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Mobility and NMT in Sustainable Urban Development –Role of City Developers

(Background Paper for EST Plenary Session-5)

Final Draft

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Background Paper on

Mobility and NMT in Sustainable Urban Transport Development

Role of City Developers

Foreword

Asian cities are continuing to grow very rapidly. In many cities the number of vehicles are doubling every 5 to 7 years. Poor road safety, increased congestion and air pollution not only negatively affect the quality of life but also carry large economic and social costs. We are running out of options and sustainable transport solutions are the way forward. An effective and sustainable transport system for people and goods is a prerequisite of sustainable economic growth. Previous policies have in many cases focused on the construction of additional roads infrastructure and capital intensive, high-cost public transport systems such as rail-based Metros. This has gone on at the expense of more environmentally sustainable transport systems such as non-motorized transport and low-cost bus rapid transit (BRT) systems. Asian countries and cities urgently need a policy framework which prioritizes the movement of goods and persons instead of vehicles. This policy reorientation requires the building of new institutional capacities to improve regulatory frameworks, introduce better land-use planning and promote integrated transport infrastructure schemes based on affordable, environment friendly public transport and non-motorized transport.

There is a strong empirical information that increased sustainability of urban passenger transport systems can be achieved through modal shifts – by increasing the modal share of public transport and non-motorized transport modes (walking and bicycling), and by reducing private motorized transport. For this, an enhanced focus on urban planning and design is required, to ensure that cities are built to encourage environmentally sustainable transportation modes. While encouraging a shift to non-motorized transport modes, the policy paper acknowledges that such modes are best suited for local travel and that motorized transport (in particular public transport) has an important role while travelling longer distances. There is however a need to enhance the acceptability of public transport systems. More needs to be done to increase reliability and efficiency of public transport services and to make these services more secure and safe.

Around the world, many people rely on walking and cycling for transport. Many more begin and end each trip on foot. Such affordable, people-friendly transport offers huge social, economic and environmental benefits for urban and rural areas. But many of these people risk their lives every time they travel. Every thirty seconds one person dies in a road accident. In 2016 1.3 million people died in road accidents. By 2030 that will add up to almost 30 million deaths in road accidents. More than a quarter of the people killed in road accidents are pedestrians; a number increasing steadily due to a tragic lack of investment.

In fact, transport has hard hitting consequences for almost every aspect of the life for drivers, cyclists and pedestrians. For example, it generates nearly a quarter of all carbon dioxide emissions and is the fastest growing contributor of greenhouse gasses. It also feeds air pollution that is killing seven million people a year and increasing health problems like bronchitis, asthma, heart disease and brain damage.

However, these trends can be reversed, and rapid progress made towards ending poverty, healing and making our planet secure by 2030. Scaling up that kind of change starts by deciding to take the first step, which can be as simple as creating a cycling and walking policy. This paper looks at ideas from around the world, including the policies for decision makers and the realities for citizens, to show what really works.

As the global population heads towards nine and half billion by 2050, we need to design mobility for our people instead of mobility for our cars. I hope this paper will inspire decision makers and all other stakeholders in Asian countries to explore and assess their commitments and adopt more of the great ideas for moving towards Environmentally Sustainable Transport in Asian Region.

Introduction

Today, 55% of people live in towns and cities. This has led to an increase in transport demand in meeting urban mobility needs. By 2030, it is estimated that nearly half of the world's projected 1.5 billion vehicles will be in Asia (ADB, 2016). According to International Energy Agency (IEA), by 2030, annual passenger traffic will exceed 80 trillion passenger-kilometers - a 50% increase; and the global freight volumes will grow by 70 %. The major challenge for Asian cities is how to address this enormous demand for mobility of the people and freight.

Meanwhile, most of the Asian cities are facing proper accessibility, connectivity and mobility challenges as well as other socioeconomic problems such as traffic congestion, air pollution/GHG emissions, traffic accidents and fatalities, and noise pollution, among others. It is estimated that road congestion alone costs Asian countries 2~5% of their GDP annually due to countless hours of delay, loss of economic opportunities, and the waste of billions of gallons of fuel and higher transport costs (ADB, 2010). According to WHO an average of 15 million people are injured in urban road accidents in developing countries each year and the majority of victims are poor pedestrians and bicyclists. Similarly, outdoor air pollution contributes to an estimated 1.6 million premature deaths in the People's Republic of China (Rohde and Muller, 2015), and 1.4 million people in India in 2013 (Indian Express, 13Feb.2016) which is half of the world's air pollution deaths.

For achieving sustainable development, there is a need to pursue an integrated approach that includes, among other things, land-use planning as well as planning of non-motorized and public transport options in both urban and rural areas[1].

There is a global consensus that the way towns and cities are structured and how they function urgently needs to change to fulfill the required demand and address the existing urban issues. Urban mobility and transport that is strategic and well planned, is crucial in making cities more safe, resilient, liveable and sustainable. It can curb sprawl, create compact, walkable neighborhoods and reduce the number of kilometers vehicles travel. Therefore, city developers need to think innovative sustainable urban design and Non-Motorized Transport (NMT) solutions for seamless mobility and accessibility for the benefit for all.

Sustainable urban transport and mobility are fundamental to progress in realizing the promise of the 2030 agenda for sustainable development and in achieving the 17 SDGs (Global Mobility Report, 2017). Of the 17 Sustainable Development Goals, that provide a global framework, Goal 11 specifically aims to build cities that are "inclusive, safe, resilient and sustainable. Although sustainable transport is not represented by a standalone SDG in the 2030 Agenda, it is mainstreamed in a direct or indirect manner into many of the SDGs including those related to energy, infrastructure, cities and human settlements, and climate change. In addition, the New Urban Agenda as adopted in Quito in October 2016 includes transport and mobility in one of its six main policy areas, with a focus on integrating land-use and transport planning, seeking innovative financing and using big data to help countries leapfrog to more sustainable modes.

The main objective of this paper on "*Mobility and NMT in Sustainable Urban Development - Role of City Developers" is* to better guide and support Asian countries through better urban planning, design and development. The policy paper looks into the (a) changing trends in urban mobility in Asian Countries particularly in the Non-Motorized Transport (b) Policies regarding NMT in Asian countries based on the secondary data/available information from country level sources as well as regional studies and (c) the role of City, State and National Governments, the private sectors as well as other stake holders including City Planners. The paper also looks at the

[1] Fifth UNCRD Regional EST Forum in Asia

guidelines for promoting and improving mobility and Non-Motorized Transport (NMT) in Asian Cities.

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ADB	Asian Development Bank
BRT	Bus rapid transit
CBD	Central business district
CO_2	Carbon dioxide
CNG	Compressed natural gas
DKK	Danish Krone
EU	European Union
GDP	Gross domestic product
GEF	Global Environment Facility
GHG	Green House Gas.
HBC	Hyderabad Bicycling Club
HMR	Hyderabad Metro Rail.
ITDP	The Institute for Transportation and Development Policy
MTA	Metropolitan Transportation Authority (New York, US)
MTRC	Mass Transit Railway Corporation (Hong Kong, China)
NGO	Non-governmental organization
NIMBY	Not-in-my-backyard
NMT	Non-motorized transport
NMV:	Non-motorized Vehicle
NUTP:	National Urban Transport Policy
NYC:	New York City
OECD	Organisation for Economic Co-operation and Development
O&M:	Operations and Management
PBS:	Public Bicycle Sharing
PM:	Particulate Matter
PMC	Pune Municipal Corporation.
PPP	Purchasing power parity
RoW:	Right of Way
SAR	Special administrative region (of China; used about Hong Kong and Macao)
SEIAA:	State Environment Impact Assessment Authority
SEZ:	Special Economic Zone
SRTS:	Safe Routes to School

STP:	Surface Transportation Program
SUTP:	Sustainable Urban Transport Project
SUV	sports utility vehicle
TfL	Transport for London (UK)
TOD:	Transit Oriented Development
TPDM:	Transport Planning and Design Manual
TRIPP:	Transportation Research and Injury Prevention Programme
UITP	International Association of Public Transport
UK	United Kingdom of Great Britain and Northern Ireland
ULBs:	Urban Local Bodies
UMTA:	Unified Metropolitan Transport Authority
UNDESA	United Nations Department of Economic and Social Affairs
UNCRD	United Nations Centre for Regional Development
UNFCC:	United Nations Framework Convention on Climate Change
USA	United States of America
USD	United States Dollar
USDM:	Urban Street Design Manual
UTTIPEC:	Unified Traffic and Transportation Infrastructure (Planning & Engineering) Centre
VKT	vehicle-kilometres travelled
WHO	World Health Organization

Executive Summary

The policy paper gives a brief background and introduction on trends in urbanization and motorization in Asia. It discusses the accessibility, connectivity and mobility challenges in Asian cities and its impact on socioeconomic development, city environment and quality of life. The Asia-Pacific region is home to more than 2.1 billion urban residents, or 60 per cent of the world's urban population. In 2014, there were 17 mega cities in Asia and the Pacific and this number is expected to go up to 22 by 2030. These trends in urbanisation in the region together with rapid motorisation pose big challenges - increased congestion, air pollution, and poor conditions for pedestrians and cyclists, high accident rates, degradation of the urban environment, and inefficient land consumption. Chapter 1 gives a brief description of the problems of traffic growth and the vicious circle of transport decline over the last 50 years. The problems of air pollution and climate change, poor road safety, poor mobility and traffic Congestion are also described. The need for strategic framework for sustainable urban transport in Asia, sustainable urban transport is highlighted together with the environmental dimensions.

The chapter on importance of Non-Motorized Transport (NMT) for sustainable urban mobility describes trends and conditions of NMT around the world including NMT in developed countries, discusses the issues of accessibility and connectivity in Asian cities and role of NMT – walking and cycling - in improving the mobility in cities. A strategy to improve the quality and safety of cycling also includes role of 3 wheeled rickshaws. The health effects of NMT encourage strengthening and improving of infrastructure for non-motorized transport

Non-motorized transport makes cities and communities safe, inclusive, accessible, inclusive and green. The economic, social, environmental and health benefits of the use of NMT are well elaborated. Non-motorized transport can be stimulated by a policy package consisting of investments in facilities, improved transportation networks, awareness campaigns, as well as disincentives for the use of private motorized vehicles. The reasons for the decline of walking and cycling in Asia, growing accidents and fatalities of NMT users, the impact of air pollution of motorization and car-centric cities and transport energy consumption and GHG emissions are also analyzed. Reasons for the decline of walking and cycling in Asia include (a) car-centric mobility culture (b) anti-cyclist lobbyists and (c) perceived unconducive weather.

The transformative change would require cities to work towards a people-oriented city. Cities need to embrace walking and cycling. Cities have started taking steps to enhance safety, urban liveability and reduce traffic congestion. Cities took steps towards NMT. Factors in cities that support or hinder NMT need to be analysed.

The possibility and desirability of promoting low carbon transport solutions in Asian Cities through NMT Development is the subject of discussion in this chapter. It looks at the transportation planning process, visioning, assessing walkability and cyclability in Asian cities and implementing NMT policies, strategies and projects.

This chapter also discusses policies, planning and design aspects to integrate NMT with the public transport and pedestrian provisions in the new road infrastructure design in their order of priority. The provision of appropriate infrastructure for NMT provides equal access to all and is a major factor in determining the use of public transport in the city. The complete network plan for promoting the use of NMT that is well integrated with the other modes of the public transport systems are discussed here and their implications to enhance the urban mobility in the cities are outlined.

City planners and developers have a major role to play for the sustainable urban planning, design and development. Issues related to infrastructure development, design, quality and data gaps have been identified and an overview of investments by national and local authorities for

improving NMT infrastructure to improve the mobility options in select cities of Asia are presented.

Chapter 5 has examined the need for strengthening NMT infrastructure and impact of improved walking and cycling facilities and growth of public bike sharing schemes around the world which can be replicated in Asian countries.

The policy paper reviews NMT projects in selected Asian cities with the objective to highlight gaps in the implementation of policy/planning/development and identify appropriate policy and design interventions required to encourage NMT use in Asian cities.

Best practices and good examples, case studies and success stories of city developers for improving the mobility of the city through successful planning, design, and investment in NMT projects are also shared here for the purpose of lesson learning.

The last chapter recommends strategies to promote NMT for sustainable mobility by analyzing policies, barriers and alternative measures. It further suggests high priority policies to create awareness and capacity building; on policies/planning/design to integrate NMT with the public transport; policies to incorporate standards for the bicyclists and pedestrians. For achieving sustainable development, there is a need to pursue an integrated approach that includes, among other things, land-use planning as well as planning of non-motorized and public transport options in both urban and rural areas,

In many countries of Asia NMT still has only modest priority. In most countries of the region, the enabling environment for NMT is not there. Strategies to Shift towards more sustainable modes require Non-Motorized Transport (NMT) components in transport master plans and also improve public transport services. Most countries are implementing NMT policies and programs with EST Forum support and encouragement. For example, Indonesia is developing pedestrian and bicycle facilities in cities.

Strategies to Shift towards more sustainable modes (Goal)[2] require Non-Motorized Transport (NMT) components in transport master plans in all major cities and prioritize transport infrastructure investments to NMT, including wide-scale improvements to pedestrian and bicycle facilities, development of facilities for intermodal connectivity, and adoption of complete street design standards, wherever feasible.

[2] Bangkok Declaration 2020.

Chapter 1
Background

1.1 Trends in Urbanization in Asia and the Pacific

The Asia-Pacific region is home to more than 2.1 billion urban residents, or 60 per cent of the world's urban population. Between 1980 and 2010, the region's cities grew by more than 1 billion, and 1 billion further will be added again by 2040. By 2050, two thirds of the region's population will live in cities. Over the past two decades, urbanization in Asia and the Pacific has transformed both the region and the world. However, in many of the countries in the region, such urbanization has not followed any national urban agenda or policy. The way in which the Asia-Pacific region urbanizes over the next two decades will have a great impact on the sustainability of the planet as a whole.

In 2014, 17 of the world's 28 megacities (cities with a population of 10 million or more) were in Asia and the Pacific. It is projected that by 2030, the region will have no less than 22 megacities. Megacity growth rates are generally decelerating, especially in their core areas. However, given the absolute population numbers and the projected growth, the impact of megacities and of regions around them will be extremely significant.

At the same time, these megacities accommodate only a little more than 10 per cent of region's total urban population. The bulk of the region's total urban residents live in the rapidly growing small and medium-sized cities where much of the region's urban transformation is unfolding. Over half of urban residents (54.4 per cent) live in smaller cities with a population of less than 500,000 inhabitants. Secondary and smaller cities and towns do not have the resource base of many larger cities and the population often has less access to basic service provisions, adequate livelihoods and transportation options.

Air pollution is a major issue affecting many of the region's cities. Of the 20 most air-polluted cities in the world, 19 are in Asia and the Pacific. According to the World Health Organization, outdoor air pollution accounted for 3.7 million deaths globally in 2012, with the highest share (2.6 million deaths, or 70 per cent) in low- and middle-income countries in Asia and the Pacific. The economic, health and other costs of environmental degradation can also be very high. China, for example, is believed to be losing 10 per cent of GDP annually to costs related to air pollution alone.

Asia-Pacific cities create 75 per cent of the region's emissions and are projected to contribute more than half the rise in global greenhouse gas emissions over the next 20 years if no action is taken. As major sources of greenhouse gases, cities in the region should urgently seek low-carbon development. Many opportunities exist to develop low-carbon cities, starting from the way in which cities are planned and designed. Compact cities with a variety of mass transit and mixed-use options can save energy in the transport sector.

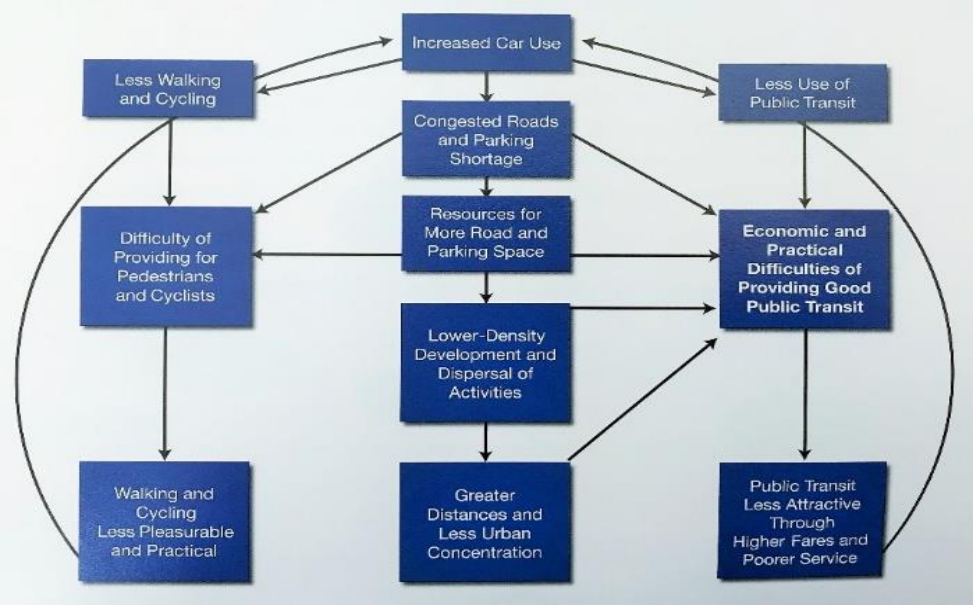
1.2 Rapid Motorization in Asia- Emerging challenges

As stated above, cities in Asia are growing rapidly. The traffic growth associated with this and increased aspirations toward motorization have meant worsening travel and environmental conditions for large numbers of people. The general quality of urban life is declining in many cities. Attempts to build our way out of the problem by providing more roads and parking space will simply lead to problems on a larger scale— more congestion, carbon emissions, pollution, social inequity, and economic decline. There is an urgent need for change because urban transport in Asia is in crisis.

In 2005, non-motorized transport made up about 37% of urban trips worldwide. For very short trips walking is the main mode of transport. Despite the high proportion of people relying on non-motorized transport, a divergence is seen between modal use, infrastructure allocation and modal funding in many cities. For example, in Dhaka, Bangladesh, almost 80% of trips are by walking, bus or informal motorized transport, yet 70% of road space is dedicated primarily to private vehicles.

There are very large projected motorization growth rates over the few decades in most countries, and particularly in Asian cities. Conventionally, this rise in travel has been regarded positively—as a reflection of increasing personal mobility and economic growth. However, the side effects of traffic have increasingly been observed and understood, including increased congestion, air pollution, and poor conditions for pedestrians and cyclists, high accident rates, degradation of the urban environment, and inefficient land consumption. The problems of traffic growth and the vicious circle of transport decline have been acknowledged for over 50 years. The universal similarity of these problems is striking. There is a need to understand the rationale as to how cities can better diagnose their problems and devise strategies and investment programs to develop more sustainable patterns of mobility.

Figure 1.1 The Vicious Circle of Transport Decline



Source: T. Pharoah. 1992. Less Traffic, Better Towns. London: Friends of the Earth

Transport plays a major role in the life of anyone living in an Asian city. Yet, for many, the experience of travel is traumatic. The adverse impacts of the growth in motorization—in economic, environmental, and social terms—are ruining the quality of life in our cities and our global climate. There is an urgent need for a change in approach. Great challenges face urban areas in the first half of the 21st century.

