditiously document and clear accidents and similarly to be able quickly clear all other traffic impediments.
- Parking Enforcement. A very important matter to resolve is the enforcement of parking restrictions. This will likely require changes to parking legislation and/or regulations. Another important matter to resolve is whether parking enforcement should be handled by the traffic police or alternatively whether this function could be handled by special deputized personnel, as is common in many cities, freeing the traffic police for more demanding traffic enforcement functions.

Maintenance

The substantial fixed investment in the urban road network needs to be maintained as a priority measure prior to considering any significant improvement or expansion of this network. It is well recognised that delays in the timely maintenance of roads results over the longer run in increased maintenance or road rehabilitation costs. The current allocation for maintaining the primary road network appears to be insufficient and hence there is a need to increase the maintenance budget for the GCR road network and for road maintenance funding to be consistent over time to ensure timely maintenance. Research has indicated that at least 20% of the total roads budget should be invested in maintenance.

Based on discussions with GCTRA there is an initiative to be implemented called the '*1m² initiative*'. This aims to start with small steps and repair and maintain roads to a high quality to send a message to users that they should respect the road network (e.g. park in the right way and not throw litter and respect lane markings). Part of this initiative includes drawing up a list of deficiencies (e.g. pot holes, manholes, signs) on 6 corridors for implementation.

Institutional Set Up

There are a multitude of various ministries and organizations responsible for transport in GCR for example:

- Various Ministries - those responsible for Transport include, MoT, MoH, Ministry of Interior, Ministry of Defence , MOI, Suez Canal Authority
- Within Ministries these are divided into various authorities e.g. within MoT there is the RTA, General Authority for Roads and Bridges, National Authority of Tunnels (NAT), Expressway Authority, GCTA, Ministry of Civil Aviation, Red Sea Ports Authority, Egyptian National Railway Authority, National Council for Road Safety Within MoH there is National Authority of Urban Dev, GOPP
- 3 Governates

The GCTRA has recently been set up to address these issues and the success of this organization will need to be monitored. This is indeed a positive step.

Institutional Capacity Building.

Addressing traffic management deficiencies in GCR will require substantial improvements in the existing institutional capacity within the GCR. Previous research has highlighted that this will include

at a minimum the creation of a civilian traffic management unit and the gradual devolution of the traffic engineering function from the traffic police to these civilian traffic units as is the practice in virtually all medium and large size cities in developing and developed countries. It must be recognized that police are not adequately trained for this increasingly complex engineering function, and that there is little prospect for this to occur in the future. By comparison, traffic engineering is being taught at the university level in Egypt but those persons who are trained in traffic engineering applications are typically not being hired by the public sector to pursue traffic engineering activities. This proposed shift of traffic engineering responsibilities to civilian authorities will permit the traffic police to concentrate solely on traffic enforcement.

Attracting, Retaining, and Training Staff.

In addition to the creation of competent urban transportation institutions (such as GCRTA) is the equally significant issue of attracting, retaining, and training qualified professional staff for addressing the complex array of urban transport issues facing the GCR.

4.2.16. SWOT Analysis Summary

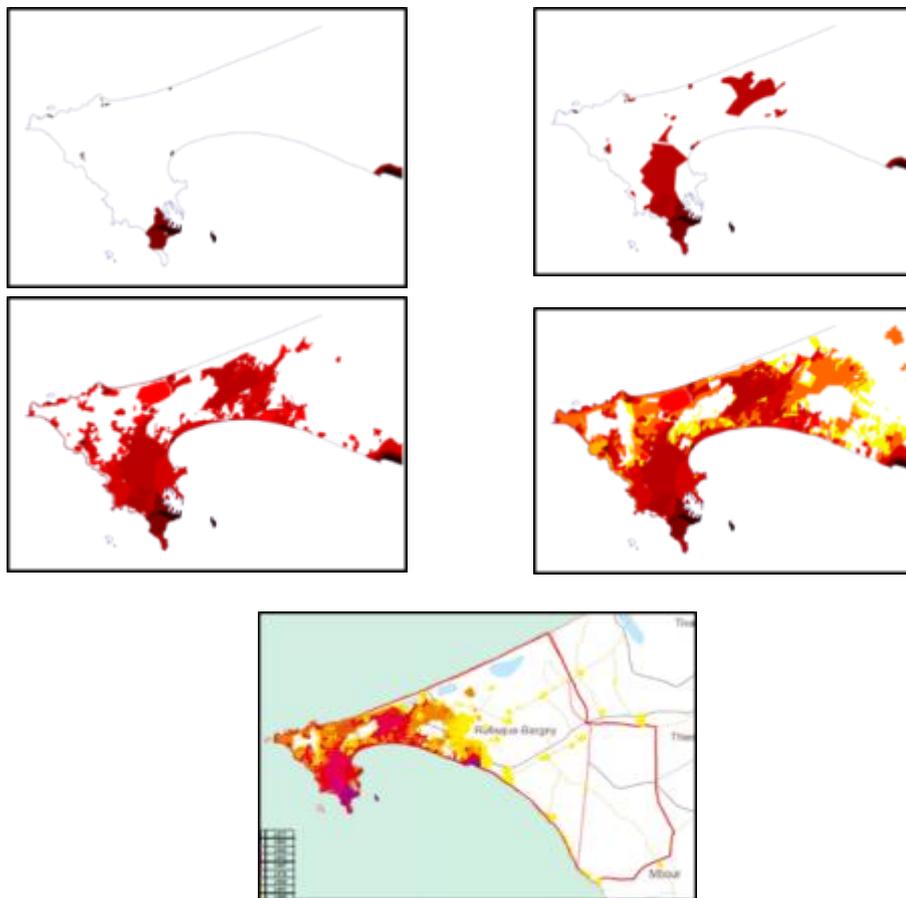
Strengths <ul style="list-style-type: none"> • Strategic location as an economic hub (great economic potential) • Global recognition as an economic centre • Political stability • Investment opportunities/climate • Large and diverse population • Centre of agglomeration areas • GCTRA - the beginning of coordination of activities • High demand for public transport 	Weaknesses <ul style="list-style-type: none"> • Chronic traffic jams • Poor road safety record • Poor public transport system • Large area, large population and rapid growth are difficult to manage • High motorization • No recognition of NMT policy • Weak enforcement of traffic laws • Lack of capacity • Concentration of activity in Cairo • Lack of public transport and NMT planning in existing New Cities
Opportunities <ul style="list-style-type: none"> • Large population • Robust economy • Growth to be concentrated outside of Cairo • Attractive for investment 	Threats <ul style="list-style-type: none"> • Insufficient (transport) infrastructure • Weak technology and innovation • Risk of climate change

4.3. Dakar

4.3.1. Urban background

Dakar is the capital and biggest city of Senegal, located on the Atlantic coast, on the Cap Vert peninsula. The city is the administrative and economic centre of the country with a population of 3 million, or 23% of the national population. The city has experienced quick population growth after WWII, when its population was only 135,000. The expansion of the city inevitable happened to the east, given the geomorphology of the region (Figure). It is estimated that the population of Dakar will reach 5 million by 2025. A big part of the population is expected to be economically active as almost 60% of the citizens in Dakar are below 25 years old, with an average age of 23.6 years.

Figure 53: From top to the right: The region of Dakar in 1900 (100,000 population), 1967 (500,000 population), 1986 (1.25 million population) and 2013 (3 million population (JICA, 2014)).



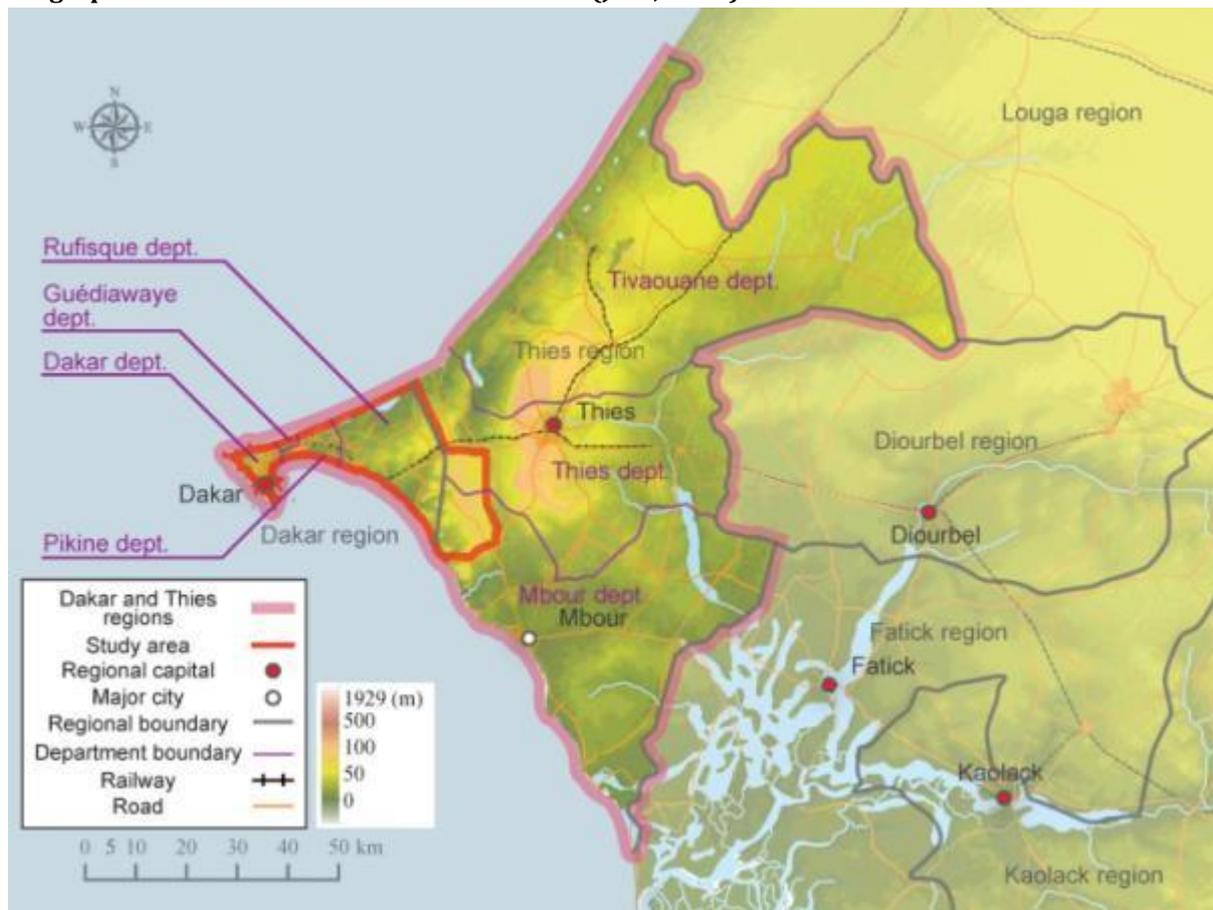
Transport network and infrastructure

The city is now experiencing the impacts of unbalanced urban development, physical separation of activities, primacy and monocentricity. The movement of public transport, private vehicles, taxis, pedestrians and non-motorized vehicles (bicycles and animal drawn vehicles) is directed to the Plateau area throughout the day where streets are empty during non-working hours. The congestion on the streets is exacerbated by the completely unregulated modal mix on the streets which makes traffic flow slower and irregular as none of the modes is prioritised. The ubiquity of street markets, vendors and informal activities are also occupying a big part of the street space and contributing to the mix of users. The interaction of slow and fast modes reduces the overall performance of the streets and although flows are better on higher speed roads, the coexistence of pedestrians and vehicles is still frequent.

Land use and urban form

The administrative region of Dakar is divided into four departments: Dakar, Rufisque, Guédiawaye and Pikine (Figure 54). The biggest part of the population of the region is concentrated in the department of Dakar (42%) while Guédiawaye is the densest department with 21,248 residents per km², compared to the average density of 433 residents per km².

Figure 54: The administrative region of Dakar and the four departments. The study area shown on the graph is that of the 2025 Urban Master Plan (JICA, 2014).



The majority of the country's administrative, military, economic and industrial activity was gradually concentrated in Dakar and created unprecedented needs to for housing and transport which have not been properly addressed by a series of urban masterplans adopted by the city's planning authorities in 1748, 1967, 1980 and 2000. Dakar is the engine of Senegalese economy and the centre of national and international trade. The city is home to 46% of the administrative functions of Senegal, 97% of transport and commercial workers, 96% of bank workers, 95% of industrial enterprises and 87% of permanent employment positions. In addition, Dakar has the only major airport in the country and the only major port as well as the only international train line to Bamako. It is not surprising that Dakar produces 55% of the national GDP and 25% of all employment. However, unemployment levels in the city remain high at almost 12%, with an additional 60% of the citizens working in the informal sector.

All the services in the region of Dakar are concentrated in the department of Dakar and more specifically in the Plateau area, the colonial centre of Dakar in the southwest of the Cap Vert peninsula. Among the services located in the Plateau are the Presidential Palace, the majority of the Ministries and Embassies, international and national businesses, the industrial zone, the main hospitals, many modern and traditional markets, the port and the main train station. However, it is noted that since

the 1980s, part of the employment positions have been moved or created in the Pikine department, providing a better spatial distribution.

Mode availability and shares

Private motorized transport

The condition and availability of infrastructure also affects the traffic conditions. In terms of the road network, although the Plateau area and the Dakar department have a well-developed street network, this is not the case in the other departments where major residential areas are located. In many parts of the suburbs only main roads are paved which reduces overall accessibility levels for both motorized and non-motorized transport. Similarly, big highways are focused on the Department of Dakar, providing quick links to the suburbs. In terms of non-motorized transport, there are no dedicated cycle lanes in the city while footways are very often elevated and badly maintained which forces pedestrians and particularly disabled people to use the road space. It is noted that highway projects going through residential developments in the suburbs are significantly reducing accessibility for pedestrians and non-motorized modes. A limited number of footbridges is provided, which is mostly accessible by steps.

Public transport

Public transport in Dakar is dominated by minibuses and buses. There is an existing train line, the Petit Train de Banlieue (PTB), which is old and has limited capacity and frequency. Buses and minibuses operate on fixed routes, and have different levels of formality. The blue, new buses Dakar Dem Dikk (DDD) are operated by the DDD company and are the official public transport for Dakar. The distinction between minibuses can be easily made from their colour. The white minibuses are operated by private operators who sign concessionary agreements with AFTU while the colourful minibuses are the old, privately operated, largely unregulated, and in the process of being replaced. The latter type of minibuses is the one that offers the best network coverage and the lowest quality of passenger experience.

Non-motorized transport/Social exclusion

Given that the majority of trips in the Dakar region are carried out using non-motorized modes (81.4%) and that 65.7% of motorized transport is trips are made by public transport (compared to 17.5% by taxi and 10.2% by private cars) it is easy to understand that the impacts of private cars on the society are highly inequitable. This modal split, along with the land use allocation in the city, is major obstacles to both the mobility and the accessibility of a large portion of the population in Dakar. The lack of proximity to basic services means that people need to take more and longer trips. Indeed, as the analysis of the family spending of the families in Dakar shows, an average of 8.3% of their budgets is spent on transport, which comes second after food.

Freight and servicing

Regarding the urban freight activity in the city, no specific loading and unloading areas were observed. The multiple small retail units in the city require multiple deliveries which means that more delivery vehicles are going around the city. However, the size of the retail units, especially in street markets, implies that a big part of the merchandise can be carried by private vans which enter and leave the city every day. This does not allow a great degree of consolidation of activity and poses significant congestion problems. Except for the small retail freight activity, the port is also generating a big amount of heavy freight traffic. It is estimated that around 200 trucks leave the port every day to go to other areas in Senegal or other countries. There is also a freight train line linking the port to Bamako, Mali, which is the only landlocked country directly dependent on the port of Dakar. The trucks are posing significant congestion problems to the area around the port as they are leaving via highway link passing through the edge of the city centre. This is the reason why the Autonomous Port of Dakar (PAD) has introduced traffic restrictions, not allowing the trucks to leave before 16:30 every day.

Road safety

In terms of road safety, despite the completely unregulated traffic on the streets, the existing modal mix acts as unintentional traffic calming, lowering vehicles' speeds and allowing vulnerable users to make their way through the traffic. Drivers as well as pedestrians are aware of the local conditions and are prepared to respond to unpredicted events. In addition, almost no aggressive reactions were observed by the drivers. This does not mean however that the current situation is desirable. Drivers show very little compliance with the traffic rules and enforcement is selective, unreliable and sometimes corrupt. In terms of accidents, they are primarily a result of speeding which is observed when traffic flows are better, mainly during off peak hours. The condition of the vehicles and the inconsistent training of the drivers also contribute to the lower safety levels.

Human dimension

Finally, in terms the human dimension of the city, Dakar is a city characterised by vibrant human activity and interaction in all its areas. The street markets and vending as well as the concentration of markets around transport nodes (for example bus terminals and the port), make an equally significant contribution to maintaining the identity, culture and economy of the city. Despite the lack of official public spaces or their poor maintenance the social element of the city is alive through its markets and everyday trade.

4.3.2. Summary of the key points of the meetings

The ten meetings held during the site visit in Dakar contributed to developing global understanding of the transport governance structures in Dakar, the plans and ambitions for the city and also the perspectives of different stakeholders on the current transport problems. Meetings were held with representatives of the Ministry of Infrastructure, Land Transport and Opening-Up, the Ministry of Urban Renewal, Housing and Living Environment, British Embassy in Dakar, the University Centre for Mobility Research and Studies (CUREM), the Urban Transport Financing Association (AFTU), the Dakar Urban Transport Executive Council (CETUD), the British Embassy in Dakar, the NGO New Road Safety (NPR), and the COMCEC nominated contact. In addition, we attended a roundtable with the Minister of Infrastructure, Land Transport and Opening-Up in London where the Minister and his advisors presented infrastructure investment opportunities in Senegal.

Transport governance and institutional cooperation in Dakar have seen a major change after the late 1990s and early 2000s. The creation of CETUD in 1997 has made a significant contribution to the improvement of the collaboration between different stakeholders in Dakar. CETUD brings together the government, the professionals and the local authorities in order to achieve better coordination of transport planning and operations for the city. However, CETUD's role still needs to be enhanced as it is currently responsible only for part of the motorized modes in the city and none of the active modes. Although efforts to expand the authority of CETUD are in progress, fragmentation of responsibilities between different authorities can still be observed. This is probably the reason why it has been stated that there is lack of global transport vision for the city.