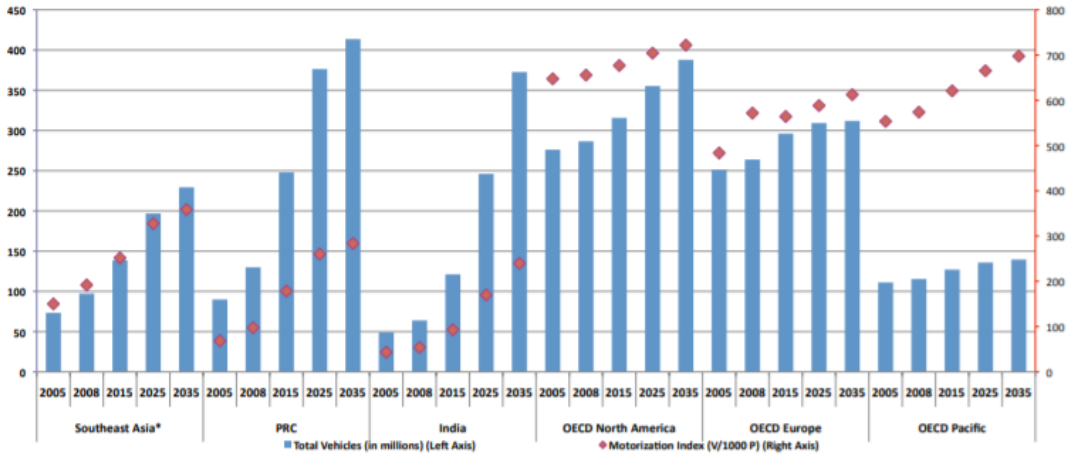
Transport is a critical part of the future liveability of cities: it is often viewed as the "maker and breaker of cities."[3] Societies depend on efficient transport, but this needs to be developed without unacceptable adverse impacts. The dominant investment in transport has conventionally been in highway building. However, a revised approach is emerging that advocates managing the transport system in a way that supports sustainable urban living. A better focus for policy and

[3] C. Clark 1957 Transport: Maker and Breaker of Cities. *Town Planning Review*. 28. pp 237-50

investment would be packaged strategies that include urban planning to support transport, traffic demand management, mass rapid transit, light rapid transit, bus rapid transit, informal non-motorized transit (like walking and bicycling), low-emission vehicles and alternative fuels, and freight planning. This changed emphasis is particularly relevant in Asia and the Pacific, where mass motorization is reaching an ever increasing number of areas, and is projected for enormous growth in future years. The potential implications for global transport and cross-sectorial greenhouse gas and carbon dioxide (CO2) emissions are profound.

As per capita incomes of urban dwellers in Asia increased, vehicle ownerships likewise have been increasing and generally following a similar path taken by developed countries. Motorization in Asia is rising very rapidly with some countries' fleets doubling every 5 to 7 years. Much of this growth is occurring in the cities and towns where the bulk of economic activities are located.

Figure 1.2 Total vehicles and motorization index



Source: ADB. 2009. Changing Course. A New Paradigm for Sustainable Urban Transport. Manila; with data from Clean Air Initiative for Asian Cities, Segment Y Automotive.

A special Asian phenomenon is the large growth of 2- and 3-wheelers, which now dominate the vehicle fleet in terms of absolute numbers in several of the cities in Asia. Many of the cities in Asia face problems with urban ambient air quality. In most cases, the transport sector is the largest or most significant contributor to air pollution. Pollutants of main concern are particulate matter (PM), especially PM10 and PM2.5, nitrogen oxides (NOx), and hydrocarbons. Increasing NOx levels contribute to an increase in ozone levels.

1.3 Air Pollution and Climate Change

Another environmental problem associated with the transport sector is climate change. The linkage is from (a) the direct emissions of greenhouse gases (GHGs), which contribute to the change in climate, and (b) the soot from sources such as transport, which have documented impacts on the precipitation patterns of specific parts of Asia.

In 2010, transport was responsible for approximately 23% of total energy-related CO2 emissions. Greenhouse Gas Emissions from the transport sector have more than doubled since 1970 - increasing at a faster rate than any other energy end-use - to reach 7.0 Gt CO2eq in 2010. The final energy Consumption for transport reached 27.4 % of total end-use energy, of which a large share was urban. In a business as usual scenario, transport emissions could increase at a faster

rate than emissions from other energy end-use sectors and reach about 12 Gt CO2 a year by 2050[4]. This trend endangers the goal of limiting the increase in global temperatures to two degrees Celsius above pre-industrial levels. However, increasing mobility and connectivity in cities brings enormous benefits to society and provides the essential means by which a city can function effectively.

The transport sector as a major and rapidly growing emitter of GHGs is responsible for almost a quarter of the world's carbon dioxide (CO_2) emissions from fuel combustion activities, and it is the fastest growing source of global GHG emissions. This percent share is increasing annually especially in developing countries with urban populations projected to double by 2030. Worldwide, the annual growth of CO_2 emissions from transport stands at approximately 2.1 per cent but in developing countries, this stands at 3.5 per cent.[5] In the transport sector, the growing number of private cars is a key determinant for fuel use and consequently CO_2 emissions. Although the developed world has the highest-per-capita ownership of private cars today, developing countries are expected to have the larger shares in future automobile use.

Ways to reduce GHG emissions from road transport include increasing the efficiency of automobiles thereby reducing emissions per kilometer traveled and shifting to less carbon-intensive fuels. As with air pollutants, GHG emissions are also cut through adequate vehicle maintenance, improved traffic management, increased public transport patronage, use of vehicles with cleaner (less carbon-intensive) fuels and use of non-motorized transport such as bicycles. Unfortunately, in Asia, vehicle maintenance is still a low priority for drivers and vehicle owners, traffic management is still very poor, public transport is still very inefficient, hybrid vehicles are still not widely available and bicycle lanes in some countries have been removed. In 2012, outdoor air pollution, which is partly caused by transport, was estimated to cause 3.7 million premature deaths worldwide; predominantly, 88% of these deaths were in low and middle-income countries. Transport also contributes to soil and water pollution. Traffic congestion, not only increases local air pollution but also causes heavy economic losses due to time and fuel wastage and increased emissions. For example, in Manila, time lost in traffic amounted to 4% of GDP, Philippines, 3.3% to 5.3% in Beijing, China and 1% to 6% in Bangkok, Thailand where people on average spend around four hours in daily travel.

1.4 Poor Road Safety

Annually, 1.30 million people are killed in road traffic accidents which occur predominantly (92%) in low and middle-income countries. Africa, which has only 2% of the world's vehicles and 12% of the population, has 16% of the fatalities6. The growth of motorization is a worldwide phenomenon. In 2010 there were 1 billion motor vehicles worldwide (excluding two wheelers). Data from 2005 indicates that almost half of all trips in cities were made by private motorized modes. This proportion continues to increase. By 2035, the number of light duty motor vehicles (cars, sports utility vehicles, light trucks and minivans) is expected to reach 1.6 billion and by 2050 this number will exceed 2.1 billion. Most of the increase will be found in Asian Countries, especially China and India. Globally, the number of new cars sold annually increased from 39 million in the 1990s to 63 million in 2012. Some countries, notably in Asia, are seeing a huge increase of motorized two wheelers on their roads. Trends also indicate that private vehicle ownership grows slowly in countries with lower per-capita incomes, faster at middle income levels, reaching saturation at highest levels of income.

[4] Climate Change 2014: Mitigation of Climate Change. Contribution of Working Group III to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change (Chapter 8 , Transport)

[5] International Energy Agency. *World Energy Outlook, 2002* as quoted in Browne et al. 2005. Getting on Track: Finding a Path for Transportation in the CDM - Final Report. International Institute for Sustainable Development. Canada.

The increase in motorization in the urban areas in Asia, especially the rapid increases in the number of motorcycles, cars and trucks has resulted in an associated growth in the number of traffic accidents. Asian countries and cities are trying to get control over the number of traffic accidents which result in 500,000 deaths and 20 million injuries per year in the Asian region. As in the case of the environmental damage resulting from air pollution, authorities still have an incomplete picture of the exact numbers of accidents and their costs. This is due to problems in the reporting. Estimates for the ASEAN region show that the annual economic losses from road accidents amounts to 2.23% of the gross annual domestic losses.[6] In many cases the pedestrians and especially the children are the hardest hit.

Present vehicle fleets result in 235,000 persons being killed and 3 million to 4 million being injured or crippled each year. Road accidents cost the developing countries of the Asia and Pacific region about US$20 billion annually and this will continue year after year. These losses undoubtedly inhibit the economic and social development of the region. The rapid rate of increase in motorized vehicle fleets (15 % to 17 % annually in many countries) will result in doubling of vehicles in only five years and tripling every eight years. This will cause even more problems and, according to present trends, there could well be 450,000 deaths and 7 to 8 million injured or crippled annually within the next decade unless appropriate action is taken.

1.5 Poor Mobility and Traffic Congestion

The rapid economic growth that has characterized development in most Asian cities has resulted in a considerable growth in the demand for transport of both persons and goods. The growth in demand for mobility has resulted in large increases in the number of vehicles and will continue to do so over the next years. In most of the Asian cities this has resulted especially in the increased number of personal vehicles.

The substantial growth in vehicles is clearly evident in the urban areas throughout the region in the form of increased congestion and pollution that is now being experienced. In many cities, congestion is pervasive and is not only being experienced in the peak hours, but the peaks are spreading, and the areas of congestion are expanding. The traffic congestion of Bangkok is almost well known as some of the city's other attributes and it is widely perceived to possess the worst congestion in the region. One government agency has calculated that on average each car spends 44 days equivalent each year in congested traffic. While it is difficult to substantiate this figure, it nevertheless reflects the seriousness of the traffic congestion that permeates all economic and social activities in the city.

Strategic Framework for Sustainable Urban Transport in Asia

Cities have started to question the relevance of the automobile driven mobility scenarios and are starting to pay more attention to public transport systems and restoring the importance of non-motorized transport.

1.6 Sustainable Urban Transport

Sustainable urban transport (SUT) focuses on easing access and mobility for people, services, and resources. This manner of thinking radically differs from transport policies in many of the countries and cities in Asia, which till now mostly focus on the movement of vehicles. SUT needs to provide access for all groups in society in a manner that is within the environmental carrying capacity of a region and in such manner that is affordable to both the providers and users of

[6] ADB/ASEAN (2005)

transport systems. The design of the transport systems should ideally follow clear land-use planning and city planning principles and priorities.

An effective and sustainable transport system for people and goods is a prerequisite for sustainable economic growth. Asian countries and cities urgently need a policy framework that prioritizes the movement of goods and persons instead of vehicles. In providing access to all sections of society including those below the poverty line, SUT makes high-class transport options available at an affordable end-price for all groups in society. Improved access to places of work, educational and health services for poor and disadvantaged groups can help these groups to improve their life. Poor people lack the resources to acquire cars or motorcycles. Traditionally they have depended on walking or mass transit. In order to improve their mobility, they depend on the availability of affordable public transport that covers a sufficiently wide geographical area whenever they need it.

Much more attention needs to be given to non-motorized transport (NMT), recognizing that transport's task is to ensure mobility of people and goods, not merely of motorized vehicles. Key measures include the clear provision for the rights and responsibilities of pedestrians and cyclists in traffic law; training of police to enforce the rights of NMT users; formulation of a national strategy for NMT as a facilitating framework for local plans; development of specific local plans as part of the planning procedures of municipal authorities; provision of separate infrastructure for movement and parking of bicycles where appropriate, and incorporation of standards for providing for cyclists, pedestrians, and freight carts in new road infrastructure design. This is not to say that NMT can be accommodated on all roads or in all densely built up areas. In some cases, a sustainable balance may require the localized ban on certain types of NMT for safety and traffic flow reasons.

The sustainability of the transport systems is defined by its impact on the environment, the social sustainability, and the economic sustainability. Three quick checks that decision makers can apply in making decisions on urban transport systems are: 1. How will it affect pollution and more generally, quality of life? 2. What will happen to safety? 3. Does it increase or decrease congestion?

1.7 Environmental Dimension

Sustainable urban transport sees to it that pollution from transport does not exceed assimilative carrying capacity of the (local) environment (air, water and soil). In considering its effects on the atmosphere, both local urban air pollution and greenhouse gas emissions are to be taken into account. Asian decision makers need to realize that transport systems should be fitted in to the cityscape rather than super-imposed as is unfortunately the case in many of the cities in Asia. Few, if any cities in Europe have systems elevated highways running through them as can be seen in an increasing number of Asian cities. People like to see trees and greens while traveling, more so than concrete. People like to be part of the city, rather than just be passers through.

Emissions from transport affect air quality and impact climate change. To enhance the environmental sustainability of transport policy, decision-makers need to consider:

- How can the transport systems in their cities be designed in a manner that minimizes the number of vehicle kilometers driven? This can be accomplished by influencing the overall demand for transport and by promoting an active shift towards the use of public transport and by maintaining or expanding the share of non-motorized transport.
- How clean are the vehicles on the road? To ensure that the vehicles that will be part of transport systems in the future are as clean as possible regulators will need to promote the use of cleaner fuels and vehicles. This applies to both commercial and private vehicles, to 4 wheeled as well as 2-3 wheeled vehicles. The technology for cleaner fuels and vehicles

is well available now. It is encouraging to see that many of the countries in Asia are following the example of Japan, Europe and the USA and have developed and issued roadmaps calling for the introduction of cleaner fuels and vehicles in the years to come. There will be differences, however, in the speed with which Asian countries will introduce cleaner fuel and vehicle standards. By 2010 a majority of new vehicles introduced into the fleet will comply with Euro 4 emission standards, while a much smaller percentage will already comply with stricter Euro 5 standards. To achieve the introduction of cleaner vehicles all Asian countries that do not yet have roadmaps developed and issued will have to do so soon.

- Special consideration needs to be given to emissions from in-use vehicles which will constitute the majority of vehicles on the road in most of the Asian cities. This will require the setting of appropriate emission standards for the in-use vehicles and to ensure that all in-use vehicles are inspected on a regular basis for compliance with emission standards and road safety. Vehicle emission standards for in-use vehicles should be gradually made more stringent and should take advantage of the cleaner engine technology in new vehicles entering the fleet and cleaner fuels that become available.
- Some countries and cities in Asia have promoted the adoption of Compressed Natural Gas for busses and other high mileage vehicles. Other cities are conducting experiments with the retrofitting of busses and other vehicles with advanced emission control devices once cleaner fuels are available. Several cities have issued age-bans for public transport vehicles in combination with scrapping of old, gross-polluting vehicles.
- Improvements in the fuel efficiency of vehicles will help to reduce the contribution of the transport sector to climate change. Considering the rapid growth in motorization and the already high contribution of transport to greenhouse gas emissions this appears to be a no-regret policy option.
- As stated before cleaner fuels and vehicles are important options and should be actively considered by policy makers. However as also previously stated reducing the number of vehicle kilometers driven is another policy option.

CHAPTER-2
Importance of sustainable urban transport.

2.1 Importance of the Non-Motorized Transport (NMT) for sustainable urban mobility, accessibility, and the connectivity in cities

Non-motorized transport refers to the transportation of passengers via human or animal powered means including bicycles, rickshaws, pedicabs, animal-drawn carts and walking. With animal power being largely a rural feature, the focus in this is on human-powered modes (bicycles, cycle rickshaws) and walking. Non-motorized transport, and particularly walking, is the principal means of transportation in most cities of developing countries. This is largely not by choice, but rather driven by the lack of affordable and accessible alternatives, with most pedestrians belonging to lower income groups. Cycling caters for the mobility needs of numerous urban dwellers in the cities of developing countries, especially in Asia. Recently, however, there has been a decline in cycling in some Asian cities, due to rising incomes and concomitant motorization, including changing social perceptions, which tend to view cycling as a means of transport for the poor. Bicycle ownership is high in developed countries, particularly in Western European countries such as the Netherlands, Denmark and Germany. This has been attributed to the transport and land-use policies introduced since the mid-1970s in these countries in favor of non-motorized and public transport facilities.

Table 2.1: Non-motorized transport benefits

User benefits:	Increased user convenience, comfort, safety, accessibility and enjoyment as well as savings from reduced vehicle ownership and use
Equity objectives:	Benefits economically, socially or physically disadvantaged people.
Congestion reduction:	Reduced traffic congestion from private cars on congested roadways.
Roadway and parking	Reduced roadway and parking construction, maintenance and operating costs.
Cost savings:	Energy conservation: Economic and environmental benefits from reduced energy consumption.
Pollution reduction:	Economic and environ mental benefits from reduced air, noise and water pollution.
Land-use impacts:	Encourages more accessible, compact, mixed, infill development (smart growth).
Improved productivity:	Increased economic productivity by improving accessibility and reducing costs.

Source: Adapted from Litman, 2013.

The only means of transport for low-income citizens in many developing country cities are cycling and walking, yet the facilities in cities like Manila (Philippines) are often non-existent. In many cities, the provision is often poor, or even denied. Most cities of developing countries have poor quality infrastructure for non-motorized transport. Poor lighting, absence of footpaths and overcrowding make walking unsafe in these countries. Facilities are often thoughtlessly designed. Pedestrians and cyclists are treated as second class citizens. Public expenditures tend to focus

on provision of infra-structure for the small minority that can afford to own a private car, in effect subsidizing the wealthiest road users. In Dhaka´s strategic transport plan, out of the US$5 billion budget, only 0.22% is allocated for pedestrian Facilities.

In developed countries, pedestrian infrastructure has rapidly improved in recent decades, with a number of Western European cities investing heavily in pedestrian areas and dedicated lanes. In contrast, investments to improve infrastructure for walking and cycling in the US have been limited. A major advantage of non-motorized transport is that it reduces energy consumption; greenhouse gas emissions and pollution, as it does not rely on fossil fuels. Furthermore, such transport modes require significantly less road and parking space and enable the preservation of natural habitats and open spaces. Cycling and walking can also directly provide the daily physical activity required for a healthy life style.

2.2 Trends and conditions of NMT around the world

Globally, walking and bicycling are the dominant modes of NMT. Yet, the needs of NMT users are often ignored, while pedestrians and cyclists together form a significant fraction of traffic accident victims. Most cities do not have dedicated infrastructure, and even if some European cities have been remodeled to become pedestrian and bicycle friendly, NMT users typically negotiate hostile urban environments. In London, UK, for instance, many cyclists are killed annually by turning trucks, despite the presence of bicycle lanes.

2.2.1 Role of NMT and bicycle in improving the mobility in cities

NMT is the principal mode of transportation in most cities of developing countries in Asia. For example, the combined average share of cycling and walking in Chinese cities is 65 per cent. Beijing, for instance, has a combined modal share of walking and cycling of 53 per cent. In Indian cities (such as Ahmedabad, Bangalore, Delhi and Mumbai) walking and cycling account for about a third of all trips. In Latin America, walking and cycling constitute more than one-third of the trips in cities such as Santiago, Chile (37 per cent), Rio de Janeiro, Brazil (37 per cent) and Guadalajara, Mexico (39 per cent), but are less significant in others such as Buenos Aires, Argentina (9 per cent), La Paz, Bolivia (10 per cent) and Caracas, Venezuela (18 per cent).

Walking

Walking is an extremely valuable means of travel, accounting for a large share of all journeys, and indeed is an integral part of all trips. The distance traveled is usually relatively short (below 1 km). The gains of walking for the individual can be important in terms of supporting an active and healthy lifestyle, and the cost to the community is minimal, unlike other modes. Despite this, the quality of the walking environment is often very poor. Improved networks and facilities can be designed to increase not only the proportion of journeys made on foot, but also the quality of the walking experience in the center and periphery of urban areas.

Walking as the principal means of transportation in cities of developing countries is largely not by choice, but rather driven by the lack of affordable and accessible alternatives, with most pedestrians belonging to lower income groups.3 Among low income groups in Santiago (Chile), NMT provides a modal share of over 50 per cent, compared to only 10 per cent among high-income groups.4 In Kenya, the majority of Nairobi's slum inhabitants walk as they cannot afford motorized transport.5 On average, walking accounts for a significant proportion of trips in African cities, and is particularly common among women and children[7]

[7] Peters, 2011; Pendakur, 2005, p147.

A strategy to improve the quality and safety of walking could include:

- New pedestrian links to create a network of convenient routes;
- Better footways (paving, landscaping, lighting, street furniture);
- Streets and public areas that create interest for pedestrians (building frontages, signs, and advertisements scaled for the pedestrian rather than the vehicle);
- Priority for pedestrians on residential and local streets and central areas;
- Better crossing facilities, including reduced speed and volume of traffic and i increased crossing time for pedestrians; and
- Developments that ensure facilities can be reached on foot easily.

In Manila (Philippines), a few high-quality pedestrian environments do exist in an otherwise car-dominated city. SEOUL (REPUBLIC OF KOREA) the dual carriageway through the city was taken down, the old river reinstated, and a pedestrian footway developed, in a classic example of sustainable, integrated transport.

"If a city is to be 'liveable' it has to be 'walkable.' Reducing car travel will lead to a repopulation of footways and public spaces, making them safer and livelier places to be."

—T. Pharoah. 1992. Less Traffic, Better Towns. London: Friends of the Earth.