Various challenges and problems have been brought up during the interviews, the most important of which is probably the lack of coordination between land use and transport planning and the lack of land use mix not only in the Dakar agglomeration but also in the country. The majority of public services and employment opportunities of the country are concentrated in Dakar and particularly in the Plateau area. The huge need for trips to the Plateau is not met by the existing public transport services and therefore significant congestion issues are caused throughout the day. The lack of offer has been identified as another key issue, not only in terms of public transport but also in terms of infrastructure. It has been suggested that the lack of road hierarchy and sufficient road infrastructure also contribute to the congestion in the streets of Dakar.

The cars rapids renewal scheme is the most important public transport project currently in progress in Dakar. The old cars rapids are being replaced by newer and bigger cars rapids, known as cars AFTU or cars blancs or TATA, after their manufacturer. AFTU is the organization responsible for the

management of the replacement scheme which has so far been funded by the World Bank, a concessionary agreement with China and a local bank. The number of the cars rapids that have been replaced is 1307 and the scheme is expected to be completed by 2018. However, the fact that both old and new cars are now in circulation, along with the delays in reimbursements have an impact on the affordability and efficiency of services.

The vast potential for Dakar to improve was stressed in all our meetings. The Government has an ambitious plan in place that will help Senegal become an emerging country by 2035. As part of this plan, two major schemes for the city are proposed. A new BRT system and an Express Regional Train (TER) linking the centre of Dakar to the suburbs located along the Cap Vert peninsula. These new mass transit projects are expected to relieve the congested street of Dakar, and particularly those of the Plateau, and meet the future demand which is expected to grow due to the high share of young and economically active people in the city, and the expected economic growth. The studies for both the BRT and the TER have progressed and the Government is now looking for investors to fund the projects under PPP agreements. A BRT pilot line is expected to be completed by 2017.

In terms urban and land use planning, the 2035 Urban Plan for Dakar is based on the most recent Transport Masterplan for Dakar (PDUD 2025) in order to achieve a balance in urban development. The 2035 Urban Plan will try to improve the land use mix in the city and the suburbs and will introduce two additional poles of urban activity, in order to remove some administrative and social services from the Plateau. The new poles will be connected by the two BRT lines and the TER as well as by improved road infrastructure. The 2035 Urban Plan for Dakar is developed by the Ministry of Urban Renewal, Housing and Living Environment in collaboration with the Japan International Cooperation Agency (JICA), which has permanent representatives in the city.

Other key issues mentioned in the interviews include road safety, accessibility, freight and logistics, and the condition of vehicles. Road safety is area that has seen significant improvement since the early 2000s. However, the rates accidents and fatalities are still high and almost 50% of accidents and 30% of the country's road fatalities are concentrated in Dakar. The Government has adopted a National Road Safety Strategy which has nine areas of action. The actions of NPR, an NGO focused on raising awareness on road safety, are also contributing to the reduction of road accidents and fatalities.

The components of accessibility that were most commonly mentioned in the meetings were economic and geographical accessibility. Walking and public transport account for almost 50% of the modal share in the city, as most people cannot afford private vehicles. Concessions and improved fare regulation are currently being examined in order to improve economic accessibility. The geographical coverage of the road was also mentioned as a major obstacle to accessibility, both in urban and rural areas. Physical accessibility was most commonly mentioned in terms of access to public transport vehicles. The lack of appropriate infrastructure for people with disabilities such as ramps, the poor management of access to pedestrian areas and the lack of maintenance were only mentioned once as factors limiting accessibility.

The activity of the port is managed the Dakar Port Authority (Port Autonome de Dakar - PAD). CETUD is responsible for the logistics in the city. Although the PDUD makes reference to logistics operations, there is still very limited management of activities in the urban area. The freight movement to Bamako is a very important to the economies of both Bamako and Mali and therefore the Ministry is trying to facilitate the transfer of goods between the two cities. Today, 90% of the goods are transferred by road and 10% by the Dakar-Bamako rail line. There are plans for both rail and highway links to Bamako to be improved as currently there are almost 200 trucks passing through the city carrying to goods to Bamako and the rail connection is old and inefficient.

Another key area of action for CETUD and the Ministry of Infrastructure, Land Transport and Opening-Up is to renew the fleet of both private and public transport vehicles in the city. In 2013, more than 25% of the vehicles circulating in the country were between 26 and 35 years old. The Ministry is currently seeking funding to introduce a digitised driving licence system which will also include

information on the condition of the vehicles in order to improve and accelerate the replacement procedure as well as the vehicle permits and servicing.

4.3.3. National, Urban and Transport Strategies adopted for Dakar

As Senegal is aiming to become an emerging economy by 2035, a number of documents and strategies have been adopted in order to put the country in the right path to achieve this goal. Transport plays a key role in the development strategies and so does Dakar, which will remain the centre of economic and social activity in the country, despite the plans to achieve a certain degree of decentralisation. Not surprisingly, the strategies that have been adopted at a national level involve ambitious plans to improve urban transport in Dakar and significant reforms in institutional structures and functions in order to accelerate growth. At the city level, the urban and transport masterplans (covering a period until 2025 and 2035 respectively) are covering the same study areas and are closely linked, recognising the importance of coordination between urban and transport planning. In addition, a ten year National Strategy for Road Safety was adopted in 2011, aiming to improve the road safety conditions at a country level.

In order to provide an overview of the current strategic framework for Dakar, a summary of four key strategy documents and their role in shaping the transport conditions in Dakar is given below. Some of these documents have not yet been officially adopted and were provided to us by the authorities we met in Dakar.

4.3.3.1. Emerging Senegal Plan (PSE)

The Plan for the Emergence of Senegal is aiming to accelerate the country's progress towards becoming an emerging economy. The PSE is the reference for economic growth and social policy in the medium and long term. The plan is based on three strategic pillars:

- The structural transformation of the economy in order to improve the capacity of existing and new sectors to grow, strengthen the exporting capacity of the country and attract investment.
- Improving the well-being of the population and reducing social inequality.
- Reinforcing security, stability and governance, and consolidating the rule of law.

The first, urgent actions of the plan involve the improvement of the administrative procedures of the country and the establishment of a fiscal and legal framework which is simple and motivating for investors by 2016. If the necessary resources and funding are attracted the plan is expected to achieve annual growth rates averaging 7.1% during the period 2014-2018, and the reduction of the fiscal deficit from 5.4% in 2013 to 3.9% in 2018. The current account deficit will be brought below 6% in 2018 and the rate of inflation, will remain below 3%.

4.3.3.2. National Strategy for Road Safety

The study was funded by the European Union and produced by the Danish Consultancy CONSIA for the Ministry of Land Transport, Rail Transport and Land Use Planning and the Ministry of Economy and Finance. The final version was issued in November 2011.

The National Strategy for Road safety is based on the United Nations Decade of Action for Road Safety 2011-2020. Senegal is interested in developing a National Strategy for Road Safety which will cover the management and financing of road safety, the management of accident data collected by the Division of Road Safety, Regulation and Circulation (in the form of Analysis Report of Road Accidents), the management of road infrastructure safety, the information, education, communication and awareness raising on road safety, the technical control of vehicles and the post-accident reaction.

The overarching objective of the Strategy is to achieve a 35% reduction in the number of the heavily injured and killed in road accidents until 2021. The Strategy also has nine specific objectives:

- Create an organization responsible for the efficient management of road safety powered by a continuous financing structure.

- Improve the accident data collection system so that reliable statistical data is readily available to inform road safety policies and facilitate monitoring.
- Establish a uniform training and examination programme for all for obtaining a driving licence.
- Provide a minimum of 50 hours of road safety education per year to all primary and secondary school students.
- Organize targeted road safety awareness campaigns
- Establish a functional vehicle technical control test by 2018
- Enhance the cooperation between the official and independent forces in order to improve the levels of enforcement.
- Improve the infrastructure road safety standards and monitoring, conduct road safety audits
- Reduce by 10 to 15% number of injuries and deaths related to road accidents by improving the post-accident reaction.

The programme involves training courses for police officers, driving instructors, professional drivers, school teachers, doctors and paramedics, safety audit team members and members of the Administration of Road Transport.

A series of actions undertaken in collaboration by various departments are planned for each objective. The monitoring of the performance of the plan will be done based on indicators measuring the success of the actions planned for each objective.

The total cost of implementation is estimated at 8,446,331,960 CFA (almost 14.6 million USD).

4.3.3.3. Urban Transport Masterplan for the Dakar Metropolitan Region – 2025 (Projet de plan de déplacements urbains pour l’agglomération de Dakar (PDUD) – Horizon 2025)

The PDUD 2025 covers the period between 2009 and 2025 as part of the Programme for the Improvement of Urban Mobility (Programme d’Amélioration de la Mobilité Urbaine -PAMU¹¹). The plan is expected to be completed in three phases in order to align with the Urban Master Plan for Dakar – 2025 (PDU 2025). Although the PDU was eventually withdrawn to be replaced by the Urban Masterplan 2025 (see summary below), PDUD is still being applied. The three implementation phases of the PDUD are:

PDUD-I : 2009 – 2015, including three evaluations in 2011, 2013, and 2015 (completed and currently being evaluated),

PDUD-II : 2016-2020, including two evaluations in 2018 and 2020, and

PDUD-III : 2021-2025, including two evaluations in 2023 and 2025.

The PDUD 2025 has seven overarching objectives, each one of which includes a number of specific objectives:

1. Improve traffic flows for passenger transport (includes specific objectives related to public transport, integration between modes, pedestrian and cycling movements, traffic management, parking and mobility of disabled people),
2. Improve the efficiency of freight movements (includes specific objectives related to parking, loading and unloading, and distribution),
3. Improve road safety (includes objectives related to drivers’ training and traffic rules),

¹¹ PAMU covered the period between 2001 and 2008 and its objectives covered a wider area than that of PDUD, covering among others institutional reorganization, road and rail infrastructure, financial support and bus fleet renewal.

4. Improve land use planning (includes objectives related to coordination between land use and transport planning, organize informal activity, facilitate the implementation of urban masterplans are applied),
5. Protect the environment and improve the quality of public spaces (includes objectives related to air quality, noise pollution, and traffic bottlenecks),
6. Secure adequate and equitable financing of the transport system (includes objectives related to operations and development financing, and preserving the value of public investments), and
7. Evaluation and monitoring of PDUD in order to secure its successful implementation (includes objectives related to defining the institutional framework for the implementation of the plan, securing the consensus of all involved parties and the involvement of people with the necessary competencies).

The PDUD 2025 is aspiring to promote and enhance public transport and while rationalising the use of private cars. The strategy has five areas of action:

- Passenger and non-motorized transport (including public transport, pedestrians, cyclists, school children, people with disabilities, taxi users, marine transport and private cars)
- Economic development (including freight movements, land use planning, and occupation of public spaces)
- Quality of life (including road safety, air pollution, energy consumption, noise pollution, and quality of public spaces)
- Financing (including transport costs management, fare structures, taxation, financing and management of transport systems, and investment optimisation), and
- Sustainable development (including institutional organization, cooperation on the PDUD, sustainability of the plan, enhancing information collection and management, and capacity building).

The PDUD 2025 was created as a response to persisting transport problems in Dakar during the implementation of PAMU. Other projects, including the renovation of the PTB trains station and the reorganization of minibus services, were also aimed at improving transport issues particularly related to transport impacts of new construction sites. However, the allocation of decision making to various authorities created discontinuities in the management of these projects.

The targets of the first implementation period 2009-2015 which is now complete and being evaluated are:

- Increase modal share of public transport by 3%
- Increase public transport peak period speed by 30%
- Increase private vehicle peak period speed by 10%
- Reduce the duration of peak periods by 40%
- Increase the number of short duration parking spaces by 30% in the urban area
- Reduce by 90% the proportion of roads in bad condition
- Create 2000 new off road parking spaces
- Create 500 new parking spaces for HGVs
- Construct and rehabilitate 200km of footways
- Construct 50km of cycle lanes
- Introduce on demand public transport services with a capacity of 500 trips per day
- Reduce by 25% the number energy intensive vehicles
- Maintain the average motorized trip lengths at the 2009 levels
- Achieve 95% coverage of the transport demand
- Reduce the frequency of accidents by 30%
- Reduce the number of on road fatalities by 30%
- Reduce emissions from road transport by 30%

- Clear 100% of public rights of way

The total cost of the plan was estimated at a total of 674 billion CFA (or \$1.1 billion) to 975.2 billion CFA (or \$1.7 billion) for the only bus, or bus-rail public transport approaches.

It is noted that as the PDUD 2025 was adopted in 2009, it does not include many of the projects that are now being pursued by the transport authorities of Dakar, such as the BRT and the TER. However, the strategic elements of the PDUD 2025 align with the new projects as the plan is focusing on public transport and prioritises rail infrastructure as the backbone of the public transport system.

4.3.3.4. World Bank Support Programme for Urban Transport and Mobility

The World Bank Support Programme for Urban Transport Mobility (PATMUR) was adopted in 2009. It is a countrywide financial and institutional support programme that ensures the continuation of the Bank's involvement in financing and capacity building of the transport sector in Senegal. The Bank is aiming to build on previous efforts and programmes applied in Senegal and maintain its principal role among the country's funding partners.

The programme has three main elements.

First element: Support for the development and the management of urban and interurban road infrastructure (estimated cost 39 million USD financed by the International Development Agency). This element involves both institutional (3 million USD) and project development (36 million USD).

Second element: Capacity building for the development of public transport in the Dakar metropolitan area (estimated cost 7.8 million USD financed by the International Development Agency and 38 million USD provided by the Senegalese government). This programme involves support for the development of public transport services (5.9 million USD) and support for the development of the new minibus leasing scheme (1.9 million USD). The additional funds for this element will be used for buying the new minibuses.

Third element: Support for the implementation, monitoring and evaluation (3.2 million USD, provided by the International Development Agency).

The programme has been assessed with medium risk after the application of risk mitigation measures. Associated risks are the lack of funding, political will and capacities to implement the agreed measures, lack of trust and political instability. The mitigation measures include the creation of a road transport fund (following an unsuccessful previous effort), institutional reforms and reinforcement of the country's cooperation with its creditors, capacity and institutional building.

4.3.3.5. Discussion of current situation and critical issues for success

Dakar is currently experiencing intense population growth. The population of the city is expected to grow from 3 million to 5 million in the next 5 years, putting additional pressure in the city's needs for energy, mobility and accessibility. The transport and traffic situation in the city is not as poor as in other cities studied in this report and this can be attributed to the current population size of the city. Dakar is a growing megacity and at the moment finds itself in a position where other Islamic megacities that are currently experiencing extreme traffic conditions have been in the past. Dakar's authorities have the opportunity to lead the city to a more sustainable future where transport is a driver of economic growth rather than a contributing factor to a deteriorating urban environment.

Dakar is suffering from a significant gaps and inconsistencies in terms of land use development and transport infrastructure. Spatial mismatches are probably the most significant factor contributing to the transport problems experienced in the city. The poor distribution of activities brings all morning trips to Dakar, and particularly to the Plateau area, causing significant traffic problems and also long travel times and loss of productive time. The lack of activity mix in the central area is evident even without examining the development patterns of the city as there is a striking difference between the vibrant and congested economic and transport activity during the day in the Plateau and the empty

almost empty streets during the night. Therefore, the decentralisation of activities is an urgent matter for Dakar.

In addition, it is crucial that any relocation of administrative, commercial or business activities should be accompanied by economically and spatially accessible public transport links so that the share of private cars in the trips made to the new areas remains low. The coordinated urban and transport plans that are in the process of being adopted currently in Dakar cater for such provision and take into account the need to reduce motorized travel. The creation of three urban poles in the region of Dakar and the development of rapid and reliable transit links between them is an ambitious plan that is going to provide significant congestion relief for the Plateau area. However, it is necessary for this system to be designed taking into account its complementarity with other modes and through which regulation this can be achieved. The proposed urban train and BRT systems can be the backbone of the transport system of Dakar, complemented by high NMT accessibility and feeder bus services.

Although Dakar does not suffer from the same extreme traffic conditions as other cities examined in this study. At the same time, Dakar does not show many differences in its development patterns and the rates of motorization. The influx of the population in the metropolitan region of Dakar will continue to increase as economic activity and employment opportunities remain concentrated there. In addition, as average incomes increase the tendency to buy a car as soon as this is affordable in order to escape from the public transport dependence will persist. If no action is taken, it is highly likely that this emerging megacity will be dealing with the same problems as Lagos or Cairo in the future.

However, the provision of public transport alone is not sufficient to guarantee high ridership levels. Restrictions on car access and ownership should be coupled with improved public transport. The main challenge of imposing private car restrictions is that it is not always a politically safe decision. Private car owners and other stakeholders involved in the automobile industry may resist to such a decision and this may affect their support to the local or national government. There is a trade-off between total and horizontal restrictions to entire areas for certain periods of the week or day and imposing fees for entry as the former approach is more equitable but the latter brings financial benefits to local authorities. The latter may be a preferable solution for cities like Dakar where the majority of people who drive cars are relatively well off and the majority of citizens uses public transport or NMT as their main mode of transportation therefore imposing fees to private vehicle circulation will benefit a large part of the population and affect financially only the less vulnerable.

Dakar benefits from the socio-political stability of Senegal, its better economic performance compared to other West African countries and its existing institutional structures in the transport domain. The city's current ambitious urban development plans for the period until 2025 and 2035 which place a great significance on the transport system and efficiency of the city. In order to put these plans forward the government is trying to attract foreign investments and to build Public Private Partnerships (PPP). However, the fact that the prioritisation and even selection of schemes depends on financing from external sources, puts the expected effectiveness of current plans at stake. The government of Senegal has currently selected 27 projects for which it seeks financing as part of the PSE, two of which are big transport infrastructure projects in Dakar (the BRT and the TER systems).

The city's ambitions for new infrastructure development aspire to make the city more mobile, accessible and human friendly. However, it should be noted from the local authorities that these plans should be accompanied by firm institutional reorganization and management of activities. Dakar already has available funding to support capacity building and institutional restructuring which should be used in order to ensure the most efficient allocation of financial and human resources in the transport sector. It is suggested that although the city's ambitious infrastructure plans have the potential to improve transport Dakar's conditions, due to the current lack of funding, there should be a wider focus on rendering Dakar an attractive investment environment. Capacity building and simple straightforward organizational structures (along with 'one stop' investment opportunities) can make a big difference in attractive international interest. It is noted here that Dakar does not enjoy the

strategic position of other cities such as Cairo and Senegal's economy is not as strong as that of other countries. Nonetheless, the city can enhance its potential using other advantages such as tourism.