Cycling

Cycling is also a very beneficial means of travel because it offers active lifestyle gains to the individual and minimal adverse impacts for the community. People are mainly deterred because cycling can be dangerous. Higher levels of use are achieved where safe and attractive facilities are provided.

Cycling caters for the mobility needs of considerable numbers of urban dwellers in developing country cities, especially in Asia. In mainland China, bicycle ownership is much higher than in other Asian countries, with an estimated 600 million bicycles.[8] In India, household bicycle ownership rates are high in cities such as Delhi (38 per cent), Ahmedabad (54 per cent) and Chandigarh (63 per cent).[9] This is reflected in the relatively higher modal share of cycling in these cities – Delhi (12 per cent) and Ahmedabad (14 per cent). In some Asian countries with relatively higher incomes, however, the modal share of cycling is much lower, such as in Singapore (1.6 per cent of work trips),[10]the Republic of Korea (1.2 per cent)[11] and Hong Kong SAR (0.5 per cent).[12]

In recent years, there has been a decline in cycling in some Asian cities. This has been attributed to rising incomes and concomitant motorization, as well as changing social perceptions, which tends to see cycling as a means of transport for the poor. India is a case in point where bicycle modal shares declined from 30 per cent in 1994 to 11 per cent in 2008. Numbers also decreased in China, particularly in big cities.

[8] China Communications Press, 2008.
[9] ADB and CAI-Asia, 2009
[10] Barter, 2008. This excludes
[11] Shin, 2007
[12] Hong Kong Transport Department, 2004.

Table 2.2 Developing Countries should target NMT- inclusive infrastructure development

	Modal Split for Travel, Percent of Trips					Vehicle Ownership	
City	Population (2001 Census)	Public Transport	Private Transport	Bicycling & Walking	Average Trip Length km	Vehicles Per 1000	Passenger Cars Per 1000
Ahmedabad	4,500,000	30	38	32	5.4	371	55
Bangalore	8,625,000	36	39	25	9.6	283	50
Bhopal	1,433,000	28	19	53	3.1	189	24
Chennai	7,014,000	39	30	31	8.6	226	45
Delhi	13,840,000	48	19	33	10.2	355	117
Indore	1,759,000	16	37	47	5.6	257	27
Jaipur	2,032,000	17	39	44	5.4	359	55
Mumbai	17,702,000	52	15	33	11.9	54	24
Mysore	787,000	26	23	51	2.5	380	40
Pune	4,200,000	12	54	33	6.1	335	48
Rajkot	1,002,000	13	38	49	3.7	403	33
Surat	2,430,000	13	31	55	5.3	492	55
London	6,679,699	40	45	14	7.5	356	288
Paris	10,661,937	54	18	28	8.3	383	338
New York	18,409,019	54	35	11	16.7	459	412

Source: Compiled by EMBARQ - URL: http://www.embarq.org/sites/default/files/12-Indian-Cities-Transport-Indicators-Database.xls

The table above gives the modal split for travel in several cities of India, besides London, Paris and New York. It is interesting to note that the percentage of trips by bicycling and walking vary from 25%-55% in Indian cities, while in New York and London, this percentage was only 11% and 14% respectively. This can be well correlated with the number of passenger cars per 1000. While in Indian cities the number of passenger cars per 1000 vary from 24 in Mumbai to 117 in Delhi; it was 412 in New York, 288 in London and 338 in Paris.

2.3 A strategy to improve the quality and safety of cycling could include

- ***Strategy for improving NMT***
  - the provision of a fully segregated cycle network alongside facilities within the main road and footpath network;
  - traffic calming so that speeds of vehicles are closer to those of cyclists; and
  - parking and storage facilities that are secure and conveniently located.26

Though cycling is still popular in parts of Asia, facilities are usually poor. The aspiration is generally toward motorization, with cycling seen as an outdated means of travel In Delhi (India) Cycling in the city has a high modal share, but the networks and facilities are very poorly developed. In Beijing (PRC) Bicycle hire schemes are becoming very popular in Chinese cities. Two- and three-wheelers and rickshaws are available to almost all income levels and can be used to carry passengers and goods. They are found in many cities across Asia and are effectively zero carbon if manually operated. Again, though they suffer from lack of segregated lanes or at least dedicated space, they can be a very effective part of a sustainable transport system.

"Twenty years ago, in Bogotá there was not 1 meter of bikeway and ridership was insignificant. Today, more than 350,000 people ride to work daily."

—Enrique Peñalosa, Colombian politician and former mayor of Bogotá

Bogotá's original masterplan of the metro and elevated highways was rejected and replaced with bus rapid transit and 155 miles of dedicated cycleways, allowing safe cycling for as much as 5% of the population.

2.3.1 Three-wheeled Rickshaw

Cycle rickshaw is an intermediate public mode of transport and best suited to provide the last mile connectivity in an integrated citywide multimodal public transport network. This mode has not received any attention from planners so far. The technology is outdated. Several American and European manufacturers of cycle rickshaws often incorporate features not found in developing world vehicles, such as hydraulic disc brakes, and lightweight fibre-glass bodies, multispeed gears to lessen the effort for the rickshaw puller. These upgrades are needed in India. There are other issues too. No driver license is required. Some cities have banned or restricted use of cycle rickshaws. They are often prohibited in inner/old city areas of major cities for causing congestion. In view of its usefulness in several ways, it is important that cycle rickshaw is assigned a role in the multi-modal public transport system. The three-wheeled rickshaw is a popular type of urban transport in Asia, especially in Cambodia, Indonesia, Myanmar, Thailand, the Philippines and Viet Nam. Known as pedicabs (padyak) in Metro Manila (the Philippines), they are able to operate in narrow alleys, walkways and other areas which are impenetrable by other modes such as jeepneys (converted jeep taxis) and buses. In Bandung (Indonesia), pedicabs known as becaks make up 33 per cent of all trips. These manually operated rickshaws are now are being transformed to battery operated rickshaws and are now extremely popular in all Indian cities; small, medium and large. The Government of India as well as the State Governments have changed their laws to recognize e-rickshaws. Initially these were being imported from PR China but now they are being manufactured in India. As these e-rickshaws are now getting covered under the Motor Vehicles act, these cannot be considered about NMT.

Walking is the principal means of transportation in cities of developing countries not by choice, but rather driven by the lack of affordable and accessible alternatives. In recent years, there has been a decline in cycling in some Asian cities [due] to rising incomes and concomitant motorization, as well as changing social perceptions reactions by city authorities in several Asian countries. Jakarta (Indonesia) banned becaks in the 1970s considering them obsolete, unsafe and hindering traffic flow, while Viet Nam banned tricycles in 2008.18 In Mandalay (Myanmar), use in the central business district is limited to daytime.[13] The city of Udon Thani (Thailand), by contrast, is actively promoting cycle rickshaws as an alternative to cars.[14]

2.4 NMT in Developed countries

The proportion of non-motorized trips varies greatly in developed countries, with walking and cycling making up less than an eighth of daily trips in car dependent countries such as Australia, Canada and the US, and over 20 per cent in most European countries. The share of journeys on foot is higher in European countries, but less than 1 per cent in Australia, Canada and the US. Bicycle ownership is high in Western Europe, especially in the Netherlands, Germany and Denmark. This has been attributed to the transport and land-use policies introduced since the mid- 1970s in these countries in favor of NMT and public transport facilities rather than motorized transport. The ratio of bicycles to inhabitants is lower in other European countries such as Hungary and France, as well as in the US and Canada. Cycling in the US is mostly for recreational and fitness purposes, whereas in Europe it is a key means of movement for utilitarian purposes.[15]

[13] UNCRD, 2008.
[14] SUTP, 2008.
[15] Pucher and Buehler, 200

A recent trend with respect to NMT in developed-country cities has been the increasing popularity of three-wheeled pedicabs. For instance, annual trips by such pedicabs have been estimated at 1 million in London (UK) and 250,000 in Berlin (Germany)[16]. Nevertheless, this mode of transport is still insignificant in the cities of developed countries.

2.5 Infrastructure for non-motorized transport

Generally, developing-country cities have poor quality infra-structure for NMT. Dedicated corridors are largely absent and, where they exist, they are often at the risk of being encroached upon for commercial purposes or used for the perennial widening of motorized carriageways.[17] Poor lighting, absence of footpaths and over-crowding make walking unsafe in these countries.[18] Furthermore, limited speed enforcement does little to deter high traffic speeds. In the absence of segregated NMT infra-structure, the dangers posed by speeding vehicles result in low cycling rates.[19] The general lack of provision and maintenance of NMT facilities in cities of developing countries is primarily a problem of financing. Such facilities are not considered to be 'revenue-generating' and private investors and international lending agencies are thus not keen to finance such expenditures. Furthermore, the costs of such NMT facilities are often considered to be beyond city capabilities.[20]

NMT infra-structure conditions in most Asian cities are inadequate. Out of the transport related projects approved under India's Jawaharlal Nehru National Urban Renewal Mission, only 2.2 per cent focused on pedestrian infra-structure. The majority of the roads in Delhi (India) do not have pavements and those that exist are often unusable.[21] Some Chinese cities, by contrast, have excellent bicycle infra-structure. In the recent past, however, these have been invaded by electric bikes. The elimination or narrowing of sidewalks to accommodate more car lanes in Chinese cities has also been reported.[22]

Generally, developing country cities have poor quality infrastructure for NMT. Dedicated corridors are largely absent. Poor lighting, absence of footpaths and overcrowding make walking unsafe in developing countries. However, encouraging measures to enhance NMT infrastructure have been observed in some developing countries.

The Republic of Korea's Bicycle Master Plan intends to build 30,000 kilometers of bike-ways (primarily for recreational purposes) and increase the modal share of cycling to 10 per cent by the end of 2019.[23] Seoul Metropolitan Government has developed a transport vision 2030 for pedestrian-friendly city and prepared measures to improve the pedestrian environment. The initiative addresses sustainable development goal 11 relating to sustainable cities and communities and sustainable development goal 12 focusing on responsible consumption and production.

In China, policies to promote NMT include planned bicycle networks and parking at public transport stations in Beijing to increase ridership.[24]Some have also adopted bicycle sharing systems where bicycles are made available for shared use to individuals on a very short-term basis. The Chinese cities of Wuhan and Hangzhou have the largest bike sharing systems in the world, with some 90,000 and 40,000 bikes, respectively.

[16] S Rahman et al, 2010.
[17] Adam Smith International, 2005, p101
[18] Jain, 2011
[19] Pendakur, 2005, p148.
[20] Beldean et al, 2007
[21] IDFC, 2010.
[22] Pucher et al, 2007
[23] Shin, 2007
[24] China Daily, 2010.

In developed countries, pedestrian infra-structure has rapidly improved in recent decades with a number of Western European cities investing heavily in pedestrian areas and dedicated lanes. In Germany and the Netherlands, there have been extensive efforts to improve infra-structure for both walking and cycling, with bike paths and lanes more than doubling in the Netherlands and tripling in Germany between the late 1970s and mid-1990s. An increasingly important approach in Western Europe has been the integration of NMT and motorized travel through urban design to enhance the safety and quality of street space for pedestrians and cyclists. Neighborhood streets have been redesigned in numerous cities in the UK, Denmark, Sweden, German and the Netherlands to create 'home zones' accessible to cars, bicyclists and pedestrians on equal terms, resulting in a significant increase in NMT use, enhancing urban landscape aesthetics and boosting the social function of public spaces.[25]

Although NMT sustains and complements public transport as a key feeder service, it is seldom integrated with it[26]. In the absence of strong policy support for NMT, the requisite infra-structure is not created, resulting in a more hostile environment with higher rates of fatal accidents and an overall decline in cycling. This downward trend is enhanced by the fact that most NMT users, at least in developing countries, use NMT due to the lack of affordable alternatives; they are captive low-income users. There is thus a social stigma against using NMT as it is seen as the travel mode of the poor.

2.6 NMT Impacts

Non-motorized transport makes cities and communities safe, inclusive, accessible and green**.** The use of NMT in cities generates numerous social, economic and environmental benefits.[27] Indeed, the existing evidence has consistently shown that the benefits of expanding NMT use outweigh the related costs by large margins. For instance, in Amsterdam (the Netherlands) the overall benefit–cost ratio of improving bicycle infra-structure was estimated to be 1.5:1 while similar calculations for Delhi (India) estimated the ratio to be 20:1.[28] The table below provides the health effects associated with the physical activities related to cycling and walking.

Table 2.3 Health effects associated with physical activity
Key: **: strong evidence; *: modest evidence.

Lower all-cause mortality**	Better body mass index and body composition**	Better fitness**
Less high blood pressure**	Better functional health in older adults**	Less breast cancer**
Less type 2 diabetes**	Less risk of falls in older adults**	Less metabolic syndrome**
Less colon cancer**	Better cognitive function**	Less coronary heart disease and stroke**
Less depression**	Better quality sleep*	Better health-related quality of life*

Source: U.S. Department of Health and Human Services (2008)

[25] Goldman and Gorham, 2006.
[26] Jain, 2011.
[27] Litman, 2013.
[28] I-ce, 2000

A major advantage of NMT is that it reduces energy consumption, greenhouse gas emissions and pollution substantially, as it does not rely on fossil fuels unlike other modes of transport in cities. Furthermore, as NMT requires significantly less road space and parking, it enables the preservation of natural habitats and open spaces. Cycling and walking can also directly provide the daily physical activity required for a healthy lifestyle. Negative health impacts have been observed where the share of NMT in urban areas is encroached by motorization.

Importantly also, the movement of passengers through NMT supports urban livelihoods in developing-country cities. For instance, 20 per cent of the population in Dhaka, Bangladesh, rely on rickshaw pulling for their livelihood[29] while figures of 5–10 per cent have been reported in the Indian cities of Kolkata, Chennai, Delhi and Hyderabad. This source of livelihood is particularly important in smaller cities with limited public transport services and narrow streets.

Yet, despite generating enormous benefits in cities, NMT is constrained in a number of ways. Perhaps most critical is the risk of injury, with pedestrians and cyclists constituting more than 27 per cent of those killed in road traffic accidents globally, rising to a third in low- and middle-income countries[30]

NMT faces the added challenge of being marginalized in urban planning and investments, partly due to an absence of adequate information and data. External loan financing in many developing countries tends to favor large projects, metro systems and BRT systems. Data on NMT are also often under-presented in transport data, resulting in low planning priority given the reliance of policy-making on mobility data.[31] Pedestrians and cyclists may thus be easily overlooked in planning at the expense of motorized transport.

Related to the above, the negative public image of NMT, especially in developing countries, is an additional factor in its neglect in planning.[32] Among users themselves the stigma of poverty leads many to shift to motorized transport when their incomes rise. For authorities, development and modernity is associated with technology and motorized transport. Promotion of NMT may thus not be considered commensurate with development.

2.7 Issues relating to NMT and last mile connectivity in Asian cities

Concerns for sustainability and equity have seen transport policies, especially in the Asian cities evolve from being traffic-centric to people-centric. The paradigm shift in policy has been accompanied by metropolitan cities opting for mass rapid transit systems. Yet, the larger context of the entire journey experience that begins at the point one steps out of a place of residence to the final destination remains an area of neglect in most transit planning exercise. Travel choice factors such as accessibility, convenience, comfort, and safety cannot be addressed through a state of the art transit system alone[33]. The lack of suitable last mile options discourages private mode users to shift to public transport. For a larger mass, cycling and walking are the only solutions for negotiating the last mile.

Most transit planning in developing Asian cities focus on improvement of safety, cost, time, comfort and convenience of the transit system per se and not of the overall transit journey which includes the first and the last mile connectivity (LMC). Most transit trips require some degree of

[29] Wipperman and Sowula, 200
[30] WHO, 2013. See also Chapter 6.
[31] OECD/ITF, 2011a.
[32] Cusset et al, 1995
[33] Greening the 'last' mile to transits: Place making for healthier and sustainable mobility, Chidambara, School of Planning and Architecture.

walking and this degree of walking can be increased with enhanced walking conditions in not merely the immediate vicinity but at a larger area/ neighborhood level.

More recent strategies at addressing the last mile, recognizing this significance have thus widened their scope to improve walking and cycling conditions at the area level, surrounding transit hubs.

It has been found through extensive research that the use of NMT (specially walking) for last mile connectivity can greatly be influenced by factors such as density, land use, street and network design and layout and overall environment[34]. Appropriate place making for 'green mobility' i.e. for pedestrians, cyclists and other non-motorized transport (NMT) will not only enhance transit ridership but also encourage healthier and sustainable ways to access the transit and promote equitable use of road space.

A large percentage of trips in Indian cities are made by non-motorized modes. A 2008 study on 30 Indian cities found that "in cities with more than 8 million population: 22% walked all the way, 8% used cycles and 44% used public transport. This adds up to 74% of people who rely on non-motorized transport for at least part of the commute" (WWF). Although walking is ubiquitous and intrinsically embedded in Indian urban mobility pattern, the apathetic attitude towards provision of pedestrian facilities does not encourage users to readily go for this option, unless when compelled to do so. Despite NMT users being the highest percentage of victims in road accidents, (44.5% pedestrians and 6.1% cyclists)[35] the urgency with which road safety need to be treated with is found wanting.

In India, new policies on urban transportation have come to recognize the significance of both LMC and NMT including the role of cycle rickshaw as an intermediate mode of transport for providing last mile connectivity. The National Urban Transport Policy recognizes the significance of improving last mile connectivity to public transport through provision of footpaths and cycle lanes, provision of feeder services, and incorporating design principle to promote safety, accessibility, reliability and affordability, amongst other measures.

However, the realization of policy to planning and its manifestation on ground is yet at a very nascent stage in most Asian cities. Most cities take up transit system and NMT planning in isolation to each other and do not plan and make policies in a holistic manner.

2.8 Supporting non-motorized transport

Transport policy measures can reduce levels of car use by supporting walking and cycling. These modes are relatively low cost, and they are important for short trips, which make up the largest share of trips in urban areas.

Non-motorized transport can be stimulated by a policy package consisting of investments in facilities, improved transportation networks, awareness campaigns, as well as disincentives for the use of private motorized vehicles. Many cities in developed countries recognize the need to plan walkable environments and street network designs that promote neighborly interactions, and through this, the development of social capital.

Some significant transport interventions offer interesting lessons. Amsterdam (the Netherlands) and Copenhagen (Denmark) have high levels of bicycle use and very low death rates from road traffic accidents. The high modal shares were made possible through decades of investment in non-motorized transport infra-structure. This includes wide-scale improvements to pedestrian

[34] Rodriguez and Joo, 2004; Cervero, 2002; Cervero and Kockelman, 1997; Ewing et al. 1994
[35] Morth, 2012 in CSE, 2014

and bicycle facilities; development of facilities for intermodal connectivity; and adoption of complete pedestrian and bicycle design standards, wherever feasible.

Many other cities have moved away from car-centric urban models and embraced full pedestrianization of downtown commercial areas such as observed in Shanghai (China) and Curitiba (Brazil). This has provided economic savings and benefits, reflected in increased land values.

Combining public transport and cycling can provide a high level of affordable mobility. A case in point is vélib, a free public bicycle rental scheme in Paris, France. Hangzhou (China) and Mexico City have also established bicycle hire schemes to encourage cycling at a minimum cost to taxpayers and users of the scheme. Such policies are increasingly linked with investments in BRT systems, for instance in Guangzhou (China) and Jakarta (Indonesia), placing non-motorized transport infra-structure as important feeder networks for BRT ridership.

Training is an important strategic instrument not only for disseminating new knowledge but also for capacity building and increasing the awareness of the needs of non-motorized transport users. The private sector could be a key partner in supply-side interventions to increase bicycle ownership and use through the promotion of micro-credit programmes and providing cycling education.

Non-motorized transport can be stimulated by a policy package consisting of investments in facilities, improved transportation networks, awareness campaigns, as well as disincentives for the use of private motorized vehicles

Box 2.1. Integrating non-motorized transport into transportation systems in Bogotá, Colombia

During the administration of Mayor Enrique Peñalosa, Bogotá's visionary goal was centred on liveability, social equity and reclamation of public space. To achieve this, the administration established policies in seven areas: institutional strengthening, restraining private car use, public space, public transport, non-motorized transport, and road maintenance and traffic management.