Finally, it is considered that the social cohesion that for any urban or transport policy to be successful, it should build upon the existing strengths and opportunities of the city. The social cohesion and remarkable vibrancy of the city are considered to be one of the strongest assets of Dakar. Future transport plans should not disrupt the social tissue of the city and facilitate interaction, trade and communication in their existing forms. At the moment, active modes, walking in particular, are beyond the authority of CETUD, and in most cases there is no management or planning for NMT. This should be one of the priorities for the planning authorities as walking makes a significant contribution to social cohesion and enhances the human dimension in megacities. In addition, the planning of streets of Dakar should build upon the current multimodality, economic activity and social interaction levels. Transport and urban planning procedures for streets should start with maximising public use and management of public space, rather than starting with design solutions or more narrowly defined outcomes. Where the self-managing capacity of informal retail does not exist, a planning process can deliver participation, self-regulation, or formalisation through investment in elevating the role of the vendor (Kent, 2013).

5. SWOT Analysis of OIC Megacity Transport Issues

5.1. Introduction

This chapter is a SWOT (Strengths Weaknesses Opportunities and Threats) analysis of urban transport in the remaining 5 OIC megacities. An analysis of the current transport conditions for each city is made based on the framework developed in the literature review. The analysis is made based on research that was not conducted on site, although our contacts in the cities were used wherever available. A SWOT analysis table for each city is provided at the end of each section, based on an assessment of each city. The purpose of the SWOT analysis is to shape a profile of the key strengths, weaknesses, opportunities and threats of each city in order to better understand its urban transport conditions. By consolidating the analysis in SWOT format not only does it become easier to identify the key challenges for a megacity but also the common problems across megacities. A SWOT analysis is a quick and straightforward contextual analysis and provides a wide range of information, which can then be used as a basis for a more thorough review of the problems of each city. However, it is noted that a SWOT analysis is not possible to reflect the complexity of transport issues in a city or provide a solid basis for the prioritisation of policies and plans.

The outcome of the SWOT analyses, along with the literature review and the outcome of the 3 case studies will be used in the following chapter where recommendations are given for all OIC megacities. The following sections therefore present the SWOT analysis of the remaining 5 OIC megacities.

Lagos

5.1.1. Urban background

In terms of administration, Lagos is not a single municipality and has therefore no overall city administration. The urban area of Greater Lagos (after this indicated as Lagos Metropolitan Area/LMA or Lagos) comprises of 16 separate municipalities, which are also known as Local Government Area (LGA). These 16 LGAs together with 4 other LGAs comprise Lagos State. For this study, LMA will be used as study area.

Lagos is the most populous city in Nigeria. Based on the Federal Census carried out by the National Population Commission (NPC) of Nigeria, the population of LMA in 2006 is 7.9 million. The annual growth rate from 1991 to 2006 was 3.5% (Lagos Metropolitan Area Transport Master Plan, 2008). The growth of Lagos is primarily the result of its location on the west coast of Africa which has fostered the development of trade with the hinterland as well as with the neighbouring international countries. The role of Lagos as the administrative capital of Nigeria until December 1991 also contributed to her growth.

Lagos State is the smallest state in Nigeria, but it is the most populous in Africa. It is interesting to note that the population characteristics of the state are heterogeneous with most parts of the nation being represented. Again, despite the relocation of the Federal Capital to Abuja, Lagos State remains, undoubtedly, the economic nerve centre of the country. It harbours almost all the headquarters of the multinational companies in the country. Lagos, occupies an eminent position based on all urban indicators, most especially demography. It should be noted that all other cities are relatively small in terms of commercial, industrial and trading activities in comparison to Lagos. Demographically, the density of Lagos is much higher than other cities in Nigeria. According to Taiwo (2005), while Nigeria's population density is 100 persons per square kilometre (psk), that of Lagos is about 2,400 psk.

5.1.2. Transport network and infrastructure

In terms of transportation, Lagos area is naturally endowed with navigable creeks, lagoons and water body that are suitable for urban transit services. It also has rail line that links the commercial southern part of the city with the dormitory settlement of the North. As a result, Lagos has the potential of benefiting from a seamless transportation system. Ironically, road transport dominates more than 90% of all urban movement (Oni, 2004). According to Taiwo (2005) there are about 2,600 km of roads

in Lagos. These roads are frequently congested with over 1 million vehicular density of over 222 vehicles/km against country average of 11 km. The average Lagos commuter spends over three hours in traffic every day (Aleshinloye, 2014).

Lagos suffers from almost all known transport illnesses, which severely limit mobility and accessibility especially to the poor. The major problems of the transport system are:

- Absence of urban rail based- mass transit system
Currently, Lagos has only a Bus Rapid Transit (BRT) system that has been in operation since 2008.
- Lack of transport infrastructure that connects the slums areas to the activity and employment centres.
- Capacity of the existing arterial road system lags behind due to a rapid annual rate of car ownership level.
- Poor traffic management
- Weak institutional structure

5.1.3. Land use and urban form

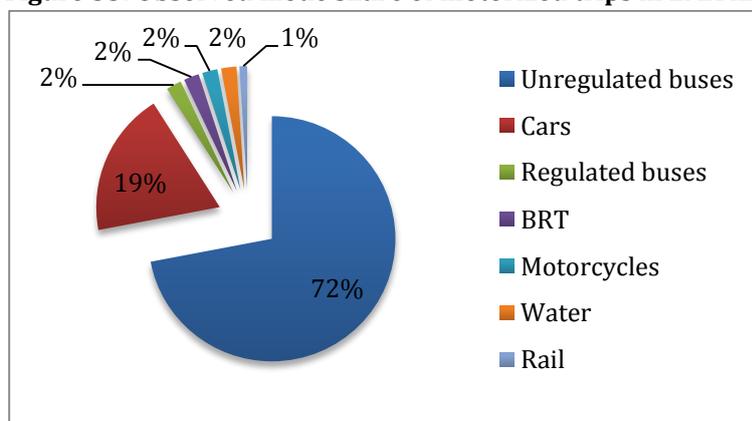
Basically the state lies on low lands, with about 17,500 ha of built up area of which residential areas occupy the single largest proportion of 51.9%, commercial 4.8%, industrial 8.4%, institutional and special use 13.7%, open spaces 2.6% and transportation 18.6% (Olayiwola et al., 2005). Lagos has several central business districts (CBDs), which reflect the city’s internal structure approximating to the “multiple nuclei structure”.

The major influencing factor on land use pattern in LMA is the physical environment. For example much development cannot take place towards the south because of the Atlantic Ocean. The over concentration of urban activities, the agglomeration and increased separation of residencies to work place have created the need for daily journey to work on a massive scale (Oni, 1992).

5.1.4. Mode availability and shares

Lagos is Nigeria’s major traffic centre and the most heavily motorized urban area in the country. In 2013, the demand for trips in LMA by all modes (including walking) was 22 million trips per day. The rapid increase in population and standard of living will bring the daily demand for trips to 40 million per day by 2032 (Mobereola, 2014).

Figure 55: Observed mode share of motorized trips in LMA in 2013



Source: Consultant

5.1.4.1. Private motorized transport

Ownership of a car or motorcycle in LMA is much more common than air conditioner or computer. The households’ primary mode of travel is public bus which accounts for around 77% of the total

number of households. In looking at the comparison of car ownership and use, it appears that more people use cars than own them, presumably because households share use of vehicles for commuting.

Although car ownership level in Lagos is still low, the absolute number of cars is growing at a rapid annual rate (more than 5%) which makes the capacity of the current arterial system, which was built more than a decade ago, cannot deal with the high demand which is still increasing rapidly.

5.1.4.2. Public transport

The current public transport in Lagos consists of:

- Danfo (minibuses), which are mostly old, and owned and operated by single operators. This kind of highly atomized and un-integrated system is very inefficient in terms of operating costs and results in poor service with long travel time and relatively expensive trips;
- Commuter rail service, that serves only 1% of the commuters in Lagos;
- A BRT corridor, which has 22 km route and is operated with 220 buses, is a key component to address transportation and other infrastructural problems in Lagos. BRT Lagos has provided Lagosians access to a decent, more comfortable bus transport system that guarantees faster travel time.
- Okada (motor cycle taxi), a commercial motorcycle used as a vehicle for hire.

In response to the enormous transport challenges in Lagos, the Lagos State Government created the Lagos Metropolitan Area Transport Authority (LAMATA), which is responsible for the formulation, coordination and implementation of urban transport policies and programmes. LAMATA has developed a Strategic Transport Master Plan that specifies the infrastructure details of the modal routes to address the urban transport challenges in Lagos. It is planned that in 2030 Lagos will have the following public transport network:

- Lagos Urban Rail Network
A network of urban rail-based systems covering six light rail and one monorail mass transit corridors of high commuter traffic demand within and beyond the LMA extending to border areas. It is currently being constructed and Transit Oriented Development (TOD) concept will be integrated around the stations to improve connections to activity areas. The Blue Line will be operational in 2016.

BRT network

The current BRT corridor is planned to be extended with eight different corridors within the metropolis.

- Water transportation
Six corridors have been identified and two of them have already been opened with passenger daily service. The development of water transportation has helped integrate transportation modes in the city and brought relief to neighbourhoods that line the water corridors, as well as helping to ease overall traffic congestion. It has also opened up new avenues of investment and employment opportunities.
- Cable car
A 12.85 km network of cable cars serving the metropolis of Lagos and connecting Lagos Island with both the mainland and Victoria Island, which is not directly served by the mass transit networks. The project is being planned and expected to start operations in 2015. This project will act to relieve pressure on the traffic system, alleviating congestion and reducing pollution.

5.1.4.3. Non-Motorized transport

In 2013, walk trips accounted for 40% of total trips in LMA. However, infrastructure and facilities for non-motorized transport (NMT) are very limited due to the problem of road capacity and land use around most cities points. As a result, the level of interaction between pedestrians and motorists is

very high. Cycle way is absent due to the non-recognition of such NMT mode, and there is no adequate funding for NMT in Lagos.

The majority of walkways in Lagos are used for trading and as parking lots. Most of the walkways also suffer from obstruction.

5.1.5. Freight

Freight transportation plays an important role in the economy of Lagos, as the demand for goods transport is strongly dependent on the level and nature of economic activities (Oni, 2004 in Somuyiwa, 2010). Vehicular volume for freight has continued to increase over the years and capacity expansion has been regarded as a major panacea to minimization of road traffic congestion in LMA. Ironically, the construction of new roads and expansion of old ones by successive administrations in Lagos has never ameliorated the problem (Somuyiwa, 2010).

Despite the large volumes of goods transported from and to LMA, there is no accurate and reliable data of origins and destinations of the goods, which hinders an effective and efficient analysis of freight transport as well as transport planning of LMA (Mckinnon, 1998; Nockold, 2001 in Somuyiwa, 2010). According to Somuyiwa (2010), industrial areas need to be planned relatively to design, operations and maintenance of roads for instance, such that ultimate objectives of logistics can be achieved. This can only be done through several advance techniques such as geographic information system, global positioning system, logistics knowledge, intelligent transport system and modelling to optimize the city environment, such that it assists in reducing both transport cost and negative environmental impact.

5.1.6. Road safety

Traffic congestion in Lagos leads to not only increased fuel consumption and emission, but also high accident rates. The increasing rate of road accidents has promoted more the need for private car ownership. NMT users are the most vulnerable ones due to poorly protected street space for them. Accident rate in Lagos is considered the highest in the world (World Bank, 2008).

5.1.7. Urban transport infrastructure financing

In the last decade, transportation infrastructure has been the focus of the public expenditure and PPP scheme is centre in financing transport sector in Lagos. For the BRT for example, LAMATA set up the first line with support from the World Bank. Private operators run the line in partnership with the National Union of Road Transport. Commercial banks also take part by funding loans for purchasing the vehicles used by the private operators.

Following the effectiveness of PPP venture for the BRT system, LAMATA was keen to explore the PPP scheme for the implementation of its rail projects, under which the first metro line is being constructed.

5.1.8. Health

5.1.8.1. Air quality and pollution

The profile of air pollution in Lagos by type and source reveals that road traffic is the major source of air pollution in the city. Other sources include industries, dumpsites, open incinerators, and power generators. The reason for this is not farfetched, 60% of all activities are carried out using motor vehicles. Air pollutants of concern in Lagos include NO_x, SO₂, and particulate matter. These gases have serious consequences on people's health. Arising from the health implications of air pollution is that of the economics of it. It is believed that cost of air pollution in Lagos would have increased medical costs such as medicines and hospital visits and on productivity losses.

5.1.8.2. Physical activity

Despite of high motorization rate in Lagos, walk trips has also a significant modal share, which is 40% of total trips in LMA (see NMT section). These trips are mostly done by low income travellers who cannot afford to pay public transport fares. The advantage of a high number of pedestrians in Lagos is the physical activity by walking that they perform regularly, can positively contribute to their health condition (reduce risk of diseases such as cancer and diabetes).

On the other hand, pedestrians are those who are directly and mostly affected by air pollution exhausted by motorized vehicles due to congested traffic in Lagos.

5.1.9. Climate Change

The humid tropical climate of Lagos is influenced by her coastal location and nearness to the equator and is characterised by two distinct seasons: wet and dry season. During the rainy season many parts of Lagos are susceptible to flooding. Major causes of floods in built-up areas are uncontrolled expansion of impermeable surfaces due to increasing urbanization resulting in increased runoff volume, runoff responses under high intensity rainfall, building on floodplains, lack of storm water drainage, failure to maintain existing drainage systems and weak institutional capacity of the urban administration.

According to many studies, climate change has been responsible to the changes in the intensity and pattern of storms in Lagos. Fewer rainstorms recorded in the latter period are much heavier than those of the earlier period with a tendency to producing more floods. Since most of Lagos lies 10 meters or less above sea level, infrastructural investments have also been driven by the need for climate resilient development.

Lagos State's transportation sector contributes to almost 50% of Nigeria's greenhouse gas (GHG) emission. The deployment of BRT has been acknowledged to reducing CO₂ emissions from urban transport by 13% (UNEP, 2013).

5.1.10. Social exclusion

5.1.10.1. Ageing population

Mobility and quality of life of elderly in Lagos are significantly related to the quality of neighbourhood (Alade et al, 2013). Quality of life in this context is linked with the socioeconomic attributes of the people and the quality of transport system available to them in the pursuit of their daily activities. Old people in planned residential neighbourhoods tend to have higher quality of life in terms of socioeconomic status and mobility than those in unplanned communities, as neighbourhood quality to a great extent determines the quality of transport infrastructure which in turn affects quality of life.

5.1.10.2. Gender

In Lagos, women are the worst hit of the prevailing criminal activities in public transport (Olufemi, 2009). Women are often perceived by perpetrators of crime as weaker sex, thus their inability to defend themselves against crime partly, made them frequent victims or prey to crime in public transport. High demand or rush for public transport during peak periods often generates disorderly behaviour and simultaneously leads to a conducive environment for criminal activities of different types.

Most criminal activities occur while waiting for buses and okada because most bus stops are being wrongly located and poorly designed. Such criminal activities in public transport have continuously affected the travel pattern and livelihoods of women in Lagos.

5.1.10.3. Urban poor

The role of Lagos as an economic activity centre has attracted migrants from other parts of the country and West Africa. However, this does not go hand in hand with adequate housing for the residents. Unmanaged urban growth has seen land prices shoot up, pushing many out of the city. As a result, slum communities have grown rapidly in Lagos which lack basic infrastructural facilities and characterized by extremely poor environmental conditions. Almost 70% of Lagos’ population consequently live in slums, makes Lagos one of the poorest of the world’s largest cities. Poverty in Lagos is deeper and more severe than in the country as a whole, with occupations of the poor mostly self-employed in street trading and unskilled tasks in the informal sector.

The slums are not properly connected to the road network because the pace of the development of the primary and secondary road network does not match the pace of the urban growth. In addition, areas that are not easily accessible cannot develop local activity centres that may substitute to some extent the traditional activity centres in the Central Business District (CBD). Furthermore, inadequate regulatory public transport framework affects the poor who are often vulnerable to high cost of transportation. The poor rely heavily on public transport to access work, health care and educational facilities. Bus remains the favoured mode of transport for the city’s large poor population. Transport fares amount to 20% of budget for poor households (World Bank, 2008).

5.1.11. Human dimension

The continued pressure on land has harmed the human dimension of urban planning in Lagos. Slums were formed that lack of basic urban infrastructure services, such as safe water, storm drainage and flood prevention, electricity, access roads, public transport, sanitation, and solid waste management. In those low-income areas, the household density is very high, i.e. 6 – 10 members per household (5 – 8 persons per room) living with minimum social amenities.

In the last decade, the Ministry of Physical Planning and Urban Development has undertaken several initiatives to improve this condition, such as renewal of urban areas, slum upgrading, upgrading urban facilities, social rehabilitation and economic empowerment.

5.1.12. SWOT Table Lagos

Based on the literature review and desk research of the urban transport conditions and plans of Lagos, the following SWOT analysis can be summarized below:

<p>Strengths</p> <ul style="list-style-type: none"> • Strategic location as the economic hub of West Africa (great economic potential). • Extensive waterfronts, water bodies and port facilities. • Global recognition as an economic centre. • Large and diverse population • High demand for public transport • Existence of LAMATA as Transport Authority and its willingness to expand public transport network. 	<p>Weaknesses</p> <ul style="list-style-type: none"> • Massive daily traffic congestion • Inadequate and overburdened transport infrastructure • Low recognition of NMT policy • Poor freight transport planning • Housing shortage • Social and economic exclusion • Increasing poverty rate • Rapid population growth • Poor regulations, weak enforcement, and lack of capacity • Low gender and urban poor inclusion • Poor road safety (very high accident rate) • Poor air quality
<p>Opportunities</p> <ul style="list-style-type: none"> • Harbours almost all the headquarters of the multinational companies in the country. • Attractive for investments. • Growing economy. • High mode share of walking. 	<p>Threats</p> <ul style="list-style-type: none"> • Uncontrolled urban sprawl due to high rate of in-migration • Unsafe urban environment and terrorism

The strategic location of Lagos has been its greatest strength. With its extensive waterfronts, water bodies and port facilities, Lagos has become the economic hub of West Africa. This contributes mainly to Lagos' rapid population growth which in turn becomes one of the weaknesses of Lagos as it creates bigger problems for Lagos, such as housing shortage and increasing poverty rate.

Lagos' large and diverse population can also be seen in a positive way, as it creates high demand for public transport which is essential to provide efficient urban transit services. The existence of LAMATA as the transport authority for Lagos Metropolitan Area is a good example for other megacities in developing worlds as it ensures an integrated and a coordinated transport policies and programmes for the metropolitan area. LAMATA's willingness to extend Lagos public transport network, not only land but also water based, is also a strength to realise sustainable urban transport in Lagos.

This is also supported by opportunities that Lagos has, such as harbouring a lot of economic headquarters, which shows that Lagos is an attractive place for investments and that it has a positive economic growth. In terms of sustainable transport, walking is a basic demand in Lagos as many people cannot afford to pay for using public transport. As such, walking has a high mode share in Lagos. This should be seen as an opportunity to promote more sustainable transport modes in Lagos as the demand already exists. However, despite the high demand of walking, the policy recognition for NMT modes is very poor. This results in a very high rate of accidents involving NMT users due to a high level of interaction between them and motorists.

Just like many other megacities, Lagos is facing massive daily traffic congestion due to its inadequate and overburdened, mainly road, transport infrastructure. Uncontrolled urban sprawl due to a high rate of in-migration, which has been threatened Lagos, also creates the need for daily journey to work on a massive scale.

5.2. Karachi Urban Background

Karachi is the largest urban and economic centre of Pakistan. According to the United Nations (2014) the population of the urban agglomeration of Karachi is currently 16 million and it expected that it will reach about 25 million by 2030. It is located in the south of Pakistan, on the Arabian Sea, west of the Indus River mouth. Karachi was the capital of Pakistan from the independence of Pakistan in 1947 until 1958, when Islamabad was built in the north of the country to provide a better distribution of functions and activity in the country. Karachi remained the capital of Sindh province and never loses its industrial, business and financial capital character and (Qureshi and Huapu, 2007; Qureshi, 2010).

The city has experienced a rapid growth since 1947, when it had a population of 0.4 million living in an urban area of 233 km². By 2004, the city had seen a 35 fold increase in its population and a 16 fold increase in its spatial expansion, reaching 14 million people and 3566km² of urban area. Urban growth in Karachi was predominantly induced by the influx of migrants and refugees. In 1971, a huge number of refugees migrated from East Pakistan (current Bangladesh) and similarly in the 80s from Afghanistan. Census in 1981 revealed a total of 1.72 million refugees in Karachi with more than 2.15 million in 1998 (Qureshi and Huapu, 2007; Qureshi, 2010).

Until 2001, Karachi was considered as division and comprised of five administrative districts: Karachi East, Karachi West, Karachi South, Karachi Central and Malir. From August 2001, it has been subdivided into 18 towns, each having Union Councils as further subdivision. Karachi has total 178 Union Councils with a population of around 55 to 65 thousand people each. After the subdivision, the City District Government Karachi (CDGK) acquired increased administrative power to steer and guide the city's growth. The current organizational structure of CDGK is detailed and complex (Qureshi, 2010).

5.2.1. Land use planning and urban form

Karachi is a monocentric city where over 70% of the businesses and about half of the retail trade and public services are located in the central business district. Rapid population growth and spatial expansion have led to a sharp increase in the demand for urban transport facilities as they were not accompanied by the appropriate development planning. Five urban plans have been developed for the city since 1949 but none of them has been implemented in the city. As a consequence the city suffers from a chronic shortage of basic facilities such as housing, water supply, electricity and public transport. It is estimated that 50% of the population of Karachi currently lives in informal housing. The density of the population varies significantly from the city centre to the suburbs, reaching more than 24,000 people per square kilometre in the densest, central areas.

5.3. Istanbul Urban Background

Istanbul has been an attractive location since even before the Byzantine era due to its strategic location, connecting Europe and Asia through the Bosphorus Strait. The city has experienced rapid growth after WWI and became the core of the Turkish economy. Today, Istanbul has a population of 14 million (18% of Turkey). The average population density has increased from 1,000 people per km² in the 1980s to an average of 2,400 people per km² today, varying considerably up to 20,000 people km² in central areas with peaks of 40,000 to 70,000 people per km² in totally urbanised areas on the European side (Alpkokin et al, 2005; Hennig, 2011). Istanbul remains Turkey's centre of economic activity, where almost one fifth of the country's GDP is produced.

5.3.1. Land use and urban form

Two thirds of the population of Istanbul live on the European part of the city. However, the population of the Asia part has grown more rapidly since the 1980s. Migration, particularly from the southeast part of Turkey, has expanded the urban limits and new residential areas have spread across the shore of the Sea of Marmara and also beyond the municipal limits, into the northern forested areas towards the Black Sea. As a result of the rapid and extensive growth the city has changed from double centred (Eminonu – Beyoglu) to multicentre with various sub centres on the European and Asia side. New areas away from the original city centre have developed as car dominated residential or mixed use with industrial and business parks (Henning, 2011).

The polycentric form of the city was supported by the 1995 Istanbul Metropolitan Area Sub-Region Master Plan which aimed to achieve linear and multi-centred urban growth, but with a degree of hierarchical ranking. The main target of this plan was to abandon the concept of the double centred developed as under the burden of rapid urbanisation this could destroy the historical identity of Istanbul. Policies to achieve this involved developing ranked sub centres, generating wing attraction centres, and the preparation and application of development plans, and removing the Law Courts, buildings of the Central Government, and similar public bodies and institutions, from the city centre and redistributing them to the sub centres. Supporting policies included creating organized employment areas and generating feasible, low priced land and planning the integration of employment areas into the residential settlement areas while considering acceptable travel time lengths for access (Alpkokin, 2005).

5.3.2. Institutions and organization

Istanbul's urban transport authority, IETT, was created in 1939, when tram, Tünel (a short funicular between Pera and Galata), bus and electricity establishments, which had been operated by various foreign companies until that time, were nationalized. Today, IETT is responsible only for the public transport system, which includes buses, BRT (Metrobüs) and Tunnel Operations and also responsible for the management and inspection of Private Bus Transit Services. Istanbul's metro and light network are operated by Ulasim, ferries are operated by Sehir Hatlari and IDO. These divisions work and are

administered like companies, nonetheless they remain within the ownership of the metropolitan municipality.

The coordination and integration of other and private operators (taxis, dolmus, minibuses, or ferry companies) into the overall system is administered by the municipality as well. The dynamic development of the city requires the formation of a single authority which will manage planning, financing and compensating the private sector under a single interface. More benefits of competition and better performance are expected when suitable contracts are awarded to independent operating companies. A private company may be more flexible to changed demands or new technologies.

5.3.3. Urban freight and logistics

Istanbul is the node of Turkey's international transportation corridors, processing 60% of the country's total trade volume and has been strengthened by recent major transnational transport infrastructure projects, expansion of the multimodal transport and improved port management systems. The city, as well as maintaining and overland routes to other countries, is a key part of a major industrial area which is located close to the vital Black Sea- Mediterranean Sea route (Oguztimur and Canci, 2011).

Both in Turkey and Istanbul logistics activities are mostly consist of transportation and custom operations. In Istanbul logistics functions have traditionally been unplanned and unbalanced. Besides the development problems, the existing ports (Ambarlı and Haydarpaşa) have inadequate capacity and do not have rail links, while highway links can also be problematic. In addition, in the absence of a logistics centres, depots are scattered in and around the city, exacerbating the congestion and reducing the efficiency of urban freight operations. The lack of coordinated and integrated transport planning and investment for logistics and freight also contributes to the lack of efficiency in operations. In the case of air transport, the lack of a master plan for air transport, and lack of research and development, is compounded by various inadequacies and management problems in cargo terminals which are already very limited in number. Also, regarding railway transportation, logistics firms suffer from an accumulated lack of investment, limited rolling stock, management problems, and an outmoded and inadequate network (Oguztimur and Canci, 2011).

In 2006 the Greater Istanbul Municipality Planning Department, prepared an Environmental Plan. In the plan report the objective of competitiveness and promoting Istanbul as a "global city", and the objective of environmental sustainability were both emphasized. The report asserted that the advantage of geographical proximity of Istanbul to Europe should be fully utilized to promote the city as a logistics centre for companies operating in the Mediterranean, Black Sea and Middle East markets. Because the quality of products and their fast and cheap delivery has become a priority, Turkey should be able to compete with China or other countries (Oguztimur and Canci, 2011).

In order to provide access for inflows and outflows of industrial products, the Greater Istanbul Municipality also proposed new logistics centres, port developments, transportation infrastructure embellishments, and improvements in existing ports and airports. In the plan, various measures have been proposed in order to relieve the city from unwanted traffic, and to increase the efficacy of logistics activities. These measures include the removal of customs facilities from residential areas, launching new roll-on, roll-off (Ro Ro) lines in the Marmara Sea, banning further housing development around existing ports and airports, and providing facilities for combined transportation (Oguztimur and Canci, 2011).

5.4. Dhaka

5.4.1. Introduction

Dhaka is the capital of Bangladesh and one of the fastest growing megacities in the world. Dhaka's population saw an exponential increase since the 1950s which was triggered by its role as the capital of East Pakistan (1949-1971) and later as the capital of Bangladesh (after the 1971 Independence).

The increase in population is attributed mainly due to rural urban migration triggered by the lack of employment opportunities, poverty, and natural disasters. The rapid development of Dhaka into a megacity was coupled with an inadequate urban management system, which led to a chronic shortage of housing, excessive overcrowding, traffic congestion, increasing informal economic activities and also, air, soil, water pollution, slum development in flood prone areas and a deteriorating situation for public health.

5.4.2. Transport network and land use planning

Dhaka's infrastructure doesn't match the scale of its population and only 7% of the city is covered by roads, compared with around 25% of Paris and Vienna and 40% of Washington and Chicago. Dhaka also suffers from the absence of road hierarchy while there are 650 major intersections, but only 60 traffic lights, which are not maintained properly. The cost of Dhaka's traffic congestion is estimated at \$3.8 billion a year, including only time losses and pollution, and not deterioration of quality of life and social capital. The poor infrastructure and undeveloped road network has forced the residents of Dhaka to crowd into the middle of the city, setting up informal settlements between high rise buildings and walk to work (Hobbes, 2014).

Figure 56: Typical rickshaw traffic conditions in Dhaka



Source: Mattia Latini/Thinkstockphotos.com

Mode availability

Out of about total 21 million trips generated in Dhaka metropolitan area every day, only 5% are carried out by private cars, which however use roughly 80% of the road space and are the main cause of traffic congestion. Yet 28% of the total trips are carried out by buses which only use about 5 % of the road space. In addition, 58% of the total trips are made by walking, bicycling, or riding on rickshaws. But these NMT modes barely get proper allocation of road space. There are no dedicated bicycle or rickshaw lanes on any roads in Dhaka and less than 25% of roads have separated, paved sidewalks, most of which are either occupied by parked cars or damaged without proper maintenance. NMT users expose their lives to risk as they move in the city (Fang, 2014).

5.4.3. Road safety

According to the Bangladesh Road Transport Authority (BRTA), the number of road fatalities in Bangladesh was higher than the number of accidents. Although these statistics refer to the entire country and do not necessarily reflect the actual figures (as it is only the information provided by the police) they provide a good idea of the current situation in the country. Older data for Dhaka indicates that almost a fifth of road accidents in Bangladesh are concentrated in Dhaka.

National road safety strategies have been adopted in the past (1997-1999 and 2002-2004) but despite the fact that they were comprehensive achieved very little. In addition, awareness campaigns have been organized, which were mostly concentrated on highway accidents. In Dhaka, almost 75% of accidents involve pedestrians¹² (Maniruzzaman and Mitra, 2005; BRAC, 2005; World Bank, 2013).

¹² For example, according to other official sources every year about 10,000 people are killed in road accidents in the country (BBC, 2011).

Table 11: Road accidents and casualties statistics

Year	Total Number of accidents	Deaths	Injuries	Total casualties
2004	3917	2968	2752	5720
2005	3955	3187	2755	5942
2006	3794	3193	2409	5602
2007	4869	3749	3273	7022
2008	4427	3765	3284	7049
2009	3381	2958	2686	5644
2010	2827	2646	1803	4449
2011	2667	2546	1641	4187
2012	2636	2538	2134	4672
2013	2029	1957	1396	3353
2014	2027	2067	1535	3602

Source: BRTA, 2015

5.4.4. Institutions and organizational structure

Dhaka Transport Coordination Authority (DTCA) was established in 2001 and is responsible for coordinating the transport operators and development agencies that are involved in transport projects in Dhaka. Along with the chronic extreme traffic conditions, DTCA has to deal with a big number of private operators who provide their services under little or no official control. At the same time, the number of operators and rickshaw drivers who operate outside of DTCA's authority lead to the further deregulation of the traffic conditions.

5.4.5. Infrastructure financing

Dhaka has received support from international organizations such as JICA and the World Bank in order to relieve its congested roads, build key infrastructure, introduce mass transit systems and develop strategic plans.

The Dhaka Urban Transport Project (DUTP) was one of the first World Bank projects aimed at easing the complex transport problems facing Bangladesh's capital. As the city's urban transport problems cannot be solved by any single project, this project focused on the most urgent infrastructure issues.

The World Bank's aim was to help the Government of Bangladesh develop, refine, and implement appropriate strategies for managing road traffic and services in Dhaka. It also aimed to assist in the preparation of an urban transport policy and a 20-year strategic transport plan for the Dhaka Metropolitan Area (DMA). The project closed on June 30, 2005.

The project has brought about some marked improvements:

- Phasing out of two stroke three wheelers has improved air quality;
- Pedestrian footbridges and footways have been built as a first effort to make movement easier for the city's poorest people who can only afford to walk;
- Flood damaged roads have been rehabilitated;
- Traffic conditions have improved with better traffic management on arterial corridors and at major junctions with some 60 traffic signals installed;

- The Mohakhali Flyover, the single largest contract under the project, is easing traffic congestions and delays;
- Some public transport services along project corridors have improved;
- Three major inter-district bus terminals have been rehabilitated;
- National vehicle and driver licensing systems have been computerized and agency personnel trained;
- The regulatory framework for public transport has been reviewed, a policy for enforcing parking restrictions drafted, and bus route franchising pilots proposed to improve bus services;
- An urban transport policy, a plan for institutional strengthening and capacity building and a strategic transport plan for improving transport services in Dhaka have been developed for the 2005-2025 period.

Despite the many improvements, however, these changes have not reached the levels intended at the project design stage. This is because the project's components had to be restructured at the time of the midterm review in early 2002, and were reduced by 40% due to unsatisfactory progress. Also, the project had limited impact on strengthening the DMA's institutional and policy framework to address transport planning and coordination issues (World Bank, 2013).

The World Bank also supported the conversion of one pilot corridor to a rickshaw free zone which reduced travel time by about 30% per trip. Studies show that most travellers in this zone support this conversion, some segments of the population, especially rickshaw pullers who plied these routes, and some travellers who relied on rickshaws for short distance trips, have been adversely affected. The wider implementation was eventually abandoned as aggregate positive impacts of NMT free conversion on transport users and transport providers did not outweigh the aggregate negative impact (World Bank, 2013; ITDP, 2005).

In addition, the government of Bangladesh has received a loan from the Asian Development Bank to implement the Greater Dhaka Sustainable Urban Transport Project which involves a building a 20 km long BRT route, starting from Hazrat Shahjalal International Airport to Gazipur. Once BRT project is in operation, it will carry 20 thousand passenger/hour/direction and travelling time will be half of the present (Bangladesh Bridge Authority, 2015).

5.4.6. Health

Air pollution is a severe problem in Dhaka. Traffic is one of the major sources of particulate matter and gaseous pollutants in the city. The numerous three wheelers and taxis are the most polluting vehicles while constant congestion leads to toxic levels of pollutants in the atmosphere. Policy interventions are primarily focused on traffic emissions. The banning of leaded petrol and two stroke vehicles in 1999 and 2003, the promotion of compressed natural gas and the introduction of air pollution control devices have led to a slow but steady improvement (Burkart et al, 2007).

5.4.7. Climate change

In Dhaka, a large proportion of greenhouse gases come from the electricity and transport sectors, although their contribution to total global greenhouse gas emissions is negligible. Given the rate of population growth in Dhaka, electricity consumption and the transport sector, the city's contribution to global greenhouse gases will increase. It must be noted that brick kilns around the city and landfill sites also contribute to global greenhouse gases. They usually operate for about six months a year, and every year in the dry season, they burn nearly 2 million tons of coal (Alam and Rabbani, 2007).

At the same time Dhaka is severely affected by the effects of climate change. The city has faced a number of severe floods since its early days and its vulnerability to these resulted in the building of the Buriganga River flood embankment in 1864. Severe flooding in Greater Dhaka is mainly the result of spill over from surrounding rivers that flow to and from the major rivers of the country, as well as internal water logging. In recent history, Dhaka has experienced major floods in 1954, 1955, 1970,

1974, 1980, 1987, 1988, 1998 and 2004, due to overflowing of surrounding rivers. Of these, the 1988, 1998 and 2004 floods were the most damaging (Alam and Rabbani, 2007).

Table 12: SWOT Table Dhaka

Strengths High densities Availability of financial support from international organizations	Weaknesses Extremely large mismatch of supply and demand Air pollution Chronic congestion
Opportunities Social cohesion Political stability Political willingness to make transport more sustainable	Threats Lack of urban management Threats of flooding Rapidly increasing population Slow development of infrastructure Informal transport and housing sectors

5.5. Tehran

5.5.1. Urban background

Tehran is the biggest and most populous city in Iran. As explained earlier, although its metropolitan area has a population of only 7.5 million, the population of the city during the day can reach up to 12 million as commuters arrive from the heavily urbanised wider region of Tehran. The city covers an area of nearly 800 square kilometres. Tehran had a population of 0.7 million in 1941 and since then it was heavily urbanised and expanded, becoming one of the major megacities in the Middle East region (ITDP, 2011; Shoar, 2008; Allen, 2013).

Over the past two decades, the metropolitan region of Tehran has been growing at a rate of about one% per year. Along with the challenge of growing transport demand the city was faced with the general public’s rising expectations in terms of quality of life. The authorities of Tehran have examined and implemented a number of sustainable transport solutions and made a significant improvement that was internationally recognised. Tehran was nominated for the Sustainable Transport Award by the Institute for Transportation & Development Policy. The city has developed a comprehensive public transport policy, which was embedded into its vision of improving quality of life by having integrated, available, safe, easy, comfortable and clean transportation system, delivered within limited resources (ITDP, 2011; Shoar, 2008; Allen, 2013).

5.5.2. Transport network and land use planning

Tehran municipality is currently organized as a monocentric city with a major CBD (districts 6, 7, 11 and 12) where most commercial activities are concentrated. The CBD is surrounded by several residential areas. Most of the future urban development is expected to take place in the north and eastern parts of the city with lower levels of development in the south of the city (districts 21 and 22). The Greater Tehran region includes several small and medium sized surrounding cities (Karaj, Varamin, Eslamshahr, Shahrian), whose populations have increased without an equivalent increase in the number of jobs, which remain concentrated in Tehran. This generates large numbers of commuting trips both within the city also to and from the smaller surrounding cities (Allen, 2013). Tehran’s planning history shows early stages in which new infrastructure was designed and developed by the government as part of its strategy for modernisation and growth management. The intensity of speculative development after the Second World War met the demands of the exponential growth of the city’s population. This, however, needed to be controlled and regulated through a planning process, which produced Tehran’s comprehensive plan of 1968. Within a decade, the revolution interrupted its implementation, and growth could only be managed through piecemeal

efforts. The period of reconstruction in the 1990s relaxed some of the limits of the 1968 plan, which showed the urgent need for an updated planning framework (Madanipour, 2006).