Large investment in infrastructure for non-motorized and public transport was justified by its impact on equality. Inclusive investments for all, such as bicycle lanes, pedestrian highways and the BRT system, demonstrated a commitment to public good over private ownership. Likewise, actions such as the removal of cars from sidewalks, car-free Sundays and establishing a highway solely for Transmileno, exhibited consideration to those on low incomes who do not benefit from investment in motorized transport infrastructure. The theme of equality was a key driver in the development of a 357-kilometre long bicycle network (known as cicloruttas). The bicycle network was deliberately designed to run through low income and wealthy areas in order to promote integration and a sense that all citizens had an equal stake in city-wide development. These developments acted as 'social equalizers', providing the poor with better transport links and free leisure facilities. People supported the measures once they saw results, and Peñalosa left office with a record approval rating. Decisive leadership, political will and strong institutions were the critical factors contributing to success.

Source: Ardila and Menckhoff, 2002.

2.9 Urban density and role of NMT through transport demand management.

Most cities in developing countries are high density and therefore suitable for policies promoting non-motorized transport. Travel-demand management has a key role to play in this context. Such urban policies affect the demand for travel through the pricing and regulation of different modes of transport. An important benefit of travel-demand management strategies, besides improving the quality of low-cost transportation modes, has been increasing public transport affordability for low-income groups. London has experienced a modal shift, in part due to its congestion charging scheme, making it possible to convert traffic lanes to bicycle lanes. The adoption of automated bus lane enforcement has dramatically improved the speed and reliability of bus services.

Box 2.2 The European Charter of Pedestrian Rights Adopted by the European Parliament in 1988

I. The pedestrian has the right to live in a healthy environment and freely enjoy the amenities offered by public areas under conditions that adequately safeguard his/her physical and psychological well-being.

II. The pedestrian has the right to live in urban or village centers tailored to the needs of human beings. Children, the elderly, and the disabled have the right to expect towns to be places of easy social contact and not places that aggravate their inherent weakness.

III. The disabled have the right to specific measures to maximize their independent mobility, including adjustments in public areas, transport systems, and public transport (guidelines, warning signs, acoustic signals, accessible buses, trams and trains).

IV. The pedestrian has the right to urban areas which are intended exclusively for his/her use, are as extensive as possible and are not mere pedestrian precincts but in harmony with the overall organization of the town, and also the exclusive right to connecting short, logical, and safe routes.

Non-motorized modes are highly cost effective as they entail the lowest capital and operating costs, because they require only sidewalks and dedicated street lanes. They also cost the least for users who expend only calories and can use relatively inexpensive bicycles. In many developing country cities, non-motorized transport is thus the predominant modal choice.

Despite its relatively low cost, infra-structure for non-motorized trans port (pedestrian bridges, paths, sidewalks and crossings) is sorely lacking in many urban areas, making it a relatively unsafe and often inconvenient mode of travel.13 Financing for such infra-structure is usually limited to central government funds, yet the historic nature of urban transportation policy has a distinct bias towards motor vehicles. This has resulted in non-motorized transport being completely ignored or allocated a budget. This is a paradox, as most trips contain at least one segment of walking.14 The main factor related to the lack of financing of non-motorized trans port facilities in cities of developing countries is that they are not 'revenue generating' and, hence, private investors and international lending agencies are not keen to provide finance, while the cost is, in many cases, beyond city capabilities.

In many cities a large share of the population uses non-motorized or public transport, while a disproportionate amount of infrastructure and funding supports private motorized transport.

2.10 Reasons for the decline of walking and cycling in Asia

In many Asian Cities, use of NMT has declined, especially that of cycling and cycle- rickshaws. Road congestion, increase in trip length due to urban sprawl, increase in purchasing power of people and totally inadequate facilities for cycling have all contributed to reducing cycling in India to less than 11% of the mode share which is down from nearly 30% in 1994. Pedestrians continue to be neglected.

Urban growth and development leads to Motorist-friendly institutional framework & policies; Car-friendly policies; Lack of Champions for NMT and Lack of legislative support. This in turn results in Motorist-oriented Infrastructure & Development; Motorist-oriented urban planning, development and infrastructure which in turn ends up in Car-centric Culture, Behavior and Perceptions;

- Car-centric mobility culture
- Anti-cyclist lobbyists
- Perceived unconducive weather

A cycling culture in Singapore was well established in the 1960s, but started to decline as a form of transport from the 1970s as the pace of economic development increased. Mobility preferences then switched to privately owned cars and public transport with transport planning focused mainly on catering for motorised traffic. By 1981, the Registry of Vehicles had even stopped registering bicycles.[36]

But with the completion of the first phase of the Mass Rapid Transit (MRT) rail line in 1987, cyclists were observed cycling to and from the stations. In response, the government started constructing public bicycle parking at the MRT stations in 1991. Singapore also started developing off-road dedicated cycling tracks with the launch of the Park Connector Network programme in 1992, although these were primarily for recreational needs. To date, more than 200 km of park connectors have been constructed for cycling, jogging, walking and other recreational activities.

'Mobility is synonymous with private cars and motorbikes' says Mayor of Bandung, H.E. Ridwan Kamil at the World Cities Summit 2014 in Singapore.

Chasing Cars: A Vicious Cycle

Motorized transport is an effective means of mobility; however motorist-friendly developments form vicious cycles in urban growth trajectories which can exclude other forms of mobility in particular walking and cycling.

Motorist-friendly policies that give rise to car-oriented urban infrastructure and developments also contribute to auto-centric culture and behaviour whereby motorists tend to be more defensive about road space and are less receptive towards other forms of road users. This in turn creates expectations among the people for further car-friendly policies to be put in place to boost vehicle infrastructure capacity and efficiency to fuel urban growth and development.

[36] Koh, P.P. and Wong, Y.D. 2012. The Evolution of Cycling in Singapore. Journeys (Nov), LTA Academy, Land Transport Authority, Singapore, pp. 39-50.

Desired Scenario

The present modal share of public transport and NMT should not be allowed to decline. The cities must be compact instead of present sprawl. In India, Public Transport Share needs to be improved to 60% of all motorized trips by 2030 and fatalities need to be reduced by 50% by 2017.

Priority in planning to modes should be as follows in descending order:

Walk and Non- motorized transport (NMT); Other motorized public transport; Mass rapid transit; Road, rail and waterways; Personal vehicle transport.

2.11 NMT and Women

A significant number of women and girls use low-carbon transport modes, particularly bicycle and walking to travel to places of work in urban areas. As per 2011 census of India, 84% of women use low-carbon transport modes to travel to work place in urban areas. However, transport or mobility plans often do not consider the needs of women and girls and neglect their views for safety, security and comfort.

The paras below explain as to what should be done in this regard and how this situation can be changed in Asia. Also given are some good examples, case studies and recommendations for the policy makers, planners and city developers.

Women as Pedestrians

Among all the NMT modes, pedestrian is the most dominant mode. Almost every city resident is a pedestrian for some distance. Although walking has no gender bias; there are differences in the way each gender perceives walking facilities. Women are discouraged from walking along specific paths, for longer distances and at specific times due to a perceived sense of insecurity. And similarly, even though people of all ages walk, there are variations in the way walking facilities are perceived. For example, young children and older people have shorter walk trip length thresholds and need barrier-free movement in order to walk comfortably.

Promoting NMT- addressing security issues for women and children

Ensuring security of vulnerable groups such as women and children in the public realm will increase attractiveness of NMT. Crime Prevention through Environmental Design (CPTED) is an approach intended to discourage criminal behaviour through urban design principles. The main goal is to address gender-specific concerns that prohibit women from using public spaces such as overcrowding or isolated environments. A populated public realm, with round the clock activities and eyes on the street create a secure environment for vulnerable pedestrians and cyclists, particularly women and children. Active Street Edges for natural surveillance; Lighting and Vending Zones are the key components of such plan and design.

Demography and NMT

Demographics that influence NMT use include population density, population size, and gender. Women are found to be less likely to use NMT by choice. Several demographic criteria are found to correlate with mode choice. Income is an important indicator for developing countries like India and other Asian cities.

Universal Accessibility

Universal Accessibility simplifies navigation and reduces physical effort to an extent that a physically handicapped person should be able to navigate the pedestrian facilities without external assistance. It is a design approach that is meant to improve the usability and appeal of places by all types of users.

- Ensure design principles that assure barrier-free movement for all types of NMT users including infant prams, children, physically or cognitively impaired pedestrians, wheelchair and luggage carts, in addition to average pedestrians, cyclists and other non-motorised vehicles.
- Provide ample scope for ease of access through universal navigational components that cater to all types of NMT users.

The purpose is to provide protection from encroachment that ensures continuity and predictability in NMT use. It allows uninterrupted non-motorised mobility and brings in a sense of order.

The main goals are to delineate space for all activities within the public realm such as street vendors, parking, street dwellers ensuring clear passage for NMT.

- Safeguard NMT zones with appropriate measures to protect vulnerable pedestrians such as the aged and children.
- Facilitate effective enforcement in protecting NMT spaces from encroachment.

The application of various principles in street design should ensure barrier-free movement for all types of NMT users, including infant prams, children, physically or cognitively impaired pedestrians, wheelchairs, and luggage carts, in addition to the average pedestrian, cyclist and other non-motorised vehicles.

Women and girls are close to 50 per cent of our urban population. They comprise only 19 per cent of other workers[37] and yet 84 per cent of their trips are by public, intermediate public and non-motorized modes of transport (Census 2011)[38]. In India, 84% of women use low-carbon transport modes to travel to work place in urban areas. However, transport or mobility plans often do not consider the needs of women and girls and neglects their view for safety, security and comfort. While personal security, time, cost and poverty are considered as the main factors that influence women's transportation accessibility, cultural perceptions and spatial location also shape women's mobility.

Policy recommendations:

National level policies and missions have addressed women's concerns primarily through the lens of safety, with project and technology centric interventions. There is a need to create urban transport indicators and benchmarks and define a process to create, implement, monitor and evaluate gender responsive comprehensive NMT plans. NMT plans need to adopt a holistic approach towards gender inclusion.

Create Safe and Comfortable Walking Environments for Women and Girls

Since a greater proportion of women make walking trips, insufficient, unshaded and poorly maintained pedestrian infrastructure affects them to a greater degree than men. Pedestrian infrastructure should be designed as per IRC 103: 2012 Guidelines for Pedestrian Facilities, which proposes three zones - a dead zone, pedestrian zone and a multi-functional zone for footpaths along with a level of service approach for determining the width of footpaths. Further, streets and pedestrian infrastructure should be consistently lit and shaded, along with access ramps and tactile pavers to facilitate universal accessibility

[37] Other workers as defined by the Census include all workers except cultivators, agricultural labourers or household industry workers

[38] Women and Transport in Indian Cities, ITDP

Box 2.3: Case study: Transport for London (TfL)

Women constitute 51 per cent of London's population. A study found that women made more trips than men, mostly for work or to escort children. In the evenings, they felt vulnerable walking to their destination from the subway station/ bus stop (Hibbett and Meager 2003). Additionally, a safety and security survey conducted by Transport for London (TfL) revealed that 90 per cent of the commuters who experienced sexual harassment did not report to the authorities. This led to Project Guardian, a joint initiative launched in 2013 between British Transport Police (BTP), the Metropolitan Police Service, the City of London Police, and TfL.

In its approach towards gender mainstreaming, TfL held a consultation with 140 women's groups across London and constituted an Action Plan. This comprehensive plan was classified into five broad categories: Accessibility, Safety and Security, Affordability, Information, (Herbel and Gaines 2009). Action on Equality, a 4-year action plan (2016-20) promotes equality and enhances access to transport services and employment for diverse groups of people. This plan takes forward the initiatives noted under Single Equality Scheme (2012–15). The plan has set 11 equality goals that aim at safer and convenient non-motorized modes of transportation in London. Some of the initiatives under this plan include speedy customer service, improved lighting around the bus stops to enhance pedestrianization and safer streets for pedestrians and cyclists.

Women and Girls' Cycling Shares – Steps to Increase Women Cycling

There are three key levers to improve adoption of cycling i.e. urban measures/design, behavioral measures, and the development of a cycling economy, which involves improving the availability of suitable products (cycles, accessories) and services (rentals, repairs, and cycle-taxis). The streets must be safe and designed for bikes. The public spaces need to be open and inviting, and the transport options abundant. However, this is the exception, not the rule

Women cycling mode shares are low across India, which is due to several reasons. Men generally get a preference in the ownership of personal motor vehicles within a household, thereby limiting women's access to non-motorized vehicles. Additionally, women have a greater concern for safer bicycling environments, which must be considered when planning for bicycling infrastructure.

The ownership of bicycles can be addressed by schemes like the ***Chief Minister's (Mukhyamantri) Cycle Scheme***, introduced by the Bihar state government in India, which provided girls with bicycles in 2006. Here, every 14-year old school girl enrolled in state government schools was given Rs. 2000 subsidy to buy a bicycle of their choice. Later, this amount was increased to Rs 2500 per student and now, Rs 3,000 would be paid to each eligible girl student for purchasing a cycle from the current fiscal year. The bicycles are not only used to go to schools, but also the family uses the bicycle for chores, from shopping for groceries to making food deliveries from the tea shop, reducing the dependence on motorized modes of transport including auto rickshaws. The bike grant money is put into a joint bank account in the names of the student and her parents, and school administrators monitor whether the girls buy bicycles and use them, or if the bike is being sold.

This has led to a 30 per cent increase in school enrolment of girls. This initiative demonstrates that safe mobility is a necessary condition for girls to continue their education, especially in rural areas of the country. The results from Bihar were so encouraging that the program has been adopted by the neighboring states of Madhya Pradesh and Chhattisgarh.

Box 2.4: Case study: West Bengal's Sabooj Saathi scheme

Free distribution of bicycles to sections of high school students has been one of the most popular inclusions in public actions in several of the Indian states. The Government of West Bengal in 2015, nevertheless, joined the bicycle distribution club in a radical way: instead of providing bicycles to certain groups of students selected on the basis of gender, caste, or economic condition, it took a wide inclusive path and launched a programme, called Sabooj Sathi, literally meaning the green companion, that aimed to distribute bicycles among all students of standard 9 through 12 studying at the government or government aided secondary and higher secondary school. The green initiative has so far listed 6 million beneficiary students in government schools, state-aided ones and madrasas. The scheme was launched with an objective to empower the students, especially the girls and reduce drop outs in higher education.

BDOs performed the task of creating delivery points and tagging schools to finalise delivery point-wise requirement of Boys & Girls bicycles. Suppliers were given opportunity through portal to enter consignment details so that those can be tracked by the officials of State Government. Under the scheme, procurement has been made in three phases so far. Leading Indian manufacturers – Hero Cycles Ltd., TI Cycles Ltd and Avon cycles ltd. were selected to distribute cycles.

Under the scheme, 34.94 lakh bi-cycles had already been procured and distributed to target group students of class IX, X, XI & XII in two phases – in phase –I 25.34 lakh followed by 9.60 lakh in phase-II during two successive fiscals, 2015-16 and 2016-17. State Government has decided to maintain continuity and create a situation that students will get bi-cycles as soon as they are admitted to class IX. As such procurement process for another 2.5 million bi-cycles has been completed in Phase-III. Distribution has also been taken up simultaneously in all the Districts.

Continuous, consistently shaded and well-lit, smooth bicycle tracks are recommended on roads above 20m, and where demand is observed. Streets less than 20m should be traffic calmed such that motor vehicle speeds do not exceed 30 kmph. This should be combined with programs to teach women how to repair and ride bicycles and create groups to increase women's confidence in riding bicycles by themselves at a later stage.

Table 2.4: Free bicycle distribution program among school children by State Governments in India.

State East and North-Eastern Zone	Type/Name of the Scheme	Coverage
Assam	Free Bicycle Distribution Under Chief Minister's special scheme 2010-11	The scheme is especially introduced for girl students (Class – VIII & IX) who are form BPL (Below Poverty Line) families and are not able to pursue education due to long distance school or any other reason. https://govinfo.me/free-bicycle-distribution-scheme-assam/
Bihar	Bicycle Yojana, 2006	Bicycle scheme for everyone, beyond category/caste/class/religion. https://www.indiatoday.in/education-today/news/story/bihar-distribute-uniforms-bicycles-students-960013-2017-02-10

Odisha	Free Bicycles to Students of Standard 10, 2016	Students residing in hilly and inaccessible areas of the state. All girls, Scheduled Tribe (ST) and Scheduled Caste (SC) boys and boys belonging to below poverty line (BPL) category and studying in Class X in government and government aided high schools, Madrassas and Sanskrit tolls. Government provides Rs 2,600 (Indian Rupees) for each identified beneficiary to purchase bicycles. http://govinfo.me/distribution-free-bicycles-students-class-x/
West Bengal	SaboojSathi, 2015	All students of standard 9-12 (irrespective of caste, religious affiliation, gender) https://wbsaboojsathi.gov.in/v2/
Northern Zone		
Punjab	Mai BhagoVidya Scheme , 2011-12	Provision of cycles to girls studying in standards 9th, 10th, 11th and 12th in government school. Girl student should belong to below poverty line (BPL). http://govinfo.me/mai-bhago-vidya-scheme-punjab/
Rajasthan	Bicycle Distribution Scheme, 2012-13	Provision of cycles by the State Government to girl students of 9th standard who live within the 5-km radius of the school. http://cmapp.rajasthan.gov.in/cmapp/frontend/frontmediacoveragedetails/rajasthan-government-starts-free-distribution-of-bicycles-among-school-girls.html
Southern Zone		
Andhra Pradesh	Badikostha Bicycle Scheme, 2017	Bicycles are provided to every girl child studying in class 9th in government schools. https://sarkariyojna.co.in/badikostha-bicycle-scheme-girl-students-andhra-pradesh/
Karnataka	Free Bicycle distribution scheme 2006 -2007	Bicycles are provided to rural and hilly region students enrolled in class 8th in Gov. and Gov. aided Schools of below poverty line (BPL) family. http://www.schooleducation.kar.nic.in/pryedn/bicycles.html
Tamil Nadu	Free by cycle, scheme Tamil Nadu for SC/ST students, 2011-02	Free bicycle scheme for students of class 11th and 12th enrolled in Government Schools. https://sarkariyojna.co.in/tamilnadu-free-bicycle-scheme-govt-school-iti-students/
Central Zone		
Madhya Pradesh	Free Bicycle Scheme, 2005-06	Girls and boys studying in standard 9th belonging to the rural sector who belong to villages where government high school has not been set up and they have to travel from one village to the other/ town/city to receive education are eligible. Boys and girls studying in standard 9th, belonging to all categories benefit under this scheme. The female and the male students are provided bicycles of their choice and their Guardian is given a crossed cheque of Rs 2,400. http://govinfo.me/free-bicycle-scheme-madhya-pradesh/

Source: Wheeling Education: An assessment of the Sabooj Sathi (Bi-cycle Distribution) Scheme for School Students of West Bengal. Department of Backward Classes Welfare, Government of West Bengal.

In a survey conducted by the Ministry of Transport and Telecommunications in Santiago, it was observed that women constituted 10 per cent of cyclists in Santiago. A cycling master plan was created, and the number of cycle tracks quadrupled from 2007-12. The cycling mode shares increased from 3 per cent in 2006 to 6 percent a decade later. However, since women did not know how to ride or were afraid to use bicycles in the city, a local women's group, Macleta (Women on Bikes), initiated classes to encourage women to learn to ride bicycles. They had a 'Learn to pedal' course, which was for beginners, while 'Get off the sidewalk' was for women who knew how to ride a bicycle but were too frightened to use it around the city. Women and girls now constitute 30 per cent of all cyclists in the city. In addition, around 30,000-40,000 people are seen cycling across the streets of Santiago every Sunday as part of the CiclRecreoVía initiative where 40 kilometres of the city's roads are closed to vehicular traffic and made available for walking, running, cycling and other social activities (Cycling in Santiago 2014).

Box 2.5 - US Department of Transportation (DOT) Policy on Bicycles and Pedestrians

The US Department of Transportation (DOT) recently announced a strongly-worded official policy statement on accommodating bicycles and pedestrians. The language of the policy statement underscores the DOT's growing interest in "liveable communities," with an emphasis on accommodating people of all ages and abilities, and all transportation modes.