The municipality of Tehran produced its own strategic plan for the period 1996– 2001, known as Tehran Municipality's First Plan, or Tehran 80. The plan allowed higher densities through bonus zoning. This, however, was not based on planning considerations, but was mainly to bring financial autonomy to the municipality. Developers could build taller buildings by paying fines to the municipality, in a policy popularly known as “selling density”, without having to show their impacts on the surrounding environment. The face of the city, particularly in its northern parts, was transformed in a short period, consisting of medium to high rise buildings connected through wide streets and motorways. In the poorer south, a major redevelopment project, Navab, cut a motorway through the dense and decayed fabric, building superstructures on each side (Madanipour, 2006).

This controversial period of reconstruction was followed by a period of democratic reform, which re-launched an elected city council for the city. The council published its own vision of the city as Tehran Charter in 2001, which was the summary of the principles agreed between council members, nongovernmental principles, which were used to develop strategies for natural and built environments, transport, social, cultural and economic issues, urban management, and the city's regional, national and international roles (Madanipour, 2006).

National government started work on a transport master plan for Iran at about this time, using outside consultants, looking at the investment needed to satisfy the growing demand and to try plan better for the future. With Tehran as the capital city and also the main urban centre for generating wealth, it was important to develop a transport master plan for Tehran that would also support the national transport plan (Allen, 2013).

5.5.3. Mode availability

In Tehran, 22% of trips are made by bus, 23% by shared taxi, 10% by metro, 10% by minibus, 7% walking and cycling (NMT) and 28% by private car (Allen, 2013).

5.5.3.1. Private motorized vehicles

Private motorized vehicles are still expensive to buy but their number is expected to grow by almost 60% within the next twenty years as people will be able to afford goods vehicles, cars and motorbikes. Increase in private car travel is observed but many vehicles are used for more than one purpose due to their high buying cost. Nonetheless, in 2009, the existing heavy subsidies on fuels were removed in order to cut down the use of private motorized vehicles. In addition, Tehran is one of the few cities in the region that has put in place comprehensive demand management measures to restrict vehicle access to inner Tehran by implementing a Congestion Charging System. Access of all vehicles to the inner central business district (19 square kilometres) has been restricted since 1981 which was later extended to cover 31 square kilometres. An annual fee has to be paid to enter this area and an even and odd number plate enforcement is in place in a slightly larger zone. Trucks and lorries are restricted across a larger area. At first, monitoring was done by the police via 65 gateway entrances but this was difficult to enforce and violations ran at over 30%. Today measures include the implementation of automatic speed cameras, and automatic control system (Allen, 2013).

5.5.3.2. Public transport

As part of historic legacy, even in the late nineties, Tehran had a reasonably dense, quite heavily used but ageing network of suburban and intercity rail transport services. In addition, the metropolitan area of Tehran has an extended network of highways (280 km) and of interchange ramps & loops (180km). In 2007 there were 130 kilometres of highways and 120 kilometres of ramps and loops under construction (Tehran Municipality, 2015).

A metro system had been planned since the 1970s but only became operational in 2001. Problems arising from the late completion of the metro led to buses taking on the role of the metro lines, serving mainly long distance routes while a large number of taxis filled the void for local journeys. The taxis

are only allowed to drive on main avenues, and only within the local area, so it may be necessary to take several taxis to reach a destination, which has also contributed to the extreme congestion and air pollution within the city (Tehran Municipality, 2015).

Tehran Municipality developed a visionary strategic plan for transport 'Tehran in 2025' during a five year period (2003–2008). This comprehensive plan is based on the wider 'Tehran's Comprehensive Strategic Development Plan – 2025 Outlook'. Stimulated by a strong interest in rail at the national level since around 1997, the plan for improving mass transit in Tehran was developed setting the framework with suburban and metropolitan rail at its heart. However, as the plan evolved it became clear that a strong bus network would be needed to complement this. The final plan catered to provide for just over 19 million daily trips by mass transit (rail and bus services) aiming for a 42% modal share by 2030.

A systematic approach for designing the public transport network was taken based on:

- Bus and Railway being the primary, high capacity modes of the public transport network (with both public and private sector involvement);
- Vans and Taxis as the second level providing complementary services to the above (mainly with the involvement of the private sector);
- Priority would be given to public services in the design of the road network.

The metro system now carries nearly 2 million passengers a day, representing 12% of the total number of trips made in Tehran. Metro development and operations are split into two publicly owned companies, one for operations and one for capital investment.

The first BRT line was introduced into Tehran in 2007. The BRT system in Tehran adapted Bogota's Transmillenio to the city's own needs in terms of design features, dedicated right of ways and pre boarding payment. The study for adapting the design of the final BRT network was carried out by Amirkabir University of Technology in Tehran. An increase of 77% passengers per day was achieved in the first year of operation. Passengers grew from 214,000 passengers to 380,000 daily in the period between May 2007 and May 2008. Two further lines were introduced in 2008. At the moment there are 10 lines.

In 2010 an integrated electronic fare collection system was introduced on metro and bus services. It is currently in use on all bus fleets directly under operation of the Municipality equipped with e-card readers. However, the bus market is still fragmented with many small operators who have entered the market in a haphazard fashion working independently from each other and thus offering different quality standards, ticketing systems and marketing approaches. Although there is a joined ticketing system of the Metro and BRT company, the Tehran Bus company engages private drivers with their buses to fill up service gaps. These private buses are also not able to fulfil or guarantee the same quality standards (Allen, 2013).

Informal transport in Tehran is not as common in Tehran as in other Asian countries due to the high costs of vehicles. This means that competition among various operators is not as intense as in other countries and therefore prices remain high. However, as vehicles become more affordable, informal transport is strengthened and becoming more competitive, covering the gaps in transport provision.

5.5.3.3. Non-Motorized Transport

The promotion of cycling as a green, safe and cost effective mode of transportation especially for local access and short distance trips has been a major preoccupation of Tehran municipality since 2011. Based on the Tehran Transportation and Traffic Master Plan and demand analysis for cycling, more than 368 kilometres of dedicated cycling routes have been put in place (Allen, 2013).

A new ambitious €40 million plan aims at fostering daily bike use and the final objective is to reach a 12% bicycle modal share by 2030.

Among the major initiatives taken are:

- Safe access of students to schools, including safe zebra street crossings equipped with buttons to change the lights and traffic signals in front of schools;
- Improved accessibility of passengers to public transport services, for example the passenger bridges are equipped with escalators and the terminal design with pedestrians in mind
- Renovation and restructuring the passages and pavements for normal pedestrians and people with physical disability.
- The construction of dedicated walkways, pedestrian areas and 'No-Car' passages especially in major amusement and shopping centres including Tehran's traditional 'Bazaar' (Allen, 2013).

Also, in 2009 also bike sharing with about 500 bikes was introduced in one of the districts of Tehran. The major feature of cycling projects is the involvement of private sector investment for the bicycles, the rental centres, and other facilities. The route and infrastructure is designed and established by the Municipality (Allen, 2013).

5.5.4. Road Safety

The road safety situation in Iran is poor, with road crashes serving as the second highest cause of death in the country. The high death tolls are blamed on excessive speed, unsafe vehicles, widespread disregard of traffic laws and inadequate emergency services. However progressive actions from road safety actors and the Road Traffic Police are slowly starting to make a difference (Global Road Safety Partnership, 2014).

Overall, 14.9% of all deaths with 26.9% of years of lost life were from injuries in Iran and deaths from traffic injuries (30.0/100,000) are among the highest in the world. The overall incidence of traffic accident was 17.3 per 1000 per year. Traffic accident rates in men and women were 22.6 and 11.8, respectively. The overall traffic accident mortality rate was 26.6 per 100,000 person years, which was almost three times higher in men than that for women (40.4 compared to 12.1 per 100,000 person years). This ratio was higher for motorcycle and bicycle accidents. The highest% among women was seen in the pedestrian involved accidents. These findings are consistent with the findings of other studies from developing countries. This relates to the gender roles of males and females and also with women's social limitations regarding riding motorcycles and bicycles. Men are more likely to be involved in work outside homes and on the street than women in Iran. It is estimated that only 12.5% of women were employed outside of their homes in Tehran. Lower economic level was associated with increased incidence and mortality of traffic accidents (Sehat et al, 2012).

It is noted that Iran does not participate in the UN's decade of action for road safety.

5.5.5. Institutions and organizational structure

During the 1990s strong political leadership from the Mayor of Tehran put a series of sustainable transport studies and projects in motion which maintained their momentum even after change in the local leadership. During that period, the city saw a thirty fold increase in its revenues, a fifteen fold increase in green space and the start of construction of the city's new metro system. In addition, the local government introduced number of measures to reduce emissions from the transport sector (ITDP, 2003).

At a regulatory level, the Iranian transport planning framework is strongly focusing physical planning aspects. Every city with more than 500,000 inhabitants has to elaborate a transport development masterplan. These masterplans have to be updated in five year intervals and are valid on municipal territory only. Usually, every transport masterplan is the product of a (semi)private consultant who has been assigned by the municipality to elaborate the plan. In the case of Tehran these consultants were the Tehran Comprehensive Transportation and Traffic Studies Company (TCTTS) and the Transport and Traffic Organization (TTO). The Supreme Council for Coordination of Iranian Cities'

Traffic within the Ministry of Interior is responsible for the plan approval. After the approval the plan is submitted to the municipality for implementation and the responsible department within the municipality assigns companies or public transport service contractors to implement the plan (Arndt and Döge, 2013).

Public Transport is mainly organized by the municipality in Tehran and the Traffic and Public Transport Office reports directly to the Mayor. There is, however, a growing proportion of operations and maintenance being outsourced to the private sector. As much as 40% of public transport operations (excluding taxis) are run by the private sector (Allen, 2013).

5.5.6. Infrastructure financing

In recent years, and especially in order to improve the quality of service, accessibility and efficiency of the public transport services, Tehran Municipality has taken important steps to attract private sector partnership into operating public transport services in Tehran. This has been especially applied to bus services. This partnership provides the system with newer vehicles provided by private companies and a higher quality of services than might have been achieved in the same timeframe by public only operators. In 2006, there were only 724 privately operated buses compared to some 6,676 public ones (Allen, 2013).

The high capacity, high speed BRT lines are mainly operated by the public sector while the regional and local bus services increasingly by the private sector. In less than 3 years, the total share of private sector in annual trips reached to more than forty% (Allen, 2013).

In addition, there are some 80,000 taxis in Tehran and over the past few years around half have changed ownership to be privately owned. These are differentiated by colour; green for those owned by private companies and yellow for those privately owned, by the driver (Allen, 2013).

5.5.7. Health

Since the late nineties, the extreme traffic congestion and the associated high levels of air pollution have gradually become a major challenge from the city's authorities. In Tehran, air quality becomes worse at certain times of the year as the city is surrounded by mountains causing temperature inversions and that trap the pollution over the city. During that period, motorized traffic is estimated to be responsible for 80% of the air pollution. In addition, daily admissions due to stable angia were significantly related to the CO levels. It was estimated that each unit increase in the CO level increase the number of hospital admissions by one person. In 2003 the National Institute for Tuberculosis and Lung Disease estimated that roughly 4,000 deaths per year could be attributed to Tehran's particulate matter alone (Arndt and Döge, 2013; Hosseinpoor et al, 2005).

The government passed the Clean Air Act in 1995 in order to address the problem of pollution in Tehran and other large cities in the country. In addition, a 10 year air pollution mitigation masterplan was developed and put into practice in 2000. The studies that led to the creation of the masterplan were co funded by the national government, the United Nations Development Programme and the Japan International Cooperation Agency (JICA). The masterplan included improvements in vehicle and fuel technology which were neglected due to the historically low process of fuel, introduction of standards in production, circulation, and registration of vehicles, discarding and replacing of vehicles, improving the quality of fuels and adoption of alternatives, integration with public transport planning and traffic management, and training and promotion of public awareness. The masterplan was at first implemented slowly as institutional, management, regulatory, enforcement and financial problems delayed the effectiveness of the adopted measures.

5.5.8. Social exclusion

Access inequality in Tehran results mainly from the lack of appropriate land use planning for low income households. The urban poor have been neglected and marginalised in the urban development

planning system and also in planning for land and housing in the country. As a result, informal settlements on the fringe of the urban area have mostly formed around the Tehran's three major transportation corridors. The rigidity of the urban planning system in Iran to adapt to fast demographic shifts, due to land use restrictions within the city and rigid municipal boundaries, and the investments in infrastructure that are not commensurate with needs, have resulted in the spill over of low income urban groups into the periphery, the un-serviced areas, or the rundown inner areas of the cities. Poor access opportunities have an even more adverse impact on the less mobile groups such as the elderly, the youth and the disabled (Zebardast, 2006).

It is noted that many low income households in Tehran do own cars which are old and poorly maintained and not only do they serve as their only means of transport but also as a secondary source of income offering unlicensed taxi services. This makes the situation even more complicated for the local authorities who need provide further incentives to low income families to replace or properly maintain their vehicles (Madanipour, 2006).

On the other hand, in terms of gender equality, planning authorities have been making efforts to promote the role of women in transport service provision. A gender balance was maintained in recruiting BRT bus drivers which helped promote equal opportunities and at the same time proved that women drivers drive more responsibly and comply with road safety rules better than men in many cases (Allen, 2013).

5.5.9. Human dimension

The available data on street and public space accessibility in Tehran is very limited. It is suggested that the overall increase in the accessibility and the improvements in public transport services overall improve the human dimension of the city. In addition, a study assessing the access opportunities to public spaces in various areas of Tehran showed that accessibility is variously distributed, but surprisingly, higher for low income groups. It can be argued that poor households usually use the nearest facilities to avoid transport costs, while high income groups prefer to travel farther distances to stay away from crowded parks, schools and other public spaces. This also reflects the cultural need for access to public spaces and interaction which may be more elevated among low income groups (Lofti and Koohsari, 2009).

5.5.10. SWOT analysis

<ul style="list-style-type: none"> • Strengths • Strong commitment to sustainability • Growing, comprehensive public transport network • Political commitment to pursue existing plans • Engagement of the private sector funding in operations • Existing vision and elaborate plans for the city • High cost of car ownership • 	<ul style="list-style-type: none"> • Weaknesses • Lack of complete integration of private bus operators • Remaining air quality problems • Remaining congestion • Existing car oriented infrastructure and previous lack of integration between transport and land use planning • Imbalanced public transport supply and demand
<ul style="list-style-type: none"> • Opportunities • Changing perceptions of the public regarding public transport • International recognition of efforts • Political stability 	<ul style="list-style-type: none"> • Threats • External influence of oil economy • Limited financial sources • Institutional lock in and refuse to change • Cultural association of car with wealth

Tehran has made an extraordinary shift to sustainable urban transport in less than ten years. The strong political commitment of the municipal authorities to change the city and the development of a vision for 2025 are the biggest strength of the transport sector in the city at the moment. In addition, the expansion of public transport infrastructure across the city provides an excellent basis for promoting sustainable transport. In addition, the high costs of private vehicles, the relatively low modal share of private cars and the existing culture of ridesharing provide a basis for changing the role of the car in Tehran. The combination of political commitment, vision and good public transport provide a framework upon which future plans, investments and further engagement of the public can be built. As the sustainable transport is gaining momentum in the city, its social, environmental and economic benefits are becoming plausible and therefore it becomes more difficult for these efforts to fail.

At the same time, the political stability of the country and the international recognition of Tehran's efforts are an opportunity for supporting growth and success. On the one hand, Tehran remains one of Iran's primary engines of economic growth and international outreach. As the city becomes more sustainable it is more likely to receive better funding from the national government due to the increased returns of such an investment. In addition, international recognition can also bring additional support and potentially benefits from sharing its experience and becoming a pioneer in sustainable transport in the Middle East region.

However, although it seems that Tehran is on the right path, there are still some obstacles to overcome. Residues from previous policies and unsustainable transport planning are the biggest weakness of the city. The lack of integration between land use and transport and the extensive car oriented infrastructure dominate the urban fabric and sustain private transport mobility. In addition they contribute to persisting poor air quality (along with the landscape formation of the surrounding area) and congestion. At the same time, public transport is expected not meet the current demand levels, at least until the full plans for the city are complete. In order to face these challenges the city will need to focus on management measures until the long term impacts of adding or removing infrastructure in the city arrive.

Finally, the Tehran is facing some external threats which may affect the effectiveness of the adopted plans or the ability of local authorities to adopt them. To begin with, Iran's economy is largely oil based. This means that it is affected by international trends of which it has little control. This means that the available budget for transport can also be affected by global market conditions. At the same time, the national funding for transport does not meet the needs for the city. Municipal revenues and contractual agreements with the private sector have a significantly lower contribution to capital investments which means that the implementation of plans can be delayed or cancelled due to limited funding. Finally, cultural and institutional refuse to change to sustainable transport, either due to existing market forces and interests or due to the association of private mobility to wealth, is posing a significant threat to the success of sustainable transport operations. In order to limit its risks, the city can work on reducing its dependency to the national government and increase public engagement with its efforts.

6. Conclusions and Recommendations

6.1. Introduction

Based on the literature review, the 3 case studies and the SWOT analysis of the 5 megacities, this chapter starts with a summary of the key findings of the report. In addition, this chapter provides recommendations and identifies prioritised possible policy options to implement these recommendations using the framework developed in the literature review chapter. The recommendations build upon the analysis of the previous chapters and aim to provide a concrete basis for understanding the urban transport challenges for the OIC megacities. Although it is not suggested that problems or solutions are the same across all megacities, the recommendations section is an effort to consolidate the results of the analysis and provide some specific suggestions about the future steps to be taken, based on our research, observations, and best practice examples from the developed and developing world. When it is considered appropriate, special recommendations will be given for the Middle East, Africa and Asia groups, based on our experience, the site visits, and the literature review.

6.2. The Case of Islamic Megacities

The rapid population growth and urbanization of megacities is one of the most urgent current global issues. The Islamic megacities have an important role to play in global sustainability as 7 of the world's 28 megacities belong to the Islamic World. The fact that they also belong to developing countries, means that they have the potential to develop further and many opportunities to do so sustainably. The size of these cities means that problems as well as improvements have a large scale effect, and it constitutes a challenge and an opportunity at the same time. Transport related issues are particularly interesting as they affect all social, economic and environmental functions of the city and therefore require coordinated action from both public and private stakeholders. This report has provided a thorough analysis of transport and transport related problems of the Islamic megacities, drawing from our experience, research and best practice examples from across the world.

All the megacities of the Islamic world belong to a developing country which means that they share some common characteristics in terms of institutional structures, motorization trends, financing problems and infrastructure availability and quality. In this report, best practice and lessons were collected from both developed and developing world megacities and cities but inevitably the majority of examples come from the developed world. This is due to the fact that developed world, particularly European, cities have already gone through rapid urbanization and motorization and have now turned to more sustainable modes than private cars, faced with the impacts of congestion. On the other hand, developed world megacities have only relatively recently started to rapidly grow economically and increase their motorization levels. African megacities are still lagging behind the other megacities of the Islamic world in terms of economic growth as well as infrastructure and motorization, while Asian megacities are growing rapidly in population and number of private cars. In both cases, the share of non-motorized transport remains very high as motorized modes are mainly used by the wealthiest members of the society. Perhaps the most important difference between Arab cities and megacities compared to the rest of OIC world is the fact that non-motorized transport has been widely ignored and has significantly lower modal share levels due to the wide availability of oil and its low prices. In Arab cities and megacities, infrastructure and planning for NMT is limited and has only recently started to gather support as a factor contributing to urban sustainability.

It is suggested that planning for the transport problems in the Islamic megacities requires coordinated actions at a local and national level and, targeted, well planned international support to accelerate development. There is a very important opportunity not to follow the development patterns of developed or even developing world megacities, and become best practice examples themselves. It should be noted that despite the fact that the recommendations given below are structured in separate sections, coordinated, integrated and multi-sector planning are considered the most important element in successful planning. At the same time, key actions aiming at meeting demand, improving

the urban quality of life and ensuring economic profitability can make a significant contribution to wider transport strategies. It is suggested that specifically in the case of Islamic megacities, the focus of such actions should be on curbing car use and motorization levels, coordinating land use with transport planning and operations, and maintaining the social cohesion and identity. In the longer term, it should be kept in mind that cities, regardless of their current size, they will continue to be places of enormous attractiveness for people and so their every aspect should be planned for people first.

The megacities of the Islamic world have both differences and similarities in terms of the scale and urgency of their problems as well as their development patterns. This means that different, adapted policies are necessary in order to address the challenges and use the opportunities of each city. However, some best practices and lessons can be drawn from the previous sections to be used as common guide for building a sustainable urban transport strategy. As it has been pointed out earlier, all best practices and lessons from other cities show that understanding the dynamics of a city, and most importantly of a megacity, is key to providing integrated planning. Best practice examples from elsewhere should be examined thoroughly and adapted to the local conditions and when this is necessary accompanied by supporting measures for this purpose. For example, BRT systems are introduced in many cities of the developed world and are expected to be as successful as that of Curitiba. However in many cases systems and stations are not properly planned, leading to disruptions in community cohesion, low response to the demand and lack of integration with other transport modes.

Trying to unravel the complexities of the interrelationships between travel, urban form and sustainable development is difficult. It is therefore necessary to have a vision of the city in its desired form. A clear vision is more likely to gather political and public support than fragmented interventions and it is easier to communicate and follow than uncoordinated sectorial strategies with different aspirations. Transport provides an essential contribution to city viability (economic sustainability), vitality (inclusiveness and fairness) and health (quality of life and environmental quality) which are all elements of a sustainable city vision. With a vision as a starting point it is then easier to prioritise and coordinate the necessary actions to build an urban transport strategy. Some of the OIC megacities, as well as Dakar, have already developed long term urban visions taking into account transport as well as transport visions. The most prominent example is probably Istanbul which has developed a transport vision to 2023, aiming to create a metro network with a length of 641km by the year 2023 as a key step to create a liveable and sustainable city in the 21st century (Banister, 2011).

Although most success stories come from the developed world, equally valuable lessons can be learned from developing world cities and megacities that have implemented successful policies and strategies. Examples of such cities are Curitiba in Brazil, Bogota in Colombia as well as Islamic megacities such as Istanbul. However, in every case attention should be paid in the transferability of solutions from one city to another. Particularly in the case of Islamic megacities, transferability issues can be related to cultural conventions as well as local identity issues. It is therefore suggested that all conclusions and recommendations are used taking into account the wider context of each city, which has also been analysed in the SWOT analyses in previous sections. In the sections that follow, the main conclusions from the literature review and the site visits are presented using the framework developed for this report along with recommendations made using the same framework.

6.2.1. Transport network and land use planning

Higher level interactions of transport with land use planning should be understood and coordinated in order to achieve sustainable urban development. Transport Oriented Development and public transport accessibility of new housing and residential developments are necessary in order to halt the excessive use of private cars. Planning for access by alternative modes allows then the adoption of a series of other supporting measures such as maximum parking space standards for new developments while it facilitates vehicle access restrictions to central areas. At this point, the coordination with land use and urban planning authorities is extremely important as it contributes to building an integrated

planning framework for new developments which can be a very good starting point for a paradigm shift.

However, infrastructure projects should also be planned and built taking into account the local environment. For example, the common practice to build more bypasses and flyovers to alleviate the congestion in central areas should be abandoned as it has been proven ineffective. Key infrastructure projects that do not disrupt the urban environment should be built in an integrated traffic management system so as to avoid induced traffic and should be maintained appropriately in order to deliver their value. It should be noted that another common misconception is that the megacities' problems can only be resolved by megaproject, which has also been proven unsuccessful. Big infrastructure projects, particularly highways and bridges are known for disrupting the cohesion and social continuity of the urban environment and contribute to its environmental degradation.

6.2.2. Mode availability and shares

However, influencing existing transport and urban development patterns is more challenging and requires further investigation of the potential synergies between different policies and measures. Curbing motorization is possibly the most challenging task for transport planners in megacities and therefore requires the utilisation of a combination of tools, measures and policies. It is considered that the most important synergy in this case is the combination of private vehicle purchase and circulation restrictions and public and non-motorized transport improvements. Banning or restricting private vehicles from central areas without providing a better alternative is unlikely to be successful. Gradual but consistent restrictions and improvements are more likely to encourage the population to make more sustainable mobility options. However, measures should be selected carefully in order to match the local conditions in a city. For example, park and ride facilities combined with dedicated free buses going to city centres have been proven successful in many cities in the developed world but they may not be a particularly good measure for cities in the developed world where land is expensive and housing needs are urgent.

In the case of Islamic megacities particular attention should be paid in order to provide balanced, solutions for all modes, especially to those that have received little attention in the past. In most cases this is NMT which has been widely ignored in favour of motorized modes over the past two decades. Curbing the use of private cars is essential in order to promote NMT and coordinated actions are needed in order to achieve the desirable results in both cases. The complementarity between the introduced measures and strategies should be examined as a whole but not in isolation of the existing conditions.

The organic patterns of development particularly in the cores of Islamic megacities can be more than a challenge. The dense street networks and the mixed uses favour movements by NMT which means that there is already a viable mobility alternative to private car. In addition, the formal public transport operations have the potential to be complemented by the existing informal operations, by allowing them to act without or under loose regulations in order to maintain their current functions of providing accessibility in informal areas, covering the need of in new housing areas and offering employment to new citizens. Finally, the existing modal mix on streets and the multiple trade activities can be preserved by introducing traffic calming regulations and therefore improve the existing conditions without disrupting the current social activity taking place on the streets. Embracing local conditions can in many cases be more efficient and effective than completely altering them to achieve western standards.

6.2.3. Institutions and organizational structure

Sustainable urban transport requires institutional and organizational coordination in order to ensure that appropriate rights and authority are given to both bottom up and top down planning. On the one hand, a clearly defined institutional framework should support the consolidation of responsibilities and coordination of activities of all stakeholders. Examples of central transport authorities in

megacities of the developed world such as the DOT in New York or TfL in London, prove that under a single entity, it is easier and efficient to define the shared responsibilities of different actors and coordinate their collaboration, whether these actors are public or private. At the same time, it is for utmost importance to allow space in the planning procedures for bottom up input. Particularly in the urban areas where social activity and human interaction and mobility are inevitably intense, it is the citizens that recognise the problems and needs of the city the most, particularly when it comes to transport. It has been proven that public participation, advocacy and awareness raising on issues such as road safety, public space planning and active travel can provide valuable inputs and solutions to urban problems. In addition, public participation provides the necessary space for 'incompleteness' in an urban environment which means that allows the rapidly changing dynamics and needs of people living in a city to be expressed rather than suppressed through stringent planning frameworks.

The coordination between different urban planning institutions is also equally important. Transport interacts with land use planning, security, enforcement, education, trade, real estate, health and many other sectors which have their own agendas and therefore it is necessary to define the boundaries and overlapping responsibilities of different authorities. Conflicts between different sectors are common both in developed and developing countries but they tend to be more difficult to resolve in developing environments. The lack of regulations and cooperation between the private and the public sector seems to be the most important obstacle in achieving the full implementation of transport policies. Conflicts can take different forms, from fully unregulated public transport operations to land ownership disagreements, which do not allow public infrastructure to proceed. In such cases, urban authorities and national regulations need to be changed appropriately in order to prioritise public to private operations, despite the contradicting benefits of the private sector. This does not mean that the private sector should be restricted horizontally, but only that the public interest should be clearly defined and put ahead as this is the only way to promote long term sustainability and welfare in urban environments.

6.2.4. Freight and servicing

Imposing restrictions to private cars while supporting public and non-motorized transport can have multiple benefits, including pollution reduction, healthier urban environment and reduced GHG emissions. However, the megacities of the Islamic world also lack significant infrastructure which will facilitate their urban freight transport. In terms of logistics operations in particular, most cities lack the appropriate infrastructure (consolidation points, loading and unloading areas etc.), as well as management skills to respond to the increasing trade and consumption needs.

It is noted however that freight is probably the area with the lowest level of transferability between developed and developing countries. Freight consolidation and planning is favoured in the developed world due to the fact that the retail sector is operating based on consistent supply and demand system. On the other hand, informal and small shops do not always need to store a large amount of stock and do not always sell a consistent range of products. This means that practices such as consolidation and efficient last mile deliveries cannot be applied in developing world cities. Similar restrictions apply for night time deliveries and online shopping deliveries as owners are unlikely to be willing to keep their stores open at night and online shipping is not very popular respectively. It is therefore suggested that consultation and research needs to be conducted on a local basis in order to identify the needs of retailers and suggest specific solutions to alleviate freight traffic. Loading and unloading facilities are considered essential in any case as the lack of them always obstructs traffic flows.

On the other hand, large scale logistics are essential to be planned for developing world megacities. All the cities examined in this report are regional and national freight hubs, playing a crucial role in local and national economies. Most cities are major regional ports and airports (with only exception being Tehran, which is only a main airport and Cairo which is on waterway). Efficient freight operations are necessary not only for the national and international economies but also for the urban economies. Efficient operations cause significantly less disruption to the urban environment and facilitate national and international trade. Dakar, for example, is the only port that offers access to

Mali, a landlocked country, via its rail and highway link to Bamako. Relationships with Bamako have a significant impact of Dakar's and Senegal's economies and therefore efficient operations should be prioritised. Large scale schemes linking megacities to other cities, although urban per se, should be put forward and be exploited in the most efficient ways, often involving the private sector.

6.2.5. Urban transport infrastructure financing

Financing is an issue for all OIC megacities. It is suggested that a combined approach should be adopted for financing involving both internal management of operations and external financial support strengthening. On one hand, internal financing should be structured in a way that savings and revenues from transport operations and charges are absorbed and reinvested in future transport plans. For example, mechanisms and organizational structures should be put in place and be created in order for revenues from parking charges or road pricing are reinvested in sustainable modes. The involvement of the private sector in operations should ensure that operations are profitable for both sides, with the public sector being able to re-evaluate the operation contracts and partnerships often in order to avoid loss of revenues resulting from the involvement of the public sector. An innovative example of cooperation with the public comes from Rio de Janeiro, Brazil, where a major part of the city's port region is currently being redeveloped without any contribution from the city's funds. The area that is known as Porto Maravilha was isolated and degraded but forma a vital part of the port and had a large historic value. The funds for the redevelopment were collected by selling the rights for increased construction capacity in the area. By selling the rights for additional development, the urban consortium has the necessary resources to redevelop the public infrastructure in the area, improve the public realm (including major changes in the mobility patterns of the area) and preserve the architectural and cultural value of the port.

On the other hand, external help can ensure that appropriate guidance is given to governments in order to efficiently manage their construction and operation projects. It is suggested that assistance on management should also be sought along with financial support in order to perform effective monitoring and evaluation of projects. Transparency should also be ensured in order to effectively and efficiently deliver high standard projects. External support and monitoring are often viable for projects to succeed as they prevent issues of corruption and deviation from the deliverable standards.

6.2.6. Road safety

Road safety is a crucial issue for the Islamic megacities as many of them are suffering from high mortality rates on the streets and traffic related injuries. Awareness raising and driver training are essential for perceptions to change and for people to realise the importance of safe driving. Campaigns organized at the workplace and at schools can be proven particularly successful as they target people who can directly apply what they have learned on specific journeys. In addition, media coverage is also very important, particularly on the radio and the television, as the internet is not always accessible by everyone. Local advocacy groups can make a significant contribution, and can often be more effective than actions taken by the authorities. However, establishing road design standards, strengthening enforcement and putting in place formal driver training and testing procedures are of utmost importance.

6.2.7. Health

Pollution, excessive heat and lack of physical activity are the three main transport related factors that contribute to the deterioration of health of the residents of Islamic megacities. Pollution levels in the cities of Asia in particular have been and in some cases remain among the highest in the world. Old vehicles are the primary source of pollution, and therefore banning their use and import is considered key in order for the air quality to improve. In addition, promoting clean public transport and non-motorized transport can contribute to this effort. Exhaust gases also contribute the increase of temperature in megacities. Fewer vehicles and more open green and light coloured spaces can make a significant difference in the temperatures of urban areas. Finally, in terms of physical activity it is

considered very important that transport facilitates multimodality and integration of active modes (walking and cycling) in the majority of trips.

6.2.8. Climate change

The means to achieve sustainable transport and liveable cities are the same that can be used to reduce the impact of megacities on climate change. Developing world megacities are contributing to climate change less than their developed counterparts and if they follow a sustainable path, they will manage to keep their impact at low levels. However, in the case of Islamic megacities, the issue of vulnerability is very important. Reinforcing the transport infrastructure, planning for floods and protecting key infrastructure from the effects of floods and droughts should be consistently prioritised in the megacities of the Islamic world.

6.2.9. Social exclusion

Transport related social exclusion is widely observed in OIC megacities. Despite the efforts made to address issues of exclusion for women, children, the elderly and people with disabilities, inefficient transport operations inevitably have a greater impact on the mobility of these groups. Although these groups are not necessarily less mobile (for example women perform more complicated everyday tasks than men including housekeeping, taking children to school and shopping), they are disadvantaged in the sense that they either do not own a car or their moves are physically restricted. Exclusion can be tackled both with infrastructure and policy interventions. To begin with, accessible infrastructure needs to be put in place wherever possible. Basic services that need to be accessible are buses and other public transport vehicles as well as bus, BRT and metro stations. In addition, well maintained and curbed footways are essential for people with disabilities as well as the elderly and children to move conveniently and take seamless walking journeys. At the same time, planning to prevent social exclusion is essential. There is a great scope for informal public transport services to be used for people with limited mobility means. Informal services can be organized as dial-a-ride services or offer rides to specific groups of people (for example mothers with their children) during specific times of the day in order to increase their accessibility. In addition, planning for the mobility of the elderly is equally important, particularly in the Islamic culture where their role and contribution to the family is highly valued. Dial-a-ride services can also be of use for the elderly as well as accessible stations and buses. Finally, concession schemes for the less well-off can make a significant difference to the accessibility of people living in informal and distant areas and still need to access the central business areas by public transport.

6.2.10. Human dimension

The importance of maintaining the human dimension even in such scale of cities has been stressed throughout this report and is considered to be one of the most important lessons Islamic megacities can learn from other cities across the world. Maintaining the human dimension can significantly improve urban life, from the everyday level to the participation of citizens in planning for their own spaces. The Islamic megacities have the advantage of strong social and cultural values which can be used as a base for bringing people and the city closer to each other. The role of transport in this effort lies in small scale planning, street level interventions and lower, more human speeds. It is considered of utmost importance that participation is promoted and supported as citizens know their cities and how their needs change as well as the most experienced planners.