Along with the policy statement, the DOT issued eight recommendations to all transportation agencies and "local communities":

1. Treat walking and bicycling as equals with other transportation modes;
2. Ensure convenient access for people of all ages and abilities, especially children;
3. Go beyond minimum design standards;
4. Accommodate cyclists and pedestrians on new, rehabilitated and limited-access bridges;
5. Collect data on walking and biking trips;
6. Set mode share targets for walking and bicycling, and track them over time;
7. Maintain sidewalks and shared-use paths to the same standard as other roadway assets; and
8. Improve non-motorized facilities during maintenance projects (e.g. road resurfacing).

Integration of bicycles and buses, Los Angeles –Route 901. |

Source: http://www.itdp-china.org/photo/picid/?picid=12570&lang=1

NMT and Gender Mainstreaming

In most countries, since urban transport is not the responsibility of one ministry or department, gender inclusion requires interventions at multiple scales and coordination with a number of ministries and departments. Further, each institution will need to create a Gender Advisory Committee (GAC) to mainstream gender in transportation projects, policies and programs, monitor implementation, evaluate impact and implement a capacity building program.

2.12 Transformative change

Working towards a people oriented city

Creating walkable and bikeable cities requires a strong level of commitment to shift away from existing policies and infrastructure development that prioritize motorized transport. It is a process that is usually propelled by important catalysts and compelling motivations. At the core of this, however, must be the desire to meet the needs of people first.

Catalysts for NMT: why have cities begun embracing walking and cycling?

Different motivations to embrace NMT have shaped the development of active mobility in cities around the world in terms of policymaking, urban planning, infrastructure design and enforcement. While these vary with each city, it is important to address the different dynamics, urban contexts and attributes of each city individually in order to identify a compelling starting point for change.

Safety

Road safety remains one of the most powerful reasons to advocate active mobility/NMT policies. Safety can be a unifying fundamental concern which impacts the whole community and can even

bring it closer together rather than polarise different user groups. For example, when New York Mayor, Bill de Blasio, introduced a programme aimed at ending traffic deaths and injuries[39] by implementing road safety policies prescribing 'arterial slow zones' to reduce speed limits to 25 m/h from 30 m/h in designated areas, there was relatively little resistance from residents. While the policies were no less extensive compared to earlier pro-active mobility initiatives under previous Mayor Bloomberg which did attract significant resistance, Mr. de Blasio believes the new policies can be, "less politically divisive when framed in the context of public safety."[40]

New York City's approach takes inspiration from Sweden's adoption of a 'Vision Zero' plan, first legislated in 1997. With this approach, safety is built into road and urban design, and this has led to reduction in accident fatalities by more than 50%. With this planning principle in place, dedicated space has been provided for cyclists and pedestrians.[41]

The success stories of Amsterdam and Copenhagen as bikeable and walkable cities also feature safety as the key catalyst that triggered the shift towards people-centric cities in the 1970s. It was the popular demand for better road safety standards, especially for children that led to the reversal of the dominance of motorised transport there.

Urban liveability and traffic congestion

Competing needs for housing and transportation have created much pressure on limited land resources within the city. Building more roads to cater to car populations has proven unfeasible with traffic congestion persisting, leaving mobility standards stagnating and even deteriorating.[42] It has also been found that beyond basic road networks, more roads neither generate more economic benefits nor deliver long term solutions for mobility.[43] Recognising this, initiatives to reclaim the city for its inhabitants have been successful in many cities around the world. In the US, where more land is used for roads than housing, a programme called PlaNYC 2030 initiated in the city of New York to improve the quality of life for city residents, communities and businesses led to bold initiatives under the strategic transport master plan, 'Sustainable Streets', to revive public spaces through pedestrianisation and the building of a comprehensive network of bicycle lanes.

"The city is growing more and denser, and that density makes the city creative and innovative. But building more roads is not the answer to that development. We need to focus on other investments and strategies." –

Other cities are also seeing the value in promoting active mobility along with public transport to improve liveability and local economic development.26 In Seoul, the busy Cheonggye Elevated Highway was removed and replaced with a project to restore the historic Cheonggyecheon stream. This not only improved urban liveability, but also encouraged the use of public transport and active modes of commuting without causing more traffic congestion. There are now more plans to invest in public transport, pedestrianisation and cycling in Seoul.

[39] Vision Zero Action Plan, City of New York Mayor Bill de Blasio, 2014
[40] Flegenheimer, M. 2014. "De Blasio looks toward Sweden for Road Safety" The New York Times, 12 May. http://www.nytimes.com/2014/05/13/nyregion/de-blasio-lookstoward-sweden-for-road-safety.html?_r=0
[41] Pollack, K.M. et al. 2012 Toward environments and policies that promote injury-free active living – it wouldn't hurt. Health & Place.18.1 (2012): 106-114.
[42] Duranton G. and Turner M.A. 2009. The fundamental law of road congestion: Evidence from US Cities. National Bureau of Economic Research working paper series, no. 15376
[43] Litman, T. 2013. Smarter Congestion Relief in Asian Cities. Transport Bulletin from Asia and the Pacific. http://www.unescap.org/sites/default/files/b82_Chapter1.pdf

i. Making it happen: how cities took steps towards NMT

Not all cities are created equal; some cities have advantageous pedestrian-friendly urban fabric retained from history, while others begin from a starting line of more motorist centric infrastructure and urban sprawl. Some cities leverage on strong civic cultures which support space sharing and while others face strong anti-cyclist sentiments. Nevertheless, active mobility success stories share certain similarities: tough decisions by governments have to be made to effect sustained paradigm shifts. To oil the gears of change, involved communities being part of public conversations can support the process of assessing trade-offs and calibrating public expectations.

2.13 Factors in cities that support or hinder NMT

Not all cities are created equal. Some cities have advantageous pedestrian friendly urban fabric retained from history, while others begin from a starting line of more motorist centric infrastructure and urban sprawl. Some cities leverage on strong civic cultures which support space sharing, while others face strong anti-cycling sentiments. The table below details out factors in cities that support or hinder NMT.

Table 2.5. Factors in cities that support or hinder NMT

Factors promoting NMT	Factors hindering NMT	Factors blocking NMT
1. High density, compact, fine grained urban form Amsterdam's 17th century city grid is compact, with amenities and buildings close to each other. This makes it practical to commute by walking and cycling. **2.Mixed use environment** Mixed uses environments reduce commuting distances allowing access to essential goods and services. The variety of services and activities also make the journey more interesting and Engaging; **3.Strong civic and sharing culture** In Taipei, the culture of sharing and mutual respect sees cyclists giving priority to pedestrians on sidewalks and motorists giving way to pedestrians on shared streets. **4. Good public transit** In cities like Tokyo, the rail and subway network are able to serve as a backbone of active mobility for longer distance journeys. Walking and cycling can be used to complete these multi-modal journeys.	**1.Car-centric/anti-cyclist culture** Car-centric culture slows down policy changes to promote walking and cycling. Pro-active mobility initiatives in New York City (NYC) met with heated responses of anti-cyclist Lobbies. In the Prospect Park West bike lane case, conflicts led to lawsuits filed at the State Supreme Court. **2. Car-oriented infrastructure design (e.g. junctions, road design)** New York City has launched its Vision Zero campaign to address its car-oriented infrastructure which poses safety problems for pedestrians and cyclists. Some of these include measures such as arterial slow zones, high visibility crosswalks and widened medians.	**1.Urban sprawl and mono-functional land use** Cities face longer trip distances which make cycling less practical. In Australia, most transport, housing and land use policies do not combat sprawl, and suburban cities which are less dense face difficulties in promoting active mobility. **2. Car-oriented transport network** Car-oriented transport networks typically feature low rail connectivity and little subway or bus provision. In lieu of people-centric development strategies, cities sometimes rely heavily on highway and road construction to fuel urban growth.

To sum up, given below are some ideas for making people-friendly walking & cycling cities in Asia:

1. **Make it convenient & efficient**
   - integrate cycling and walking infrastructure with public transit
   - bike share systems for cities starting to promote cycling
2. **Provide dedicated space for all**
   - protected bike lanes alongside pedestrian sidewalks and vehicular carriageways
3. **Ensure viability at junctions**
   - safe junction designs that allow drivers to look out for pedestrians and cyclists when turning
   - painted cycling lanes at junctions maximize and hold onto drivers' attention
4. **Maintain continuity of movement**
   - cyclist friendly junction designs with gentle bends to facilitate continuous cycling
   - continuous sidewalks that require cars to stop and allow pedestrians and cyclists to continue through intersection without stopping
5. **Keep it slow**
   - stringent speed limits and slow speed zones at high pedestrian traffic areas
   - shared streets with design interventions to slow vehicles and allow co-existence of road users
6. **Prioritize at-grade crossings**
   - at grade crossings to facilitate continuous movement by pedestrians and cyclists
   - above/sub-grade crossings only for direct connections between destinations
   - diagonal crosswalks at high pedestrian traffic areas
7. **Ensure consistency in design standards**
   - standard infrastructure design for the whole network for user friendliness
   - consistent signage
8. **Make it comfortable & attractive**
   - street planting to provide shade and visual relief for all road users
   - sheltered walkways for pedestrians
   - prioritize maintenance for pedestrian and cycling infrastructure
9. **Mixed land use**
   - mixed use developments to make walking and cycling more convenient for daily commutes
10. **Close the loop with end-of-trip amenities**
    - adequate public bike parking facilities at destinations
    - showers and Laundromats at workplaces

Chapter 3.
Promoting Low Carbon Transport Solution in Asian Cities through NMT Development

Many urban residents in developing countries and emerging economies rely on cycling or walking but with economic growth, the Non-Motorized Transport (NMT) share in transport systems is being threatened. Yet, NMT or Active Transport (AT) bears a relevant potential in low carbon transport scenarios and in urban mitigation action. This makes NMT a key element in the transition of transport policies to sustainable mobility.

Asia-Pacific cities create 75 per cent of the region's emissions and are projected to contribute more than half the rise in global greenhouse gas emissions over the next 20 years if no action is taken. As major sources of greenhouse gases, cities in the region should urgently seek low-carbon development. Many opportunities exist to develop low-carbon cities, starting from the way in which cities are planned and designed. Compact cities with a variety of mass transit and mixed-use options can save energy in the transport sector. Trends in the urban transport sector have focused on increasing physical capacity to alleviate congestion, often allocating additional road space to private vehicles. The end result is increasingly congested and polluted cities, in which energy-efficient and inclusive non-motorized and public transport—the main modes of travel for the urban poor—compete with private cars. It is estimated that around 20% of urban transport trips, which are made by private vehicles, receive around 80% of the sector's investments. A new approach is needed to move goods and services through integrated land use, inclusive urban transport services, and restraints to private vehicle use.

Box 3.1. Low-Carbon Transport Policy in Four ASEAN Countries: Indonesia, the Philippines, Thailand and Vietnam

The member countries of the Association of Southeast Asian Nations (ASEAN) are experiencing robust economic growth in recent years. This growth has resulted in a rapid increase in the demand for motorized transportation. Southeast Asian countries already face serious problems including congestion, fossil fuel consumption, air pollution and road crashes, while significantly contributing to the ever-increasing global greenhouse gas (GHG) emissions, notably CO_2 and black carbon, as transport accounts for approximately one-quarter of regional final energy consumption [1]. This picture is likely to get worse with vehicle registrations increasing by over 10% annually in many countries [2] and demand for transport in ASEAN projected to increase by 60% from 2013 to 2040 in a business-as-usual scenario [1]. Many of the ASEAN countries are facing challenges in providing timely sustainable transport solutions to keep up with the rapid increase in transport demand and motorization rates.

In the ASEAN Transport Strategic Plan 2016–2025 [3], ASEAN member countries agreed to "actively pursue sustainable transport" and "develop 'Avoid', 'Shift' and 'Improve' strategies at the regional and Member States level"

Local stakeholders are also relevant factors. For example, non-motorized transport policies such as those for cycling appear to be more developed in Thailand and the Philippines, in the development of which an advocacy role for civil society groups was observed [56], although in transport policy development in general non-governmental organizations are important in Indonesia as well [44]. Aside from local stakeholders, international organizations and processes such as ASEAN meetings, UNFCCC conferences and the UNCRD Environmentally Sustainable Transport Forum are likewise relevant. Such meetings (according to three interviews with policymakers) appear to influence policymakers in transport agencies who develop strategies and action plans.

Mitigation measures

Half of all trips in cities are short and within cycling distance. The protection and revitalization of cycling in Asia and the promotion of cycling elsewhere have to become an ingredient in comprehensive mobility plans to mitigate GHG emission in developing country parties of the IPCC.

Cycling bears substantial significance for avoiding emissions, poverty alleviation and development. The first results of calculating the carbon value of cycling can be found here. The earlier cycling expertise is brought into transport and urban planning processes, the larger the long term benefits from a cycling inclusive transport system will be. The post 2012 framework should lever government investments in planning for such systems. We can build upon the transition in transport strategy by, among others, the multilateral development banks. Local, national or international strategies and plans should be translated into Nationally Appropriate Mitigation Actions (NAMAs). The NAMA framework can become a stimulus for most of the developing country parties to take up planning for cycling but only if cycling's GHG reduction potential and other benefits to society are better understood and made measurable, reportable and verifiable. The European Cyclist Federation (ECF) took the initiative to establish a World Cycling Alliance (WCA).

Box 3.2. What makes people cycling?

Bicycle-friendly infrastructure has to satisfy five main requirements that have to be considered in planning, detailed design, implementation and management of bicycle friendly infrastructure:

1**. Coherence:** a complete network with a very dense mesh of cycle lanes to connect origins and destinations

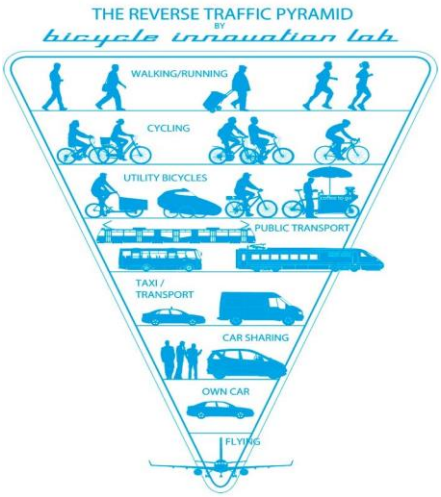
2**. Directness**: routes with minimal detours and journeys with minimal stops (such as intersections with exclusive right of way for cyclists

3. **Safety**: minimum number of conflicting points or intersections with motorized vehicles or reduced intensity of conflict between cyclists and motorists (such as removing parking spaces from cycling lanes

4. **Comfort**: ease of finding and selecting routes and minimum nuisance such as noise, fumes, congestion, and motorized interferences

5. **Attractiveness:** degree of visual and spatial experience of the ride during the users' journey.

Figure 3.1: The reverse traffic pyramid. Source: Bicycle Innovation Lab



3.1 Non-motorized transportation planning process

In order to ensure sustainability, cities need to adopt transportation policies and strategies as reflected in Figure 3. Sustainability requires right mix of modes of transport with the highest priority on walking and cycling, followed by utility bicycles and public transport that include taxi and car sharing. Private cars should get the least priority for infrastructure development.

Historically, little attention was paid to systematizing a transportation planning methodology for non-motorized transport. Most traffic demand models in developed countries are based on origin and destination surveys that include some information about bike trips, though often not about walking trips. Even if specific origin destination surveys do not have information on bicycle or other non-motorized vehicle travel, all trips under roughly 10 kilometers are potential non-motorized vehicle trips and hence can be used in the planning process. As a result, bicycle planning can build on traditional transport planning models, whereas information about very short pedestrian trips is likely to require further data collection and some different techniques. Planning for bicycle and cycle rickshaw facilities should be integrated into standard transportation planning as much as possible. NMT planning and policy making has these steps:

3.1.1 Initiating a non-motorized transport project

When initiating a non-motorized transport improvement project, a project team must be selected. Normally this team should initially consist of an international planning consultant, an international civil engineer, a local partner with influence and contacts inside the city government and a local NGO, university, or planning firm with experience in working with and surveying the affected population (pedestrians, cycle rickshaw drivers, community organizations and local politicians). This Task Force will be responsible for hosting public hearings when more developed plans are completed, for overseeing the proper implementation of the plans, and for acting as an advocate for the plans within the administration.

3.1.2 Selection area to be improved

Identifying key stakeholders will depend to some extent on the location for which non-motorized travel is to be improved. The planning methodology is also going to differ depending on whether it is a neighborhood-specific pilot project or a city-wide master plan that is being developed. Certain types of facilities tend to generate a large number of non-motorized trips. Among them are : Schools and universities, popular markets and shopping centers, factories and other employers of large numbers of people who do not have access to motor vehicles. For cycle rickshaws, the vast majority of trips are to schools, public transit stations, popular markets, and tourist locations. Programs can also focus only on such locations. This would greatly simplify the planning and prioritization process.

3.2 Inventory of existing regulations and conditions

While appropriate locations for prioritizing non-motorized vehicle facilities may be fairly self-evident to people familiar with the area, the data collection process also can play an important educational role with municipal officials. Simply demonstrating that 30% of the trips on a given road are made by pedestrians and cyclists, or that 60% of the victims of traffic accidents are non-motorized road users, can help to sensitize policy makers and the public to the importance of the measures that later stages will propose. Before conducting expensive new surveys, the availability of data from pre-existing surveys should be fully explored. Most police departments collect at least some data on traffic accidents that can be mapped, and some cities may actually have decent traffic safety database and black spot mapping.

Collection of useful additional data

To comprehensively improve non-motorized travel in a pilot location or for the city as a whole, the following steps need to be followed:

Division of the project area into zones

In order to map the data you are going to collect, the project area needs to be divided into zones. For bicycle and cycle rickshaw plans, the Dutch recommend that each zone be roughly 250 sq. meters, and that maps roughly 1:10,000 scale be used initially. For pedestrian improvements 1:2000 or smaller are necessary.

Supplemental household surveys

If pre-existing household surveys exist but do not have any information about bicycle and walking trips, and about bicycle and motorcycle ownership levels, some additional surveying should be done that includes this data.

Roadside surveys

This information is necessary to supplement the household survey data to capture those trips originating outside the study area.

Roadside counts

Because many vehicle counts exclude bicycle, cycle rickshaw and walking trips, it is good to collect baseline data on the number of bicycle, pedestrian, and other NMV trips on the major roads.

Origin and destination mapping

Ideally a map identifying all significant origin destination (OD) pairs for trips under 10 kilo-meters should be mapped. A model can be developed with this data indicating the factors which explain the divergence between the non-motorized trip mode shares in some corridors compared to others. Such a model can be used then to calculate the potential modal shift impact of various non-motorized facility interventions. From this modal shift data, emissions reductions and fuel savings can be calculated.

Actual route mapping

This actual route mapping can be used to calculate ***detour factors***. Detour factors are the most systematic way of identifying major ***severance*** problems. Severance problems can be created by unsafe, high-speed roads, by restrictions on non- motorized vehicles on specific streets, by barriers to crossing streets, by a one-way street system, and by large canals, railroad tracks, and other impassable infrastructure.

- ***Mapping of existing NMT facilities and perceived quality of NMV travel***

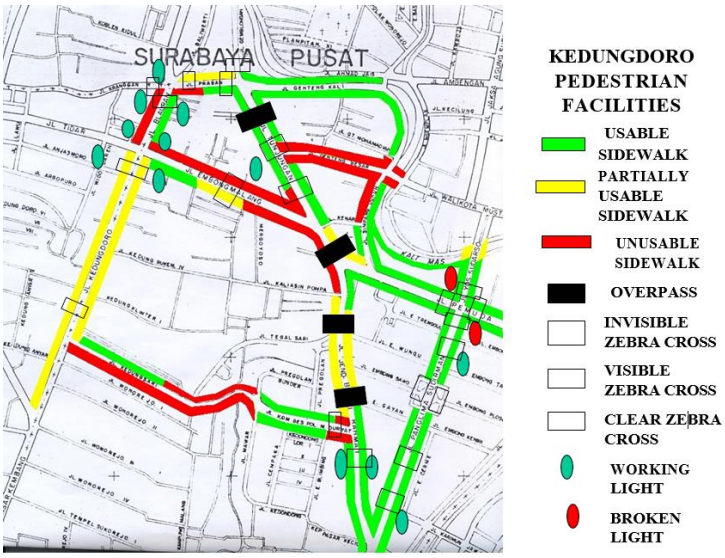
Some bicycle and pedestrian planners recommend mapping each of the actual and potential NMV routes and color coding them based on the perceived quality of the bicycling environment, coding:

Red: very dangerous and uncomfortable

Yellow: somewhat dangerous and uncomfortable, and

Green: adequate.

Figure 3.2 Simple map of existing NMT facilities, Central Surabaya, Indonesia.



- ***Mapping of existing NMV flows***

If an urban area still has a significant amount of non-motorized travel, it is important to map the current levels of non-motorized vehicle trips.

- ***Mapping of traffic accidents***

It is also useful to collect traffic accident data for accidents involving non-motorized road users from the police and map the locations as precisely as possible. A division at least between intersection and non-intersection accidents is required.

- ***Intersection conflict diagrams***

Once an intersection has been identified as dangerous through mapping of traffic accidents (as above) or based on the perceived danger of cycling groups, a detailed mapping of likely con- flicts at this intersection is likely to be necessary. These diagrams should indicate the location and type of design interventions that will be necessary.

- ***Additional pedestrian and safe routes to schools mapping***

Because pedestrian trips are so short, some additional information is sometimes used by planners for pedestrian and safe routes to schools programs: a) mapping of children's walking routes to school, and b) mapping of pedestrian 'desire lines'.

- ***Collection and review of all other transport plans for the project area for impacts on NMT***

Armed with all the data collected above, your project team and the NMT Task Force should review all these parallel plans for their impacts on non-motorized travel, and propose concrete changes if necessary.

Identification of priority improvement locations

With all of the above information, the project team should present this data to the NMT Task Force and together a priority list of locations, corridors, and sites in need of improvement should be identified and mapped. The selection criteria should be similar to those which were used to identify the project area.

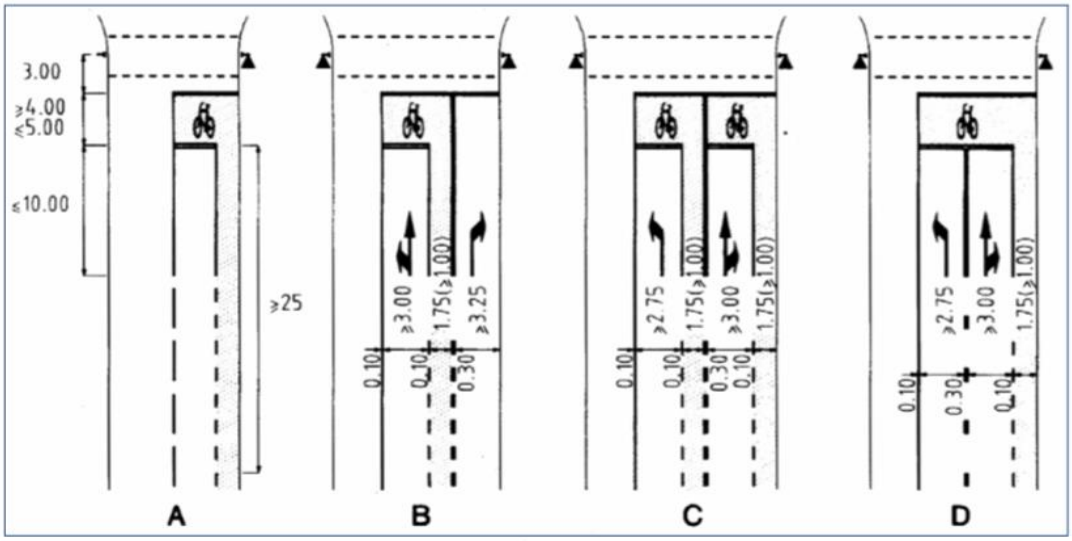
3.3 Selection and design of appropriate facilities for each location

Once the locations where improving non-motorized vehicle and pedestrian facilities are a priority, are identified, specific designs can be developed. The *CROW Manual* makes recommendations regarding when to use different types of facilities. The two determinants are the volume of motor vehicles and the motor vehicle speeds.

Sometimes the simple posting of bicycle route signs on existing streets can be important for two reasons. First, sometimes non-motorized traffic can be routed off major arterials by taking secondary and tertiary arterials. The availability of these routes, however, may not be commonly known. Coded bike routes, coupled with bike maps, can help cyclists identify more bicycle or NMV friendly routes. Secondly, it can be used to indicate that along this route traffic signals, intersections, and roadway maintenance have been designed to prioritize bicycle and other NMV use. A bicycle lane can give cyclists a greater sense of entitlement to the road, and sends a signal to motorists that the bicycles have a clear right to be there. The painted facility can lead to more orderly and predictable traffic behavior by the motorized and non-motorized modes, modestly increasing traffic capacity for the motorized modes by preventing the NMVS from occupying a full vehicle lane.

If the number of cyclists or cyclist equivalents (with three wheelers counting for three cyclists), rises above 150 per direction per hour, the *CROW Manual* recommends the width of the cycle lane be increased from a minimum of 1.5 to 2.5 meters, and if volumes are over 750 per direction per hour, they recommend 3.5 meters. If mopeds or other slow moving motorcycles are allowed on the same facility, the recommend increasing the width by another half meter.

Figure 3.3 Expanded bicycle streaming lanes. Source: CROW Manual 1993



A = Standard model
B = Right-turning model
C = Left-turning model
D = Left-turning model w/o a separate green phase

In developed countries, most accidents occur at intersections. In developing countries there are also a significant number of accidents between intersections, mainly caused by crossings of long arterials. There are two basic theories about how to integrate non-motorized vehicles into intersections. One is to pull them out of the intersection, and the other is to have them pulled into the intersection and clear the intersection first.

Pedestrian and traffic calming facilities

The basic principles to protect pedestrians are:

1.2.1.1 Slow down traffic speeds through both speed restrictions and physical infrastructure changes.

1.2.1.2 Reduce the distance pedestrian needs to cross at any one time at uncontrolled intersections.

1.2.1.3 Reduce the amount of overall motor vehicle traffic on routes heavily used by non-motorized modes.

1.2.1.4 Physically protect pedestrian facilities from incursions by motor vehicles.

1.2.1.5 Send signals to drivers that they are operating on areas intended for pedestrians.

The key challenge for cities in India is to bring a paradigm shift in the way urban transport is viewed by (a) keeping the interests of the pedestrians/cyclists at the core of all urban infrastructure and transport projects and (b) aligning the land-use and urban planning with the transport requirements.

A paradigm shift is needed to promote environmentally sustainable transport and shift the focus from mobility to accessibility with the long-term goal of decoupling transport demand from population and economic growth and a short-term goal of reducing the rate of energy demand and CO2 emissions. Sustainable transport is an essential ingredient and enabler of sustainable development. Transport infrastructure lasts for decades, which means that the decisions that national and local governments make today will have long-lasting impacts on how transport contributes to improving people's lives.

3.4 Design considerations for NMT

In shaping NMT-friendly street designs, strategies are needed for integrating accessibility with land use and infrastructure investment decisions. Issues also relate to:

1. Mapping Existing Infrastructure and Developing NMT Demand Estimates

2. Analyze challenges encountered in attempting to invest in pedestrian and cycling infrastructure

3. For NMT infrastructure development, private stakeholders are to be incentivized for making investments.

4. Pedestrians and cyclists are the most vulnerable street users. The physical road conditions for walking and cycling in many Asian cities are abysmal, despite having such a high modal share. These choices are a reflection of the lack of options the commuters have due to low income levels and the unreliability of other systems like public transport. Given a choice, people will move out of walking and cycling to private motorized modes which have better support infrastructure. This is why economic development is leading to increased motorization in our cities. The primary challenge of NMT in our cities is to convert this captive use to choice use by planning and designing better infrastructure and policy environments for them.

5. Safety and security issues related to non-motorised transport are other important challenges.

6. Issues related to infrastructure quality and data gaps.

Quality of infrastructure: There is a need to plan and provide safe and comfortable facilities and urban environment for both pedestrians and bicyclists. Various studies identify the change in policies and the infrastructure required, in the Indian context, to provide safe, secure and comfortable movement for pedestrians and bicyclists in the cities.

Table 4.1: Summary of findings from relevant studies: NMT infrastructure quality in Indian cities.

City/Country	Infrastructure quality		Source
	Pedestrians	**Bicyclists**	
Delhi, Vadodara, Jaipur& Patna	Non-existent or poorly maintained footpaths. Pedestrians are, therefore, directly conflicting with motorized traffic.	Non-availability of specific infrastructure.	(Maunder & Four acre 1989)
	Government authorities least concerned with low income groups who are highly dependent on NMT.		
Chennai and Bangalore	Non-existent, broken-down, and/ or obstructed sidewalks; large height differences between sidewalks and frequent driveways/ alleyways; danger at street crossings and distance between crosswalk locations; and flooding in monsoon seasons.	Few exclusive-use lanes, and on other roads bicyclists being pushed off of busy roads by motor vehicles.	(World Bank 2005)
Chandigarh	On some arterials, special pedestrian paths have been constructed.	Constructed 160 km of wide cycle paths between 2001 and 2003.	(Pucher et al., 2005)
Bangalore	Most of the footpaths along the major arterial and sub-arterial roads need extensive repairs and upgradations.		(IDES 2008)
	The footpaths lack continuity, with major portions being in bad shape due to utility repairs and maintenance.		(Kumar and Sudhir 2008)
Delhi	Presently, 40% of roads in the city do not have a pavement refuge, and those that do exist are often unusable, especially by the mobility impaired. Zebra crossings are routinely ignored, and there is large spacing between light controlled crossings. More focus is on providing hurdlefree mobility to MV by building foot over bridges and subways.		(Ghate and Sundar 2010)
India	There is little provision of facilities for pedestrians and bicyclists. The existing transport infrastructure development programmes are designed for faster modes of transport claiming ROW by displacing NMT.		(World Bank 2002)

Source: Promoting low carbon transport in India NMT Infrastructure in India: Investment, Policy and Design.

Table above summarises infrastructure quality for both pedestrians and bicyclists in different Indian cities, and the initiatives planned by local bodies for improvement during different time periods.

In Pune, India, with increased use of motorized vehicles, there is an increasing risk of accidents to the bicyclists and pedestrians. However, Pune has been working to develop a bicycle network. Likewise in Kanpur, due to the increasing risk of accidents of the bicyclists, city authorities experimented with yellow lane markings on certain main streets.

A paradigm shift towards creating cities for people.

Creating walkable and bikeable cities requires a fundamental change in how we design our cities. This involves nothing less than a paradigm shift away from motorist-centric urban planning prevalent in the last century. A new design ethos that prioritizes the safety and needs of more vulnerable groups of road-users – pedestrians and cyclists – needs to be established. But giving greater priority to more vulnerable road-users does not mean that drivers should be subjugated by the needs of pedestrians and cyclists throughout the city. The level of priority for road-users should be varied according to the context of the street. The 'soft traffic' created by pedestrians and cyclists on residential or downtown streets should, for example, be given priority over motorized traffic. In situations of fast moving traffic on highways, motorized traffic can take precedence. This will allow for a greater diversity of mobility options. Walkable and Bikeable Cities are more than just Bicycle Lanes and Footpaths. Most people equate the notion of walkable and bikeable cities with the provision of ample bicycle lanes and wider sidewalks. However, a comparison of cycling rates and total cycling network in cities across the world shows that the provision of infrastructure does not always result in a higher incidence of active mobility. For instance, while the leading cycling cities of the world, Copenhagen and Amsterdam do enjoy a generous provision of dedicated cycling infrastructure and high cycling rates, the popularity of cycling despite the lack of infrastructure in cities such as Tokyo suggests that there are other factors just as important in contributing to a successful cycling culture.

3.5 Ideas to make Cities more walkable and bikeable

Design in a way that is convenient and efficient

A comprehensive and well-connected network of footpaths and bicycle lanes for pedestrians and cyclists will make door-to-door travel on foot or by bicycle more convenient and efficient. Public transit systems should make it as convenient as possible for people to complete their journeys on foot or bicycle. Effective cycling connections can be a viable alternative to "last mile" challenges and can help alleviate the need for bus feeders at rail transit stations. This is especially important in promoting NMT/active mobility for tropical cities like Singapore, as transit integration allows people to cycle for the first or last legs of longer commutes, which may otherwise be unfeasible for most people to complete on bike due to the hot and wet weather. Bike share programmes are effective for cities that are starting to promote active mobility. A well-conceived and designed bicycle sharing system provides convenient access to bicycles for short distance trips and serves as a good alternative to other motorized modes of transport.

Provide dedicated spaces for all

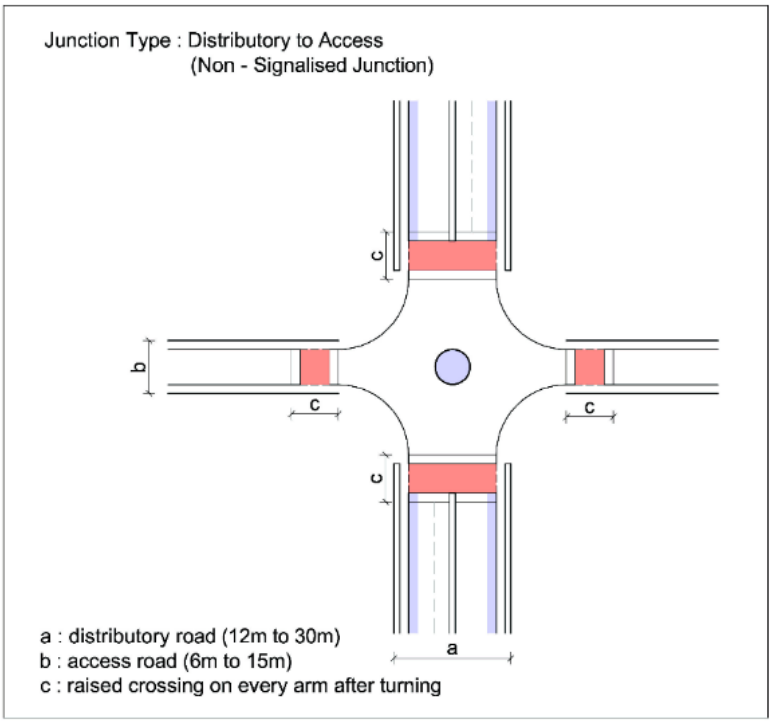
Dedicated infrastructure is essential for most areas within the city to encourage more people to adopt walking and cycling and enhance travel efficiency for all road-users. The provision of dedicated infrastructure has also been proven to generate tangible results in increasing walking and cycling rates and if implemented correctly, it can enhance safety for all road-users. In New York, the five-fold increase in its cycling network from 119 miles to 561 miles between 1997 and 2009 corresponded with a 221% increase in commuter cycling rates. The popularity of cycling later increased by another 29%, following a further 42% increase in the cycling network.

Ensure visibility at junctions

Accidents often occur when pedestrians and cyclists are caught in the blind spot of a driver's peripheral vision. Junctions are particularly problematic because drivers have to look out for oncoming vehicles in addition to pedestrians and cyclists before proceeding. In the

Netherlands, this is addressed by designing junctions and roundabouts with ample space to allow drivers to stop if necessary to avoid pedestrians and cyclists.

Figure 3.4 Roundabouts with ample space to allow drivers to stop if necessary to avoid pedestrians and cyclists



Maintain Continuity of Movement

Pedestrians and cyclists often find their journeys interrupted by various types of traffic junctions. This reduces travel efficiency and can also make a journey an irksome experience particularly in the tropics. In the Netherlands, junction designs provide a high degree of continuous movement for cyclists. This is achieved by continuing the cycling lanes through junctions in the form of bicycle crossings, and also by consciously creating gentle bends on the cycling lanes around junctions.

Ensure Consistency in Design Standards

Consistent design standards and traffic codes throughout the city will provide road-users with the information to anticipate traffic conditions in the city. For example, locating the bicycle lane on a consistent side of the road allows for easy recognition of designated paths by pedestrians and cyclists. Drivers will also be able to anticipate the direction in which cyclists will be coming from, thereby helping to reduce road accidents. Consistency should also be extended to signage systems to enhance user-friendliness and improve the communication of traffic conditions.

Make it Comfortable and Appealing

As pedestrians and cyclists are exposed to the elements, addressing climatic conditions is the first step towards creating a more comfortable and appealing environment for active mobility. In Copenhagen, snow clearance of cycling tracks in winter is prioritized over clearance of roads to ensure that cyclists can ride comfortably even during inclement

weather. Countries with hot and humid weather face a different set of climatic challenges. In Singapore, an extensive street planting programme has contributed significantly to enhancing the comfort and appeal of walking and cycling with large trees providing much needed visual relief as well as shade from the sun and some shelter from the rain.

Mixing up the Uses

Studies have proven that compact, mixed-use urban environments can encourage people to walk and cycle.75 Mixed-use developments can reduce the distances for daily commutes and provide convenient access to essential goods and services. With a greater variety of activities and services, such environments can create a more engaging journey for walking and cycling. This also opens up more opportunities for social interaction and increases traffic for local businesses, helping to reinforce the positive attributes of walking and cycling within a community.

Prioritize At-Grade Crossings

People are generally "energy-efficient" creatures; making crossings simple and direct minimizes the effort required for pedestrians and cyclists to complete their journeys and enhances the continuity of movement. Overhead bridges and underpasses, especially at non-arterial roads, can create 'mini-highways" that inconvenience pedestrians and cyclists.

In Seoul, several efforts have been made in recent years to create a more pedestrian- friendly city. One of the key initiatives includes the Gwanghwamun Pedestrian Belt where underpasses have been replaced by at-grade crossings to create direct connections for people. Doubly wide pedestrian crossings are also commonly found in Seoul, allowing crowds to cross the road comfortably. Many high-density cities such as Tokyo and Taipei have diagonal crosswalks that bring all motorised traffic to a stop at junctions with high pedestrian volumes during peak periods. This enables safe and direct crossings for pedestrians and cyclists alike.

Keep it Slow

To make comfort and safety a priority for pedestrians and cyclists, motorized traffic speeds have to be kept low, especially in zones of high pedestrian and cyclist traffic. In Tokyo, speed limits are heavily regulated. On smaller neighborhood roads the speed limit is capped at 20km/h to 30km/h. This allows pedestrians and cyclists to share the same space, despite the lack of dedicated cycling lanes or pedestrian paths. Speed limits are also prominently painted on the road, prompting drivers to slow down, giving them more time to react if necessary.

The benefits of slower street traffic are best exemplified by the Netherland's 'woonerf', or living streets, where traffic-moderating design interventions are cleverly integrated. Painted cycling paths at junction in Copenhagen increases visibility to cut traffic speeds in residential areas to a pace of 12m/h. This allows cars, cyclists and pedestrians to share the streets safely. Shared streets are also common in Asian cities where traditional street markets and retailers are dominant. The constant volume of pedestrian and cycling traffic through such streets forces cars to slow down despite the lack of traffic-moderating design interventions. The absence of street kerbs in such high-pedestrian traffic areas also allows for pedestrians and cars to negotiate for space in a flexible manner without compromising on safety as motorized speeds are kept low.

As most end-of-trip amenities are typically best integrated with destination developments, building and planning guidelines as well as green building incentives such as LEED or Greenmark in Singapore can encourage developers to provide adequate bicycle facilities. In

Australia, Brisbane is one of the more proactive city governments when it comes to providing such amenities. Cycle2City, Australia's first and only commuter cycle centre in Brisbane's CBD was completed in 2008 and offers secure bicycle parking spaces, lockers, showers, fresh towels and spare bicycle parts for a fee of between AUD$5 – $7 per day.77 Bicycle parking is more commonly provided as a public amenity. In Tokyo, innovative underground public parking carousels can be found at train stations. Called the Eco Cycle system, this underground bicycle parking system lets cyclists deposit their bicycles at ground level. The bicycles are then taken underground by mechanical lifts and stored to protect bicycles from the elements and theft. This system also serves the dual purpose of eliminating bicycle clutter from the street level and frees up more space for pedestrians and public activities, a boon for high-density cities facing the shortage of space.

CHAPTER-4
Role of urban planners in developing NMT

Many urban residents in developing countries and emerging economies rely on cycling or walking but with economic growth, the Non-Motorized Transport (NMT) share in transport systems is being threatened. Yet, NMT or Active Transport (AT) bears a relevant potential in low carbon transport scenarios and in urban mitigation action. This makes NMT a key element in the transition of transport policies to sustainable mobility.