6.2.11. Summary

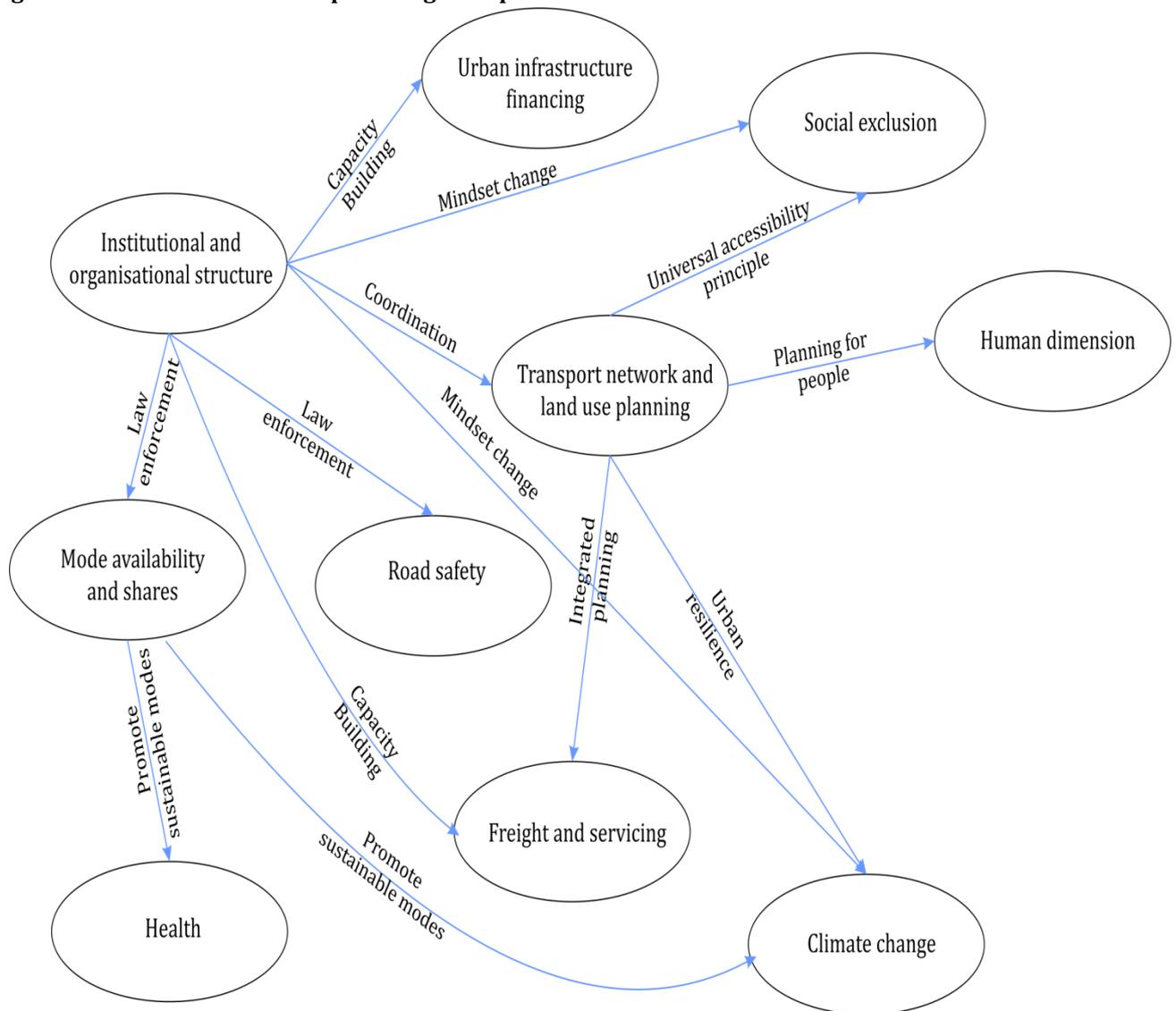
Table 13 below provides a summary of the recommendations:

Table 13: Summary of key recommendations

Framework area	Key actions
Transport network and land use planning	<ul style="list-style-type: none"> Make sure transport infrastructure does not cause fragmentation of the urban environment Plan for land use and transport integration Promote multiple centre and multiple land use development Support TOD
Mode availability and shares	<ul style="list-style-type: none"> Promote NMT Promote public transport Reduce motorization and car use using fiscal measures
Institutional and organizational structure	<ul style="list-style-type: none"> Promote central management and planning of operations Clearly define the role of the private sector
Freight and servicing	<ul style="list-style-type: none"> Examine particular local needs Enhance international freight links
Urban infrastructure financing	<ul style="list-style-type: none"> Seek help with monitoring and evaluation Ensure transparency Clearly define the role of the private sector
Road safety	<ul style="list-style-type: none"> Provide appropriate training and testing for drivers Raise awareness
Health	<ul style="list-style-type: none"> Ban circulation and import of old vehicles Plan for active transport Use lighter colours in infrastructure
Climate change	<ul style="list-style-type: none"> Plan for resilience
Social exclusion	<ul style="list-style-type: none"> Plan for accessible infrastructure Introduce flexible transport services for the elderly, women, the urban poor and people with disabilities
Human dimension	<ul style="list-style-type: none"> Support participation Plan for small scale

Figure 57 below provides an overview of the interrelationships among transport related areas.

Figure 57: The interrelationships among transport related areas



Source: Consultant

Based on the above, it is clear that strengthening institutional and organizational structure is the first thing that needs to be done in order to realise a sustainable urban transport system. Appropriate institutional arrangements are of importance for effective law enforcement strategies. The SWOT analyses show that weak law enforcement is a common weakness among the megacities. In terms of mode availability and share framework area, strengthening law enforcement will ensure the effectiveness of fiscal measures to reduce motorization and car use, which in the end benefits the efforts to promote more sustainable transport modes, i.e. public transport and NMT. Strong law enforcement is also very important to increase road safety, as this area is very sensitive for corruption and bribery.

Strengthening institutional and organizational structure can also be defined as organizational capacity building that is required to increase organizational capabilities and overall institutional capabilities. This is certainly the case for urban infrastructure financing and freight and servicing. Policy makers are expected to be able to develop creative solutions to finance urban infrastructure and to mastering the available schemes such as PPP. Freight and servicing area on the other hand is very challenging as there are no common solutions for freight and servicing issues. As such, capacity building is important

to improve the competence of the responsible institutions to develop specific solutions to address freight transport challenges.

Furthermore, mind set change at the institutional level is necessary to develop a sustainable transport system that addresses climate change and social issues. Finally, a robust institutional and organizational structure is essential to ensure a smooth integration between transport network and land use planning. In this sense, a coordinating role, which is ideally under the responsibility of a Transport Authority, is of importance.

The second priority is an integrated transport network and land use planning, as it influences other sectors such as freight and servicing, and climate change. A robust integration between transport network and land use planning can also tackle social exclusion issues by implementing the principle of universal accessibility, a very important aspect when considering special needs of the elderly, women, and the poor and disabled people. Including human dimension in every aspect of transport and land use planning is also not less important since the end purpose of transport system is to serve transport users, as such embracing their participation in the planning process will ensure the effectiveness of the measures.

In short, institutional and organizational structure, and transport network and land use planning are the most important areas that need to be strengthened due to their strong influence on other areas. A strong institutional and organizational structure, and a robust transport network and land use planning are two areas that are very mature and advanced in developed countries in comparison to their developing counterparts. Therefore, improvements in these two areas are recommended to be prioritised by Islamic megacities in order to realise their vision of sustainable urban transport.

Appendix A – Literature Review Case Studies

Appendix A1

Transport Oriented Development and Public Transport Planning in Hong Kong and Singapore: Lessons on integration, regulation and car ownership restriction

Hong Kong and Singapore are very successful and long standing examples of integrated, public transport oriented urban transport policies. Hong Kong and Singapore have followed distinctively different transport policies than other Asian cities under the pressure of urbanisation, economic development and resource constraints. Many lessons can be learned from both cities as they have excellent examples of using synergies between different policies to provide high levels of accessibility for all.

The cities

Although Hong Kong and Singapore have the status of a country and not a city, they are both almost 100% urbanised and therefore considered here as cities. They are both densely populated as only a relatively small portion of their land is suitable for development. Singapore has a land area of 710.2 square kilometres and 4.8 million inhabitants, while Hong Kong's land area is 1104 square kilometres and its population is 6.9 million. In order to accommodate their growing populations' needs, they have been expanding their usable land by land reclamation over the past century so that they can accommodate the demand for new development. The high population densities and the role of both cities as global business hubs generate huge transport demand which is managed with innovative and strictly implemented long term transport and land use strategies.

Singapore: Sustainable, safe and smart transport policies

Singapore has adopted and implemented sustainable transport strategies since the 1970s in order to mitigate rising congestion levels generated by very nearly full employment coupled with a rapidly growing economy as a manufacturing and financial hub. Sustainability, safety and smartness are three important policy directions of the urban mobility system of Singapore. Sustainability is achieved through the integration of land use and transport planning, transport supply measures and incorporation of environmentally friendly technologies for vehicles. Safety measures are covering all modes and enforcement and smart transport systems are used for traffic control, monitoring and enforcement, information management and revenue management (Lam and Toan, 2006; Haque et al, 2013).

Probably the two key policies that contribute the most to the successful performance of Singapore's transport system are the integration of transport and land use planning and the control of the growth of motorization. Transit Oriented Development (TOD) has been central to the transport strategies of Singapore since the 1970s. Residential, commercial and economic activities were gradually decentralised in order to create regional and sub regional centres around Mass Rapid Transit (MRT) stations. Locating employment centres, business parks and commercial centres near residential areas reduce people's need to travel while resulting in a good utilisation of the MRT network. As a result, more than 60% of the Singaporeans use the MRT for commuting and other purposes daily. For better integration, the role of each transport mode is clearly defined, with MRT serving long distance trips and Light Rapid Transit (LRT) and buses providing feeder services to the MRT system. At the same time, continuous improvement of the supply of each mode but also the complementarity between different modes (coordination of service network, stations, fares and information systems) ensure that accessibility is provided for all and journeys on public transport are seamless and convenient (Lam and Toan, 2006; Haque et al, 2013).

In order to maintain a sustainable growth rate of its vehicle population, Singapore has adopted a Vehicle Quota System (VQS) policy since 1990. The VQS works by determining a suitable number of new vehicles allowed for registration annually and subsequently letting market forces determine the price of ownership via bidding. Using the VQS, the vehicle growth rate has been kept in tandem with the rate of road development. The rate of road development from 1990 to 2006 was about 1.0% p.a. but it is projected to be only 0.5% p.a. over the next 15 years. In addition to purchase based constraints, road pricing was adopted in 1975 as a usage based tax system mainly to reduce congestion by discouraging travel on expressways and major arterials towards the Central Business District (CBD) during peak hours (Lam and Toan, 2006; Haque et al, 2013).

One of the main lessons learned from Singapore is that fiscal measures of restraining car ownership are effective only up to a certain point. Under conditions of rapidly rising incomes, car ownership increases quickly despite high prices. This is because demand for cars is more income elastic than price elastic. In the end, the growth of car population can only be arrested by more radical measures such as the VQS. Singapore adopted the VQS which was implemented as a supporting measure to control motorization more effectively after two decades of road pricing (Barter, 2004; Olszewski, 2007).

Hong Kong: transport, land use and intense market competition

Hong Kong has been growing rapidly in population and population density in the past four decades due to migration and its relatively small portion of usable land for development. Since the 1970s nine new towns were developed to cope with the population growth were developed and 43km² of land were reclaimed to cope with population growth. Hong Kong has experienced. Transport systems and other supporting infrastructure were developed to link the new cities with the traditional urban core areas and big part of the development was built along major transportation arteries (Tang and Lo, 2008; Loo and Chow, 2006).

Similar to Singapore, Hong Kong has adopted a coordinated and integrated transport and land use planning approach combined with policies of limiting private car ownership and usage. The land development strategies have been a catalyst for the high population density sustaining over the years. On the one hand, the controlled supply has put the prices of land and property on the fast rising track. As a result, the average income from land premium has contributed to over three quarters of funds for capital works in the territory. On the other hand, the high density residential estates built around railway stations have further formed a large pool of potential passengers to support the operation of mass transit railways and the payback for the investment. At the same time, the limited space and high population density of the territory have shaped the transport policy of giving priority to mass carriers especially off street modes that do not occupy road space, and controlling the growth of private cars. New private cars in Hong Kong are subject to the first registration tax from 35% to 100% of the vehicle cost. In addition to ownership control, car usage has also been discouraged through high fuel tax. The limited number of parking spaces and hence the high garage cost and parking charge especially in urban areas further discouraged owning and using a car in Hong Kong (Tang and Lo, 2008).

However, the major lessons to be learnt from Hong Kong are related to service regulation and prioritisation. Hong Kong's Mass Transit Railway (MTR) was constructed in the 1970s to provide an off street, efficient means of travel through the urban areas. The Kowloon Canton Railway (KCR) was also electrified in 1982 to provide transit services for the suburban New Territories and to support the development of new towns. Both railways were corporatized to operate in prudent commercial principles in accordance with their respective ordinances, although they were wholly owned by the government. In October 2000, MTR was privatised and since then her shares have been traded on the stock exchange of Hong Kong (Tang and Lo, 2008).

The transport policy adopted in the 1980s focused on an integrated public transport system defined the non-rail modes as the feeding role and prevented direct competition in order to secure the return of public investments on the railways and minimize wasteful duplication of resources. Franchised bus

services were also protected against other lower priority public transport modes. For example, at most only half of non-franchised (residential) bus routes could run parallel to existing franchised bus routes. This policy assured that the traffic demand for the mass transit railways would not be diluted by other modes of transport, and hence the huge investment on such projects would be paid back within a reasonable return period. During the 1990s, the government of Hong Kong also relaxed the regulations on bus services with an aim to improve the quality of public transport services through competition. In 1991, Hong Kong started open tendering for new franchised bus routes (Tang and Lo, 2008).

However, by the 2000s Hong Kong's planning authorities were under the political pressure for the freedom of choice between modes and faced strong opposition to plans of consolidating bus services in coordination with the commissioning of new railway lines. New towns were first serviced by bus services until they grew enough to justify the introduction of a rail service. However, these towns were sufficiently accommodated by bus services before the respective rail links were built. Upon completion of the railways, the development of the new towns had become basically flattened and the traffic demand (both existing and derived) was not sufficient to fill up the increased supply of transport services from the new railways in addition to the existing bus services. Besides, the residents had been accustomed to the door-to-door bus services and transport providers were not given incentives to give up profitable routes (Tang and Lo, 2008).

The public transport market as a result of the indiscriminate expansion of both rail and bus services lost its equilibrium as per the well-coordinated transport system established in the 1980s. The oversupply of public transport services as a whole can be reflected by the lower than anticipated patronage level of the new railway lines recently commissioned to serve the new towns. In addition, service competition and overwhelming increase in bus services has resulted in the negative externalities of not only road congestion, but also the increased demand for more roadway capacity expansion. The lesson to be learned in this case is that such a problem cannot be resolved purely through market processes, but there is a need for administrative measures to make the public transport market more coordinated so as to alleviate the negative externalities caused by service oversupply and wasteful competition (Tang and Lo, 2008).

Comparison with other cities: Tokyo

Tokyo is the world's biggest megacity. Except for its size, what makes Tokyo different is that it has been one of the world's biggest metropolitan areas since the early 1700s. Railway construction was one of the national modernization policies that started in the 1860s, and the national railway network connecting central Tokyo and other cities in Japan was established by the end of the nineteenth century. Beginning in the 1920s, private railway companies purchased huge areas of land in the suburbs of Tokyo and developed housing estates or garden suburbs. Private railway companies were able to pay for the railway constructions by the profits they made from selling or leasing the developed housing estates and commercial areas around the stations. On the other hand in central Tokyo, the subway network has been developed continuously since 1927. As a result, nearly 73% of morning commuters to Tokyo used railway lines while only 9% of them used private automobiles in 1998. Not only the railway system is well equipped, but also the season ticket discount for commuter was introduced since before the war, employers usually pay commuting cost to employees, major companies often inhibit employees to commute by a private car because of limitation of parking place and reparations risk for car accidents caused by employees, and traffic congestion in commuting time in Tokyo is so terrible that makes commuting to central Tokyo from suburb impossible in fact (Okata and Murayama, 2011).

However, for the past two decades the population of Tokyo is growing very slowly and it is expected to remain almost stable in the coming decades. With the decrease of working population, it may become more difficult to maintain today's sophisticated railway system and a monocentric spatial structure. In addition, suburbs without sufficient public transit services have already become automobile oriented. On the other hand, population decline is observed in the outer suburbs and people are

coming back to the selected areas of Tokyo including central Tokyo. At the same time, although Tokyo left the phase of rapid growth, transportation infrastructures, both roads and railways, are continuously developed. Nonetheless, despite the continuous expansion of transport networks, road infrastructure around many of the suburban stations is not well provided, resulting in narrow sidewalks unfriendly to baby strollers and wheelchairs, and small rotaries difficult to access by buses, taxis and private automobiles. In addition, lack of reasonable bicycle parking facilities often leads to illegal bicycle parking on narrow sidewalks. While the governments try to promote functional TOD with large scale redevelopment and modern infrastructure, many people including local people and urban professionals emphasize the importance of vernacular urban form and pedestrian oriented environment (Okata and Murayama, 2011).

Appendix A2

Public Transport, Land Use Planning and Social Innovation The case of Curitiba, Brazil

Curitiba is an important reference for public transportation and urban regeneration in Latin America. The city has gained international recognition for its technically and managerially innovative bus-based public transport system and the radical improvements in urban life.

The city

Curitiba is the capital of the Parana state in the south of Brazil with a population of 1.7 million and a total of more than 3 million including the metropolitan area. In the 1960s, the city adopted a Master plan according to which the city growth should be organized along linear axes concentrating high population density and mass public transport. Over the years, two of the four main transit axes of the urban area, presented the highest concentration and diversity of services, commerce, and public facilities, all distinctive characteristics of Transit Oriented Development (TOD) (Duarte and Ultramari, 2012).

Public transport

The first BRT line in Curitiba was launched in 1974, when the city had 609,000 inhabitants. The main characteristics of Curitiba's BRT include bus platforms at the same level as the floor of the bus, speedy boarding and alighting, prepaid integrated fares, automated fare collection, greater spacing between bus stops (from up to 500m to 3km) and integration of trunk and feeder lines in main stations (Duarte and Rojas, 2012).

The BRT network extends over 72 kilometres and runs along what are known as the North-South, East-West and Boqueirao corridors. The current fleet consists of 1,915 buses, 60 of which run on bio fuels and 185 run in segregated corridors (Duarte and Rojas, 2012).

Each axis is designed as a "trinary" road system. The central road has two exclusive bus lanes in the centre for express buses, and two local roads. One block away of each side of the local road there are high capacity free-flowing one way roads for traffic heading into and out of the city (Rabinovitch, 1992).

All public transportation in Curitiba is part of the RIT (Integrated Transport Network), which also provides partial coverage in neighbouring cities. It is run by URBS, a 99.9% publicly-owned company, whose president is appointed by the Mayor of Curitiba.

Land use planning

The "trinary" road system is also complemented by land-use legislation that is encouraging high density occupation, together with services and commerce. According to this legislation, the first two floors of the buildings along the busway do not count against permissible plot ratios (building height/land area), are planned for retail uses. Above the second floor, buildings must be set back at least five meters from the property line, to allow the sun to cast on the transitway. Upper-level housing offers density bonuses to property owners and has led to vertical mixing of land uses (Cervero, 2013).

An important benefit of mixed land uses is that they provide balanced bidirectional flows and ensure efficient use of bus capacity. The higher densities along the busways are translated into higher ridership levels. Concentrated commercial development has also channelled trips from residences beyond BRT terminals to the trinary corridors (Cervero, 2013).

A key complementary action was the municipal government's acquisition of land along or close to the new transport axes prior to their construction. This permitted the local government to organize high density housing programmes close to the BRT corridors (Rabinovitch, 1992).

Social innovation

Although Curitiba is known for its innovative public transport system, this is only one of the series of policies implemented in order to improve the quality of life and social responsibility in the city. According to Jaime Lerner, who was the mayor of Curitiba three times between 1971 and 1992 and had a leading role in the city's transformation, "if the inhabitants feel respected, they will respect the environmental issues presented to them" (Lerner, 1996, no page).

The municipal authorities implemented a series of policies aiming to improve the urban quality of life. For example, the purchase of garbage programme was aimed at alleviating the hygiene and poverty issues of the Favela (slums) residents by encouraging them to "sell" their bags of garbage in return for bus tickets and dairy products. In addition, the city launched environmental education programmes for all citizens in low-income districts in order to raise awareness around the issues of urban sustainability (Rabinovitch, 1992).

In addition, the integrated planning approach allowed the expansion of green spaces and parks and the preservation of architectural and cultural heritage in the city centre. During the 1970s, many streets became pedestrian areas while old buildings and squares were upgraded (Rabinovitch, 1992).

Lessons learned

Strong political leadership: Curitiba followed a long-term vision for regional growth which was coordinated by a politically insulated regional planning organization, the Institute for Research and Urban Planning (IPPUC).