Cycling - Half of all trips in cities are short and within cycling distance. The protection (and revitalization) of cycling in Asia and the promotion of cycling elsewhere have to become an ingredient in comprehensive mobility plans to mitigate GHG emission in developing country parties of the IPCC. Cycling bears substantial significance for avoiding emissions, poverty alleviation and development. The first results of calculating the carbon value of cycling can be found here. The earlier cycling expertise is brought into transport and urban planning processes, the larger the long term benefits from a cycling inclusive transport system will be. The post 2012 framework should lever government investments in planning for such systems. We can build upon the transition in transport strategy by, among others, the multilateral development banks. Local, national or international strategies and plans should be translated into Nationally Appropriate Mitigation Actions (NAMAs). The NAMA framework can become a stimulus for most of the developing country parties to take up planning for cycling but only if cycling's GHG reduction potential and other benefits to society are better understood and made measurable, reportable and verifiable. A review of literature to better understand the essential components of an NMT policy, and the core actions required in order to create an enabling environment for better walking, cycling and other NMT modes suggests that a combination of both standalone and integrated NMT policies; political will; clear, measurable goal-setting as part of local strategies; a variety of supporting policies; and traffic calming or speed and vehicle-reduction interventions; will produce cities and countries where walking, cycling and other NMT modes is significantly more safe, attractive, comfortable and desirable.

4.1 Strengthening urban planning in Asian cities

Asian Cities need to strengthen planning regimes to more effectively guide and shape the location and form of development. Urban Planning considerations to help achieve sustainable travel behaviors include:

- Settlement size
- Strategic development location
- Density
- Jobs–housing balance
- Accessibility of key facilities
- Development site location
- Mix of uses
- Neighborhood design and street layout

Alongside transport and infrastructure provision, traffic demand management measures, and wider efforts to change travel behavior norms and aspirations, urban planning can create the appropriate physical location of activities for sustainable travel patterns.

Why non-motorized transport?

The use of NMT in cities generates numerous social, economic and environmental benefits such as non-low cost infrastructure, higher user safety, low cost for users, healthy for users, low-cost vehicles and it is environment friendly as it reduces greenhouse gases emissions and lower our dependence on fossil fuels.

Planning to promote walk and cycle

A number of guides and resources including ADONIS (1998), Litman, et al. (2000), NYBC (2002), and GDOT (2003) provide information on best practices for improving non-motorized travel conditions and encouraging non-motorized transport. These include: Integrate non-motorized planning into all transport and land use planning activities; Educate all transportation professionals in non-motorized transport planning principles; Fund non-motorized planning at a comparable rate as other travel modes; Ensure that all roads are suitable for walking and cycling unless these modes are specifically prohibited and suitable alternatives are available; Use current planning practices and design standards, including Universally Accessible Design; Include non-motorized travel in transport surveys and models; Create pedestrian-oriented commercial centers and neighbourhoods; Perform user surveys to identify problems and barriers to non-motorized travel.

Other steps to promote walk and bicycle

1. Improve sidewalks, crosswalks, paths and bike lanes; Correct specific roadway hazards to non-motorized transport (sometimes called “spot improvement” programs);

2. Improve non-motorized facility management and maintenance, including reducing conflicts between users, and maintain cleanliness;

3. Develop pedestrian oriented land use and building design (New Urbanism); Increase road and path connectivity, with special non-motorized shortcuts, such as paths between cul-de-sac heads and mid-block pedestrian links;

4. Street furniture (e.g., benches) and design features (e.g., human-scale street lights); traffic calming, streetscape improvements, traffic speed reductions, vehicle restrictions and road space reallocation; Safety education, law enforcement and encouragement programs;

5. Integrate with transit (Bike/Transit Integration and Transit Oriented Development);

6. Provide bicycle parking; Address security concerns of pedestrians and cyclists; Public Bike Systems (PBS), which are automated bicycle rental systems designed to provide efficient mobility for short, utilitarian urban trips; Pedestrians-ways, which are indoor urban walking networks that connect buildings and transportation terminals;

7. Create a Multi-Modal Access Guide, which includes maps and other information on how to walk and cycle to a particular destination; Provision of multi-storey car parks for residents in order to gain public space on the road and gradually reducing parking space on the streets in order to promote cycle and walking.

8. Monitoring of the public parking space with a special control task force; Additional park and ride facilities at the periphery of the city.

9. Non-motorized improvements are provided primarily by regional and local governments, sometimes with federal and state/provincial support. Businesses can provide sidewalks, bicycle parking, and shower facilities.

Box 4.1 Investing in public, non-motorized and low-emission transport can save cities up to $500 billion by 2030.

In a working paper titled Accelerating Low-Carbon Development in the World's Cities, the New Climate Economy project estimates that these investments can yield up to 2.5Gt CO2e in annual abatement by 2050, which is equivalent to 29% of potential urban abatement. Similarly, logistics improvements and freight vehicle efficiency and electrification can contribute an additional $110 billion in energy cost savings and 6% of urban abatement. Apart from committing to implement low-carbon urban transport strategies by 2020, the report also recommends that cities commit to prioritising policies and investments in building efficiency, renewable energy and efficient waste management. Cycling is one mode of transport that yields significant savings, especially from reduced healthcare costs. This results from increased physical activity, reduced air pollution levels and reduced road fatalities. Thus, enhancing cycling infrastructure would enable cities shrink their carbon footprints and improve public health. It is estimated that Copenhagen's planned Super Cycle Highways would yield up to 19% annual return on investment. Although it can be difficult to retrofit mature cities with bike lanes, developing country cities can leapfrog the hyper-motorization of transport by developing pedestrian and cycling networks.

4.2 Role of City Developers for the Sustainable Urban Transport/Development

The city developers and urban planners should make efforts to bring about a transformative change by working towards a people oriented city. Large proportion of urban population in Asian or low income cities remains outside the formal planning process. Survival compulsions force them to evolve as self-organized systems. These systems rest on the innovative skills of people struggling to survive in a hostile environment and meet their mobility and accessibility needs. The actors in this complex street environment cannot be wished away. They are here to stay. The city developers should make consistent efforts in creating healthy places through NMT, improve the health and quality of life of their residents in holistic, integrated ways through the use of alternative, green modes of transport or new technology, develop most strategic plans and bold mobility projects, develop solutions to their own cities' challenges, being mindful of their unique resources, capabilities and needs. Making NMT as an active transportation a priority has multiple benefits, including: effective and convenient mobility, an enriched urban experience, economic and environmental dividends, and improved cohesiveness and connectivity between neighborhoods.

Why city planners should be talking more about NMT (Walking and Cycling)?

- Urban capacity for motorized transport is reaching its threshold.
- Active mobility is necessary for building healthy and livable cities.
- NMT is gaining global prominence and tropical cities like Singapore can also be walkable and bikeable too.

The city developers should need to emphasize on NMT planning and work in coordination through a series of processes including as ***regulation, planning, data & network identification, design*** and ***implementation.***

a. Regulation:

Vehicle use regulation

Justifications for restrictions of NMT modes accessing some roads and determining priority between motorized and non-motorized vehicles.

Vehicles operation regulation

Regulate the operations of non-motorized vehicle usage

Infrastructure design regulations

Standardize NMT planning and design process, integrating NMT facilities within the existing transport network and linking design standards to speed limits and the road hierarchy.

b. Planning:

In the NMT planning process, NMT planning principles should be established i.e. coherence & directness, attractiveness and comfort, and safety & security. Once the principles are successfully established, road inventory data and travel behavior pattern should be established. The collected data then should be analyzed using Traffic Analysis Zone (TAZ), Bicycle Compatibility Index, trip generation, distribution and assignment. Finally after data is analyzed using the specific tools, needs assessment through NMT specific transport modelling process is executed.

c. Data and network identification:

Preparing a network plan instead of a corridor wise plan. The network plan includes recommendations on the network of arterial roads/ links for which segregated cycle tracks and pedestrian footpaths are needed, the links for which traffic calming is needed. Recreation routes can also be identified as a part of the network planning exercise but as addition to the main street hierarchy and not as an alternative.

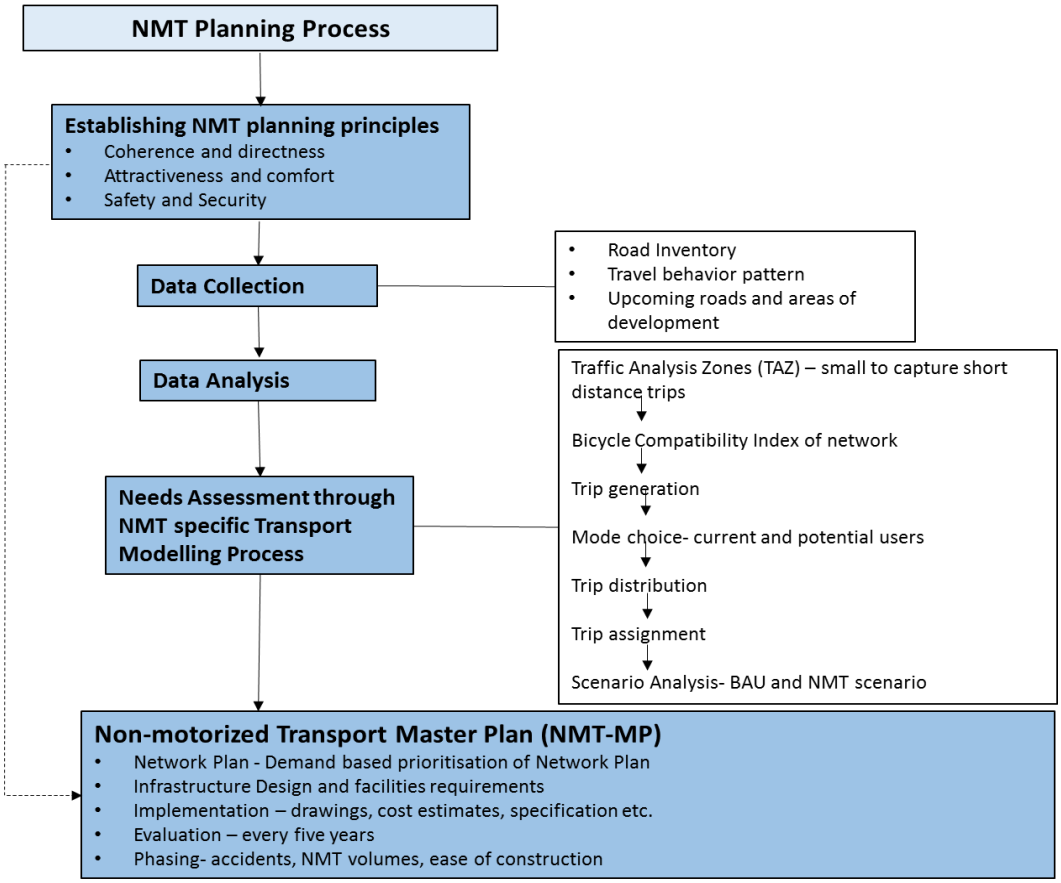
d. Design:

Redesigning of entire alignment including roads and street to ensure optimum use of available space within the Right of Way (ROW) for accommodating all functions and demands from the route. There are advantages and disadvantages of having physically separated NMV lanes as opposed to lanes only separated by road markings. Advantages are that they are less frequently obstructed by double parked cars or illegal use by motor vehicle and motorcycles, they provide a greater sense of security to the NMV user, they can allow for 2-directional NMV travel, even on one-way roads, they ensure that NMV users will not make sudden movements into the motor vehicle lanes or obstruct motorists, they are self-enforcing. Disadvantages are that if they are too narrow, a single three-wheeler can obstruct the lane.

e. Implementation and evaluation:

The implementation phase includes detailed cost estimates based on the implementation drawings. Contractors/developers are invited to bid for the development project. The successful bidder is selected based on the specifications in the invitation of bids. An independent project manager should also be appointed. Subsequent changes/improvements in designs/drawings may be necessitated due to limitation of site, time, cost overruns, etc. The NMT master plan should preferably be updated every five to eight years. Each developed route should also independently be evaluated to assess the performance, and to gather feedback from users. The guidelines and methodology of evaluation should preferably be laid in the NMT master plan, where different components of NMT infrastructure are graded on a scale of 1 to 6.

Figure 4.1 NMT planning process schematic diagram.



NMT planning - 5 key requirements also called SPACE.

Safety: speed, visibility, pre-visibility

Priority/Direct routes: horizontal design, traffic lights

Accessible/Coherence

Comfort: vertical design, traffic lights

Enjoyable/Attractiveness (less important)

Safety – Reduce Speed and mode separation. An infrastructure that guarantees safety of the pedestrians and cyclists. Perceptions of poor safety discourages walking/cycling. Pedestrian safety should be prioritized while design roads for NMT. Access at crossing should be designed considering requirements of various user groups (e.g. young children, vision- and mobility-impaired people, etc.).

Direct routes/ express routes without detour and delay- NMT networks should always be as direct as possible. This means constructing paths over through highways, urban arterial roads, operating railways, and watercourses wherever possible. An infrastructure that offers the cyclist direct routes, without detours and without delays should be planned and executed. It will in turn reduce the time of the trip and reduce the effort to cycle.

Accessibility / Coherence: The infrastructure should form a coherent unit and should be linked to the origins and the destinations of cyclists. That's why consistent quality and design,

continuity in pattern, new changes in the design & width, ccomplete routes and adequate signalling are needed.

4.3 Steps taken by cities towards non-motorized transport

Factors in cities supporting NMT.

1. High density, compact, fine grained urban form
2. Mixed use environment
3. Strong civic and sharing culture
4. Good public transit

Factors in cities hindering NMT

1. Car-centric/anti-cyclist culture
2. Car-oriented infrastructure design (e.g. junctions, road design)

Factors in cities blocking NMT

1. Urban sprawl and mono-functional land use
2. Car-oriented transport network

4.4 Success Factors for City Transformation

1. Effective collaboration between government and civic society

Amsterdam: NGOs like the Fietsersbond promoted the bicycle as an instrument of liveability and sustainability.

2. Visionary Leadership: transformation in a snap

New York City: The Bloomberg administration demonstrated the positive impacts of pedestrianisation and bicycle infrastructure.

3. People-oriented planning

Copenhagen: Tracking the performance of their walking and cycling initiatives, supporting policy-making and review with concrete pedestrian and cyclist traffic counts.

4. Transformation through major impactful projects

Seoul: implement bold major projects, including transforming a major viaduct in the heart of downtown into an elevated park

5. Strong civic culture

Taipei: Taipei's success is based on a strong civic culture of sharing and mutual respect which facilitates space sharing.

Roadblocks to active mobility

Institutional frameworks and development policies-Are cities getting built for cars or for people? Is there sufficient legislative support?

Infrastructure development and design- Does the planning framework support active mobility / NMT? Lack of seamless multi-mode journeys and complementary facilities. Is the

infrastructure designed for cars or for people? Transport infrastructure that prioritizes motorized transport.

Culture, behavior and perceptions- Pedestrians and cyclists sometimes viewed by drivers as annoying encumbrances on the roads. This sentiment poses a formidable challenge to changing the status quo.

Box 4.2. Roles and responsibilities of city developers for NMT Development and Maintenance

The city developers have to be involved in the entire NMT process from feasibility assessment to completion. This entire process may have 5 major steps- 1. Assess 2. Enable 3. Plan + Design 4. Invest 5. Implement which are described below.

1. **Assess:**

   To plan for NMT infrastructure, it is critical to first assess the preparedness of the city, before giving a road map for interventions needed to achieve the desired vision. At the first stage of assessment, a set of tasks and sub-tasks are identified for establishing baseline needs and understanding the current status of the city. This includes a review of existing institutional structures, physical infrastructure, citizen needs, existing initiatives and stakeholders' interests.

2. **Enable:**

   NMT needs to have good policy support at a national level. As in India, there is a National Urban Transport Policy (NUTP), National Mission on Sustainable Habitat (NMSH) and other initiatives; Indian cities now have good policy support for NMT at the national level. There is a need to convert these sound policies to lifestyle choices for citizens that would make a favorable environment for the smooth implementation of these policies.

   At this second stage, a set of tasks to translate these policies into local actions and aims at building commitment and encouraging leadership to change culture and perceptions are identified. This stage to enable also includes a discussion on integrating NMT principles with urban planning and decision- making processes and budgets; it builds capacities to enable effective implementation.

3. **Plan + Design:**

   Cities involve multiple stakeholders and it is impractical to assume that everyone in a city will behave the way the design assumes they will. The planning process needs to ensure that the NMT users have direct, coherent, safe, attractive and comfortable routes to complete trips. This process can provide long-term benefits and support the plan's implementation. This stage of 'Plan' component identifies a flexible planning process that cities may adapt based on their local context to undertake planning and implementation of NMT infrastructure at varying scales. This is supported with design guidelines refers to standards and benchmarks for NMT facility design being used in the country and discusses how to resolve site specific conditions.

4. **Invest:**

   This stage builds a case for investing in NMT projects and explores the possible financing options that cities could use to ensure that more funding is dedicated for NMT use. Strategies from analysing the city budgets to bundling NMT with larger infrastructure projects are some of the micro and macro-level tools for consideration at this stage of investment and mobilisation of resources.

5. **Implement:**
   Implementing and executing an NMT project on the ground is a complex task not only because of issues faced during implementing street upgradation projects but also because of the multiplicity of stakeholders involved. It becomes important then to clearly define the organizational roles and responsibilities during the construction process. The 'Implement' stage discusses the various components of NMT implementation- from the organizational framework to community engagement and outreach and from project management and supervision to monitoring and evaluation.

Provision for NMT in mid to large cities is almost exclusively a municipal responsibility in India and several other Asian Countries. There are many, however other government and non-government organizations involved in the planning and implementation process and need to be mapped. An indicative list and their roles could be as follows:

1. Local Governments: Master planning, local area planning, road network planning, NMT infrastructure planning, construction, upgradation and maintenance.

2. Transit Agencies: NMT infrastructure investment around transit stations and corridors.

3. Regional Planning Agencies (UMTA/Metropolitan Authorities in India): Long-Range Transportation Plan, Regional Low-Carbon Mobility Plan, Regional Growth Management Plan, technical assistance to local agencies, and monitoring of Urban Transport Fund.

4. Citizens, NGOs and Advocacy Groups: Advocacy for NMT improvements, community participation in planning and design, education, attend planning meetings and advocate high quality design.

5. Elected officials: Developer and citizen awareness about benefits of NMT, changing regulatory climate, advocate transportation demand management policies and local economic development incentives.

6. Businesses/Real Estate Developers: Joint development with transit agencies, Public Private Partnerships, affordable housing construction, private sector investment in real estate, and employee incentives.

7. City Government: To adapt the steps to their own individual situations to develop solutions and approaches based on local conditions and explore potential funding options.

8. State Government: Policy changes, funding assistance, capacity building, technical assistance, Land and Market Reforms.

9. Central Government: Policy changes, guidelines formulation, funding assistance, and capacity building. To formulate policies such as National Urban Transport Policy in India and to finance NMT infrastructures.

Urban Local Bodies like Municipal Corporations, Development Authorities, Public Works Departments, Traffic Police, Transport Department, Environment Pollution Control Authority (EPCA), Fire and Ambulance Services, Environment Department, Cantonment Boards, Transport Corporations, etc. play the role in planning, implementing and supporting NMT processes depending on the scale and scope of identified NMT projects. Academic Institutes and Research bodies and Consultants or practitioners provide expertise in the field of transport.

4.5 Urban Mobility Challenges in Asian Cities

1. With fast growing economies in Asia, the Increased Car Ownership is leading to increased Traffic Volumes and Congestion.
2. Urban Sprawl is resulting in greater car dependency, increased trip lengths and high costs for extending infrastructure and services
3. Road safety is another challenge due to (a) increased conflicts among modes and (b)increased accidents and fatalities
4. Increased motorization is impacting climate change resulting in (a) global warming (b) higher emission levels and (c) air and noise pollution; and
5. Accelerated energy consumption as a result of 30% energy consumption by the transport sector, increased demand for fossil fuel and increased GHG emissions.