Sustained political commitment has been pivotal to Curitiba's success. The harmonisation of transit and land-use development took place over 40 years of political continuity, and was supported by determined mayors who built on the work of their predecessors.

Housing: An area in which Curitiba did not perform well was the provision of public housing. Although both public transport and public housing programmes are planned by municipal agencies, almost all public housing built in Curitiba in the last 40 years (with the exception of that built on land that bought along the transport corridors in the central areas) was built far from the main transport axes. The integration of public transport and housing policies was made impossible by the fact that, on a pragmatic basis, housing improvements were focused on areas where Favelas already existed rather than on building new housing in different areas. However, the Favelas were generally located in areas where planning guidelines did not recommend building, eg floodplains, due to the low cost of land.

Although improving existing conditions of irregular settlements can have an instant positive result by providing better shelter for those in need of it, it can jeopardise long-term urban planning and eventually reinforce the social exclusion of low income families (Cervero, 2013; Duarte and Ultramari, 2012).

Multimodality: There is still potential for Curitiba to enhance the interaction between public transport and other modes. Integration with non-motorized modes is particularly important, as they often are the only option for lower income groups. In Curitiba, most terminals have taxi stands, half of the terminals have poor pedestrian access, only 6 out of 22 can be easily and safely accessed by bicycle, and only two have bicycle parking.

By providing taxi stands and car parks, park-and-ride schemes can be stimulated. In addition, as the number of cars increases in the city centres and the shortage of parking spaces becomes more intense,

new car parks integrated with BRT terminals can become a source of revenue for the municipality that can be reinvested in the public transport system (Duarte and Rojas, 2012).

Comparison with other cities: Bogota and Ahmedabad

Although Curitiba is not a megacity, its public transport and land-use practices have been considered a leading example for bigger sized cities across the world. Comparison with other cities, shows the importance of integrated urban and transport development.

Bogota: Bogota, the capital of Colombia is city of 9.5 million inhabitants. Bogota introduced its BRT system, Transmilenio, in the late 1990s. The system has a capacity of 45,000 passengers per direction per hour. The BRT lines were placed in mostly economically stagnant zones in order to enhance affordable transport for the poor. However, the introduction of the first phase of system was not accompanied by proactive station area planning. Neither the city nor the neighbourhood districts prepared plans for the areas around the stations to coordinate private development, change zoning (including increasing permissible densities), introduced complementary improvements such as pedestrian environment or to attract private investments. Learning from their mistakes, the city of Bogota started implementing coordinated improvements along new Transmilenio corridors, aiming to capture the value of improvements for future public transport investments (Cervero, 2013).

Ahmedabad: Ahmedabad is India's fifth largest city with a population of 5.5 million and one of the fastest growing cities in the world. In 2009 Ahmedabad opened the first and largest BRT system in India, called Janmarg. Janmarg lines were selected to serve the fastest growing areas in the city but, similar to Bogota, little attention was given to the physical integration of bus stops with the surrounding areas. Ahmedabad's planning authorities are trying to maintain uniform densities across the city, regardless of the proximity of the development to public transport corridors. This approach is shifting growth to the periphery and will eventually lead to bigger areas to be served by public transport, and auto-oriented development (Cervero, 2013).

Appendix A3

Cycling in the Netherlands: Lessons learned from integrated environmental, urban and transport planning

The Netherlands

More than any other country in the Western World, the Netherlands is famous for its high levels of cycling. Almost every Dutch city is served by extensive cycling facilities, and the widespread presence of cyclists is an integral part of the urban landscape, central to the very image of Dutch cities (Pucher and Buehler, 2007).

Cycling as part of national policies

The scarcity of usable land in the Netherlands that has raised high and early awareness on spatial development issues and its connections with natural and environmental protection. Transport policies have always been well integrated with spatial, environmental and economic policies in order to achieve environmental, social and economic sustainability. Cycling and walking in particular, have received significant support over the past three decades as the country put significant barriers to the usage of private cars. Although motorization and car trips increased rapidly between 1960 and 1970, the increase has been moderate increase ever since (Alpkokin, 2012).

The country is currently focused on allowing urban planners the freedom to formulate area specific environmental ambitions that are based on existing functions and characteristics of urban areas. A distinct type of 'hybrid' planning tool has been developed specifically for defining area based environmental ambitions in spatial plans, coupled with the appropriate development measures. The strong background of policy integration is expected to contribute to making the most of environmental and spatial planning, resulting in more sustainable urban areas (Runhaaret al, 2009).

Cycling policies

The Dutch success story in making cycling so appealing is largely attributable to the coordinated implementation of measures that reinforce the impact of each other in promoting cycling. Indeed, the necessity of a coordinated, multifaceted approach is perhaps the key lesson to be learned from the Netherlands (Pucher and Buehler, 2008). In order to provide as much information as possible, the key policies and innovative measures for direct and indirect promotion of cycling in all Dutch cities are presented in Tables 14 and 15 below.

Table 14: Key policies and innovative measures used to promote safe and convenient cycling

Extensive systems of separate cycling facilities

- Well-maintained, fully integrated paths, lanes and special bicycle streets in cities and surrounding regions
- Fully coordinated system of colour coded directional signs for bicyclists
- Off street shortcuts, such as midblock connections and passages through dead ends for cars

Intersection modifications and priority traffic signals

- Advance green lights for cyclists at most intersections

- Advanced cyclist waiting positions (ahead of cars) fed by special bike lanes facilitate safer and quicker crossings and turns
- Cyclist shortcuts to make right hand turns before intersections and exemption from red traffic signals at T intersections, thus increasing cyclist speed and safety
- Bike paths turn into brightly coloured bike lanes when crossing intersections
- Traffic signals are synchronized at cyclist speeds assuring consecutive green lights for cyclists (green wave)
- Bollards with flashing lights along bike routes signal cyclists the right speed to reach the next intersection at a green light

Traffic calming

- Traffic calming of all residential neighbourhoods via speed limit (30 km/hr) and physical infrastructure deterrents for cars
- Bicycle streets, narrow roads where bikes have absolute priority over cars
- 'Home Zones' with 7 km/hr speed limit, where cars must yield to pedestrians and cyclists using the road

Bike parking

- Large supply of good bike parking throughout the cities
- Improved lighting and security of bike parking facilities often featuring guards, video surveillance and priority parking for women

Coordination with public transport

- Extensive bike parking at all metro, suburban and regional train stations
- 'Call a Bike' programmes: bikes can be rented by cell phone at transit stops, paid for by the minute and left at any busy intersection in the city
- Bike rentals at most train stations
- Deluxe bike parking garages at some train stations, with video surveillance, special lighting, music, repair services and bike rentals

Traffic education and training

- Comprehensive cycling training courses for virtually all school children with test by traffic police
- Special cycling training test tracks for children
- Stringent training of motorists to respect pedestrians and cyclists and avoid hitting them

Traffic laws

- Special legal protection for children and elderly cyclists

- Motorists assumed by law to be responsible for almost all crashes with cyclists
 - Strict enforcement of cyclist rights by police and courts
- Access to bikes**
- Free use of distinctive, simple city bikes parked throughout the city
 - Easy, convenient and inexpensive bike rentals at train stations ('OV Fiets')
 - Company bikes loaned for free to employees who can use them during the day for short business trips
 - Tax breaks to purchase a bike in the Netherlands
 - Convenient air pumps for bikes in city centre
 - 'Park and Bike': discount bike rentals for motorists who park their cars and bike for the rest of the journey
- Bike trip planning**
- Bicycling websites with extensive information for cyclists on bicycling routes, activities, special programmes, health benefits of cycling, bikes and bike accessories, etc.
 - Flexible Internet bike trip planning tool allows finding the most comfortable or quickest route by bike tailored to the specific preferences and needs of each person
 - Comprehensive bike maps for most cities as well as most regions and states
- Public awareness campaigns**
- Focus on health benefits of cycling
 - Special fun programmes for young children
 - Cycling ambassador programmes that send well trained cyclists to residential neighbourhoods to serve as role models of safe cycling and help with cycling promotion, distributing newsletters and information
 - Annual bicycling festivals and car free days that promote the environmental advantages of bicycling, display the latest bike models and accessories, and disseminate various other relevant information for bike enthusiasts
 - Wide range of cycling competitions for different ages and skill levels
 - Special guided bike tours for seniors
- Public participation in bike planning**
- Regular surveys of cyclists to assess their satisfaction with cycling facilities and programmes and to gather specific suggestions for improvement

- Bike councils that provide a platform for opinion exchange among stakeholders from businesses, the bike industry, the city administration, research institutes, universities, bike experts and citizen advocacy groups

Source: Pucher and Buehler, 2008

Table 15: Taxation, parking and land use policies that encourage cycling indirectly

Automobile speed limitations in cities

- Traffic calming of residential neighbourhoods limits cars to speeds of 30 km/hr or less
- 'Home Zones' in many neighbourhoods give cyclists and pedestrians equal rights to road use and limit cars to walking speed (about 7 km/hr)
- Car free zones, one way streets and artificial dead ends make car travel through the city centre slow and inconvenient
- Turn restrictions for cars but not for cyclists
- Almost no limited access motorways in city centres
- Strictly enforced speed limits and traffic rules in cities (such as police cameras at intersections)
- Frequent random speed limit enforcement checks by the police
- Advance stop lines and traffic signal priority for cyclists

Road and parking capacity limitations

- Limited number of car parking places in city centres
- Parking management schemes limit easy car access to urban neighbourhoods, often with resident only parking or strict time limits
- Replacing car parking facilities with bike parking instead
- Combined bus bike lanes that permit bike use but prohibit car use
- Deliberately narrowed roads in city centres force cars to drive slowly
- Special bicycle streets that sharply limit car speeds and give cyclists priority in roadway use over the entire width of the road

Taxation of automobile ownership and use

- High taxes and fees on car purchase, ownership and use
- Especially high excise and sales taxes on petrol
- High hourly parking rates in city centre, even in medium size cities
- High fees and strict training requirements for obtaining a driver's licence

Strict land use planning policies

- Most land beyond already built up areas is off limits for new development
- Most new development occurs adjacent to already built up areas, which keeps overall population high
- Transport and land use planning are integrated at several levels of government, with regional coordination that fosters cooperation between adjacent communities
- Many local governments specifically require cycling and walking facilities for new suburban developments, thus reducing the need for car use
- Mixed use zoning keeps trip distances short and feasible by bicycle and on foot
- Limited separation of land uses, thus enabling natural development of mixed use neighbourhoods

Source: Pucher and Buehler, 2008

Comparison with other cities: Rio de Janeiro, Brazil

Despite the cultural norms that widely favour motorized vehicles and their drivers, cycling has been steadily gaining popularity since the 1990s in Rio de Janeiro. Cycling is considered healthy, matches Brazilians' widespread preoccupation with the body and is being referred to as something genuinely 'carioca' (part of Rio de Janeiro). Rio has 300 kilometres of physically segregated cycle paths (ciclovias), painted lanes (ciclofaixas) and signalized shared routes (either with traffic or pedestrians). Civil society organizations and NGOs are closely working with local planning authorities in order to strengthen the voice of local people, enhance dialogue between all parts and give continuity to bicycle related projects in case local administration changes after elections (Aichinger and Reinbacher, 2010).

BikeRio, the city's bike sharing programme is one of the most successful bike sharing systems in the world in terms of penetration and infrastructure usage (ranked 7th in 2013). BikeRio has been operational since 2011 and averages 6.9 trips per bike and 44.2 trips per 1,000 residents daily. The system is operated privately by Sertell but is overseen by the city office that defines concessions in the mayor's cabinet and by the secretary of the environment (known as SMAC). BikeRio's stations are powered entirely by solar energy and are completely wireless (ITDP, 2013). Rio de Janeiro gives an encouraging example of how to preserve or expand high levels of cycling in similar places, by joining the potential and skills of civil society organizations and municipal governments. This megacity proves that in postcolonial societies bicycles are being redefined as symbols of postmodern resistance and means of more efficient, egalitarian and sustainable urban mobility.

Appendix A4

Sustainable urban freight operations, better air quality and safety in London

London is considered to be a pioneer in city logistics and has implemented a range of initiatives to help reduce the negative social, environmental and economic impacts of freight transport, especially in relation to reducing emissions of greenhouse gases and local air pollution (Browne et al, 2012).

The city

The urban agglomeration of London has a population of nearly 10 million (United Nations, 2014a). The majority of the city's freight policies and measures have been implemented since the introduction of a Mayor of London in 2000. All efforts to promote sustainable freight have been assisted by the formation of a freight unit in Transport for London (TfL), an executive body of the Mayor.

Freight planning

In 2007, the Mayor of London adopted the 'Sustainable freight distribution: a plan for London' plan (referred here as the Freight Plan) which set out the steps for the following five to ten years in order to identify and begin to address the challenge of delivering freight sustainability in the city. The plan contains proposals to deliver real improvements on the ground, alongside others designed to improve understanding of the issues around freight and to contribute to the longer term process of addressing London's transport needs (TfL, 2007). TfL is currently in the process of developing the Mayor of London's Long Term Freight Strategy (2016-2030), which will replace the London Freight Plan.

One of the key points made in the plan is that sustainable freight is a shared responsibility of TfL, the London Boroughs, businesses, freight operators, and other bodies and associations. Therefore, in order to implement the proposed measures and realise their potential new relationships, roles and responsibilities would have to be built, particularly at sub-regional level. Communication to each target audience was made by publishing supporting documents (for example, the rail sector, operators, and boroughs), an ongoing process of workshops and the delivery of additional resources related to best practice (TfL, 2007).

The key projects included in the Freight Plan are:

- 1) **Fleet Operator Recognition Scheme (FORS):** FORS is an accreditation scheme that is available to any company operating vans or lorries in London, UK and Europe. FORS provides operators with practical advice and guidance to help reduce fuel consumption, CO₂ emissions, vehicle collisions, and penalty charges (Browne et al, 2012). The projects sets FORS standards are a quality benchmark to be used by commissioning bodies when awarding servicing, maintenance and delivery contracts. This provides a simple way for clients to ensure the sustainable credentials of fleet and freight operators.
- 2) **Delivery and Servicing Plans (DSPs):** DSPs are intended to provide a framework to better manage all types of deliveries of freight vehicle movement to and from individual buildings of all types (e.g. shops, offices, factories, and depots). Improved freight management at sites contributes to better operational efficiency, safety and reliability of deliveries. DSPs are designed to reduce the number of trips to the sites and ensure the use of safe and legal loading facilities. This is accomplished using a range of measures including consolidation solutions, delivery booking management systems and out-of-hours deliveries (Browne et al, 2012; TfL, 2007).
- 3) **Construction Logistics Plans (CLPs):** CLPs are similar to DSPs but provide a framework for freight vehicle movements to and from construction sites.

Finally, the Freight Plan defined a series of measures against which progress in sustainable freight distribution is reported annually. Continuous monitoring and reporting contribute to the timely identification of areas for improvement and thus continuous development (TfL, 2007).

Synergies with other transport policies

The Freight Plan is complemented by safety and environmental measures and strategies for London. Examples of complementary measures are the Low Emission Zone (LEZ) and the Safer Lorry Scheme. The LEZ covers most of Greater London and was introduced in 2008 to encourage the most polluting heavy diesel vehicles driving in the city to become cleaner. Delivery vehicles are also affected and need to pay a daily LEZ charge if they do not meet the emission standards. The introduction of an Ultra Low Emission Zone (ULEZ) is confirmed and will be applied in 2020. The ULEZ will cover a smaller area than the LEZ (same as the current Congestion Charging Zone) and will introduce even stricter emission standards for almost all vehicles.

The Safer Lorry Scheme will come into force in September 2015 and it ensures that only lorries that meet the Mayor's higher road safety standards will be allowed to operate on London's roads. This includes construction vehicles, which are involved in a disproportionate number of fatal collisions involving cyclists and pedestrians. Vehicles will have to be fitted with mirrors providing better direct vision of vulnerable road users and side guards to protect cyclists from being dragged under the vehicle in the event of a collision.

Lessons learned

Lessons for London come from the application of pilot schemes and the experiences during the 2012 Olympic Games.

In order to investigate the potential of DSP, a pilot project was applied at one of TfL's main offices. This resulted in 20% reduction of the total number of delivery trips to the site. Stationery deliveries were reduced from twice a day to three times a week while catering delivering were also reduced by 40% (Browne et al, 2012).

The London Construction Consolidation Centre (LCCC) was a two-year trial project operated from 2005 to 2007 as part of additional projects supported by the Freight Plan. Its objective was to serve four major construction sites in the City of London. It was intended for a rapid flow, on a just-in-time basis, of materials from suppliers to site with storage time limited to 10 days. It is estimated that there was a 60-70% reduction in the number of vehicles delivering to the four construction sites. It is estimated that this resulted in a 70-80% reduction in CO₂ emissions for these flows. In addition, consolidating goods at the LCCC eliminated the use of articulated vehicles for site delivery and significantly reduced the use of vans (Browne et al, 2012). The London Construction Consolidation Centre is still operational, as a commercial business, and its operator is looking to replicate the concept in other areas within London.

The experience from the London Olympic Games in 2012 showed that through positive engagement and collaboration, the freight industry can change the way it operates for the wider benefit of London. The Freight Forum was established as the central focus for improving communication between TfL and freight operators, businesses, trade associations, regulators and highway authorities (TfL, 2013). The Forum meets twice a year and its membership grows annually.

Looking forward

Building upon the success from the 2012 Games, TfL continues to work with operations and the wider business community to deliver better results for the city. The next actions of TfL are organized around seven themes: better planning, improving safety, re-timing deliveries and collections, kerbside access, effective communications, and journey planning. Examples of identified schemes involve out-of-hours operations, revising kerbside loading guidance to ensure the safety of vulnerable groups, and potentially using London's waterways for freight movements (TfL, 2013).

Comparison with other cities: Paris

A significant amount of urban freight research and initiatives have been undertaken in French cities. In Paris, a series of regulations affecting access, loading and unloading are in place, many of them based on different criteria such as weight or size and often different times. Additional schemes have been implemented such as local logistic points known as “Espaces Logistiques de Proximité” (ELP). These small spaces serve as a type of micro-consolidation point serving certain areas of the city. As most ELPs are initiated by the private sector, the city assists the initiatives by renting logistics spaces at lower prices (Browne et al, 2012).

Other initiatives in Paris involve night deliveries using clean vehicles and the creation of a Charter of Good Practice for Transport and Goods Delivery in Paris which promotes regulations that respect the priorities of both the private and public sector. Finally, an interesting example of shared space comes from Paris. A site designed to operate as a site providing construction materials during certain times and then as a public space for the rest of the day, offers high levels of accessibility to workers, minimises the distances travelled for the deliveries and does not affect public space (Browne et al, 2012).

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