Development of infrastructure and seamless inter-modality is essential for Sustainable Urban Transport. Non-Motorized Transport is an important component of seamless inter-modality. Promoting NMT is an important part of the multi-pronged approach for improving environment. For physical integration it is essential for the city developers to plan footpaths for pedestrians and cycle tracks and cycle parking stations. Cities should create facilities for walking and cycling in all cities and develop an upgraded cycle rickshaw as an integral part of the last mile connectivity.

In Asia, India is the second fastest growing major economy in the world and highest populated country in the world after China. 63% of India's GDP is contributed by the urban population (Census 2011) which is 31% of India's total population. Based on current trends, it is expected by 2030 urban areas to house 40% of India's population and contribute 75% of India's GDP.

As a result of the rapid increase in urban population, urban planning based on zonal land-use planning and expanding economic activity, India has experienced a tremendous growth of motor vehicles in the last decade i.e. an average growth rate of 9% per year. Rapid motorization has also resulted in increased air pollution. Today transport sector alone contributes towards 8% of the total emission. Rapid increase in urbanization and motorization has led to sprawling cities; declining share of public transport and non-motorized transport; focus on supply side yet with low investments for transport infrastructure; sheer neglect of pedestrians, cyclists and public transport users; high road fatalities/injuries. The problem is getting further aggravated by a multiplicity of authorities/departments involved in urban transport that often have conflicting agendas, as well as lack of understanding of the role of public authorities on various issues relating to urban transport. Such a scenario is neither desirable nor sustainable even for the present and needs to be proactively reversed on an urgent basis.

Acknowledging these issues, the Ministry of Urban Development (MoUD), Government of India (GoI), has taken up some initiatives to improve & formalize the urban transport scenario in the country - in the form of formulating an urban transport policy (i.e. National Urban Transport Policy, 2006), Working Group Report on Urban Transport of National Transport Development

Policy Committee (NTDPC), a chapter on urban transport in the 12th Five Year Plan of the Country, setting up of Service Level Benchmarks (Urban Transport), National mission on Sustainable Habitat, etc.

Also, during the recently held COP21 Conference in Paris, India has pledged in its Intended Nationally Determined Contribution (INDC) document to curb its greenhouse gas emission intensity of its GDP by 33 to 35 percent by 2030 from 2005 levels.

Strategy to improve the quality and safety of walking

- New pedestrian links to create a network of convenient routes;
- Better footways (paving, landscaping, lighting, street furniture);
- Streets and public areas that create interest for pedestrians (building frontages, signs, and advertisements scaled for the pedestrian rather than the vehicle);
- Priority for pedestrians on residential and local streets and central areas;
- Better crossing facilities, including reduced speed and volume of traffic and increased crossing time for pedestrians; and
- Developments that ensure facilities can be reached on foot easily.
- The provision of a fully segregated cycle network alongside facilities within the main road and footpath network;
- Traffic calming so that speeds of vehicles are closer to those of cyclists; and
- Parking and storage facilities that are secure and conveniently located.

4.6 Recommendations

Acknowledging these issues, the recommendations to improve & formalize the urban transport scenario in Asian countries are as follows:

- **Institutional framework**: The cities in Asia should be empowered to take care of their needs including urban transport. The National Government needs to take care of issues such as financing, PPP, capacity building, developing a data base and R&D. State Governments should support the city with an organizational set-up, legislation, a resource generation policy and professional staff. A Road Transport Safety Board needs to be set up at State level to deal with safety issues in a comprehensive, scientific and a systematic manner. It should be supported by relevant R&D. Rescue services should be organized for fast relief.
- **Legislation:** Urban transport affects all aspects of city life and the working of nearly all other city agencies. A comprehensive Urban Transport act to cover all aspects of urban transport should be enacted by the Central Government and State Governments may draft rules under it as per its needs as in the case of Motor vehicles act.
- **Infrastructure and seamless inter-modality:** Transport is inherently multimodal and should offer a seamless journey to the users through multimodal integration i.e. Physical integration, Network integration, Fare integration, Information integration and Institutional integration. Need to enable the establishment of quality focused multi-modal public transport systems that are well integrated, providing seamless travel across modes.
- **Safety**[44]**:** The organizational framework to deal with all road safety related issues should be provided by creating a Safety Board at State level with safety cells in cities with dedicated personnel and budget. Cities should undertake safety audit for hazardous locations (yr. 1-10) to reduce accidents, fatalities and injuries. Relevant R&D should be a part of the research program to minimize injury and the consequences in the event of an accident. Rescue services should be organized to provide relief in the fastest time possible. Also, a National Road Safety Commission at the central level needs to be set up to set standards and parameters for Road Safety in the country.

[44] National Transport Development Policy Committee(NTDPC)-Working Group Report on Urban Transport

- **Training:** There is also an urgent need for capacity building; both at institutional and individual level. The focus of training for existing city officials should be to develop awareness, skills and a deeper understanding of the requisite issues in urban transport. The curriculum in universities should be reviewed so that the professionals coming out should have skills in tasks needed today such as planning and design of Bus rapid transit, facilities for NMT etc.
- **Accessibility:** Universal accessibility needs to be provided, by the urban transport systems, both at the systemic level and the Infrastructure level. It should be done in terms of time, cost and convenience to commuter. Improved accessibility of stations/stops or the last mile connectivity should be a vital feature of public transport planning.
- **Users' needs:** The major factors for designing access to pedestrian and public transport systems for all users are as follows:
    - Safety: A Safety Board/Cell in each State/city should deal with safety issues in a comprehensive, scientific and a systematic manner.
    - Comfort: To improve the commuter travel time and comfort, enactments that include provisions such as giving buses priority at the junctions, mandatory give way at bus ways, creating full day bus lanes, and using more energy efficient buses and trains.
    - Accessibility: The better transport provision is a key to improving accessibility to jobs, services, education and training opportunities and social networks. A standard measure of accessibility essential in determining areas most in need of improvement.
    - Affordability: Affordability is clearly an extremely important consideration in most of the cities of developing countries. The impression is that public transport users are well aware of all the various ticket prices and the ticket differentials between the different services and operators. Talking about affordability passes and concessions are often important.

Environment: Vehicle efficiency improvements, regulation of fuel and vehicles, Vehicle emission standards, and the modernization of taxi, truck, bus and other commercial fleets generates exceptional economic returns. Use of new fuels and vehicle technologies should be supported by suitable tax concessions. Inspection and certification of old vehicles should be made mandatory. Regular maintenance of vehicles should be enforced. **Fund allocation for major transport infrastructure should be linked to achieving targets for creating citywide facilities for NMT.**

Chapter 5.
Best practices, good examples and lessons learnt.

5.1 Need for strengthening NMT infrastructure and impact of improved walking and cycling facilities.

Most of the Asian cities are facing several socio-economic problems related to transport such as traffic congestion, air pollution/GHG emissions, traffic accidents and fatalities, and noise pollution among others. It is estimated that road congestion alone cost Asian countries 2-5% of their GDP annually due to countless hours of delay, loss of economic opportunities and the waste of billions of gallons of fuel and higher transport cost. According to WHO, an average of 15 million people are injured in urban road accidents in developing countries each year and the majority of victims are poor pedestrians and bicyclists. Similarly, outdoor air pollution contributes to an estimated 1.6 million pre mature deaths in PR China and 1.4 million people in India in 2013, which is half of the world's air pollution deaths.

There is a global consensus that the way towns and cities are structured and how they function urgently need to change to fulfill the required demand and address the existing urban issues. Urban mobility and transport, that is strategically and well planned, is crucial in making cities safer, resilient, livable and sustainable. It can curb sprawl, create compact, walkable neighborhoods and reduce the number of kilometers vehicles travel. Therefore, city developers need to think innovative sustainable urban design and non-motorized transport solutions for seamless mobility and accessibility for the benefit of all.

5.1.1 Benefits of a greater role for non- motorized transport

An increasing number of city governments in developed and developing cities have recently begun actively promoting bicycling and walking.

a. Pedestrians, bicyclists, and cycle rickshaw passengers generate no air pollution, no greenhouse gases, and little noise pollution

Reducing these emissions and noise are critical to slowing global warming, reducing incidents of asthma and other upper respiratory and cardio-vascular disease, and reducing sleep disorders.

b. Bicyclists and pedestrians are more efficient users of scarce road space than private motor vehicles, helping to combat congestion.

While fully occupied public transit vehicles are the most efficient users of road space, bicyclists use less than a third of the road space used by private motor vehicles, and pedestrians use less than a sixth. Even cycle rickshaws use considerably less road space per passenger than motorized taxis and single occupancy private motor vehicles.

c. Bicycling and walking are the most efficient and environmentally sustainable means of making short trips.

In most developing cities, average trip distances are extremely short. Over 60% of trips are generally less than 3 kilometers long. In well planned German cities, over 80% of trips under 3 kilometers would be made by walking or bicycling, generating no pollution and minimal traffic congestion. Surabaya in Indonesia, for example, is only 15 kilometers north to south. This means virtually no trip inside the city is too far for an average healthy cyclist's average commute.

In Bogotá, in 1998, 70% of the private car trips were less than 3 kilometers. Even though this percentage is lower today thanks to the bike and pedestrian facilities, it is still too high compared to some Northern European cities. In Asian cities, however, even with per capita incomes less

than one-twentieth of Germany, over 60% of these short trips less than three kilometers are made by motor vehicles, usually motorcycle, moped, or para-transit. ITDP studies indicate three reasons for this:

1. Few pedestrian or cycling facilities have been provided in many cities. Over 60% of the roads in Jakarta, for example, have no sidewalks, and those that exist are heavily obstructed by telephone poles, trees, construction materials, trash, and open sewer and drainage ditches.
2. Secondly, the traffic system has been designed to increase motor vehicle speeds, at the expense of pedestrian and bicycle safety. Many Asian cities make minimal use of traffic lights with zebra crossings and medians which provide a place for pedestrians to cross safely. As a result, the number of roadway fatalities per vehicle is many times higher than in Europe or the US.
3. Finally, pedestrian barricades and one-way streets have been used to facilitate long distance motorized trips, but which simultaneously impose huge detours for short distance cycling and pedestrian trips. People wishing to cross a main shopping street often find it easier to take a taxi for two kilometers than to walk across the street. In Surabaya, a World Bank financed study estimated that these measures generate an additional daily 7000 kilometers of needless vehicle traffic.

Most people feel that ***culture and heat*** are reasons for low levels of cycling in parts of the developing world where cycling is no longer ubiquitous. Streets need to be designed to provide shade and pavements that do not radiate heat. Cultural factors are clearly involved but cycling culture did not happen overnight anywhere. In Holland the cycling culture has long historical roots, but the dramatic increases in cycling in the last two decades resulted from concerted government efforts. Use of the Mayor's Office as a 'bully pulpit' in Bogotá coupled with the construction of extensive cycling paths has resulted in an increase of cycling from 0.5% of daily trips to 4% of daily trips in only 3 years.

d. Improving the efficiency of non-motorized travel is economically vital

Virtually every trip begins and ends with a walking or cycling trip, whether between a parking lot and an office building or a home and a bus station. Because walking trips and cycling trips are very slow, inefficiency in making these trips, forcing people to walk or bicycle a long way out of their way, has very high economic cost because of the slowness of travel by these modes.

e. Increasing the modal share of bicycling and walking can reduce a country's dependence on imported oil.

f. Promoting safe bicycling and walking are crucial to improving the accessibility of the poor and social cohesion.

g. Promoting safe bicycling and walking is vital to reducing over 500,000 premature deaths from traffic accidents each year.

The majority of trips in Asian cities are done on foot or using cycles. However, often developing countries face challenges in the form of (a) inadequate pedestrian infrastructure (b) non-existent sidewalks and (c) inadequate cycling infrastructure. Asian cities should design facilities for promoting the use of NMT because infrastructure development for NMT costs less, is environmentally friendly and healthy for users. NMT vehicles are also low cost, it reduces GHG emissions and provides important health benefits.

5.1.2 Public bike sharing schemes around the world

Sustainable transportation policies and strategies require adoption of right mix, there has to be more emphasis on NMT planning, regulation, data network identification, design and implementation. Some of the key requirements for NMT planning are safety, priority, accessible, coherence, comfort and enjoyable attractiveness. Some of the best examples are from developed

cities namely, Copenhagen, Munich, Tokyo, Singapore, Stockholm and London. The cities of Netherlands have separate bus and bicycle lanes. Among the developing city examples are the cities of Shanghai and Bogota.

In Copenhagen, Denmark, the bicycle has become embedded in Danish society. Copenhagen is a city of 1.2 million inhabitant. Bicycles have always been a part of Copenhagen life since the 19th century; the second world ward substantially increased the level of bicycle use. However, in the post war era until 1960, cars dominated urban policies due to high GDP and per capita income. In 1970, due to the oil crisis and growing traffic congestion, the city started facing challenge of providing affordable transport to all. As a result, Copenhagen redirected its transport policy to one where bicycle have a predominant role. After 2000, as a result of a comprehensive urban development plan, there was a more systematic approach to cycling. The urban development plan was a 5 finger plan that included the following: i) A cycle track network as part of their National Bicycle Route network ii) Green Waves of cyclists based on traffic light phase iii) 6-second "green advance" for cyclists at stop lights iv) Green Cyclists Routes, which are essentially a very high level network of cycle routes, have little or no contact with other traffic, making trips in the city more agile and safer. V) Green Cyclists Routes, which are essentially a very high level network of cycle routes, have little or no contact with other traffic, making trips in the city more agile and safer.

Bicycles in Copenhagen now account for 37% of the trips in the city. Traffic accidents have been reduced. A survey was conducted in 2010. Given below are the survey results.

Table 5.1 New Cyclist's reasons for starting to cycle.	
It's faster.	51%
It's more convenient.	32%
It's healthy.	31%
It's cheap.	30%
It feels good/good way to start the day.	20%
19% of existent cyclist started cycling more than two years ago and 9% started cycling within the past two years. 70% have always cycled.	

Table 5.2 Health impacts of cycling- DKK per cycled km.			
	Impact on society	Impact on individual cyclists	Total
Health benefits.	1.74	3.77	5.51
Accident costs.	0.54	0.25	0.79
Total health impact.	1.20	3.52	4.72
Source: Copenhagen Bicycle Account, 2010.			

There are more than 330 active bicycle sharing systems across the world.[45] These systems allow users to pick up and drop off bicycles at any of the automated stations within the network. Bicycle sharing systems are in various countries of Europe, that include United Kingdom, Netherlands, Cyprus, Turkey, Denmark, Greece, Norway, France, Portugal, Germany, Austria, Spain, Poland, Italy, Kazakhstan, Russia, Luxemburg, Romania, Switzerland, Ireland, Albania and Slovenia. Similarly, bike sharing systems are also popular in USA, Canada and Columbia and Ecuador in Latin America. Among the Asian countries, China is far ahead in bicycle sharing schemes than various Asian cities. In addition, Australia, Thailand, Taiwan, India, Malaysia and few others are among the several Asia Pacific countries where bicycle sharing schemes have been introduced. In most cities bicycle sharing schemes are introduced only in the current decade, while in Europe it has been largely launched towards the close of 20th century. Later, several private companies, introduced different models of the scheme.

Denmark introduced the first next generation bike sharing system in 1991. Later, Copenhagen's ByCyklen program was introduced in 1995 as the first large scale urban bike sharing program. Copenhagen was amongst the first cities in the world to have a free bike scheme called city bikes which was paid by the advertising on the bikes. In 2013, Copenhagen started a new program with electric bikes. City bike scheme in Helsinki launched in 2016 has 1500 bikes in 150 locations. French cities offering a bicycle sharing scheme include Marseille, Lyon, Bordeaux, Nice, Toulouse, Rennes, Rouen, La Rochelle, Orléans, Montpellier, Nantes, Lille, Dunkirk, Strasbourg, Clermont-Ferrand, Avignon, Saint-Étienne, Chalon sur Saône, Belfort, Lorient, Annemasse, Valence, and Aix-en-Provence.

Germany has bike-sharing programs in many cities. The station based system Metropolradruhr is located in the Ruhr Area.

The city of Hangzhou in China, with a population of around 7 million, boasts the world's largest bike share program. In fact, no other bike share on earth touches the sheer numbers they have. Let's take a tally. There are somewhere between 66,500 and 78,000 bicycles in their program, scattered across around 2700 stations. Despite the program's success, there has been some minor controversy surrounding it; in 2010 an app was created which told users how many bikes were available at every station. While hailed among users as a real life-saver, Hangzhou Public Bicycle's staff were not impressed. They claimed the data was taken illegally by the developers, and in 2012 they blocked Zhang Guangyu, the developers, from accessing the information, rendering the app useless[46]. Shanghai in China has a successful bike share program mainly due to the consistent efforts by Forever Bike, who supply the city with its iconic and aesthetically pleasing orange bikes. The bike share has over 19,000 bikes in service and roughly 600 different stations in use. The bike share program is very popular among tourists.

The system might be a little hard to understand for those who are unfamiliar with how bike shares works, but there are plenty of guides. Shanghai's bike share benefits from the city's modern infrastructure and massive population looking to avoid traffic. Like Beijing, part of the success of the bike share comes from the sheer volume of people living in the city. Shanghai has the highest population in the country with the most people on earth. There is a high demand for bicycles there. Like most bike share programs, Shanghai's comes from a co-operative effort between business and government. Like all bike shares, there are a few downsides to Forever Bike's orange fleet, but ultimately the program has been profitable and successful[47].

[45] https://en.wikipedia.org/wiki/List_of_bicycle-sharing_systems
[46] https://www.icebike.org/bike-share-programs/
[47] https://www.icebike.org/bike-share-programs/

5.2 NMT projects in selected Asian cities (Gaps in policy implementation)

There is a growing number of cities in Asia which have initiated pedestrianization schemes and which have discovered that such schemes promote business opportunities rather than reduce it. The Maliaboro Traffic Management and Pedestrianization Scheme is one of the urban development strategies that was implemented in Yogyakarta, Indonesia last decade. The other being the de-concentration of city development and promotion of new growth centers. The traffic management scheme involves initial re-routing and reduction of traffic. The main goal of such strategy is to attract investment and create a climate, conducive to business establishments, at the same time it reduces air quality problems caused by congestion in the city center and traffic jams, and underutilization of road network. The increased use of pedestrian area, non-motorized vehicles, public transport and reduction of traffic delays will reduce emissions and energy consumption. Thus, such strategic measures create a bundled benefit – increasing attractiveness of the city for investment, tourism and business as well as improving local environmental condition and contributing to the reduction of global emissions.

The Dongshan District government in Guangzhou, China has implemented a form of 'post traffic calming' in which the street is paved not with asphalt but with pedestrian-oriented tiles. There is no sidewalk; the street is raised to a single, flat level. Cars and motor vehicles are not banned from entering the area, but the paving, lack of sidewalks, and high volumes of pedestrians generally: (1) deter drivers from entering the area, (2) cause drivers to hesitate, and feel that they are intruding on a pedestrian area, (3) effectively confer a pedestrian priority and claim to the space, and (4) cause drivers who enter the area to drive slowly.[48]

An elevated pedestrian network in Bangkok, linked to Sky train stations, shields pedestrians from traffic. The walkway has been built along the Skytrain alignment, underneath the elevated Skytrain structure. This further entrenches a trend in Bangkok to link Skytrain stations to nearby buildings - especially shopping centres, which are charged a fee by the Skytrain operators. This benefits both Skytrain passengers as well as pedestrians wishing to cross the road and enter the building.

In Thailand, the Asian Institute of Technology and Thamassat University widely use bicycles as the primary means of transportation within their campuses. Separate parking spaces are allotted for the two wheelers. Bangkok has plans of holding a “car-free day,” similar to what is being practiced in cities such as Bogotá, Colombia in Latin America.[49] On a smaller scale, motor vehicles are banned from the academic oval to make way for joggers and bikers during weekends at University of the Philippines, Diliman campus

5.3 Appropriate policy and design interventions required to encourage NMT use in Asian cities.

Many Asian cities often reserve 15-20% of total space for transport infrastructure. But the space is often utilized inefficiently for the movement of vehicles rather than people. The available road design guidelines are often ambiguous, with little or no priority given for pedestrians and cyclists; and where guidelines do set aside space for pedestrians and cyclists, these guidelines are often not enforced. There is an urgent need for appropriate policy and design interventions to encourage NMT use in Asian cities. Any NMT improvement policy, strategy and project should be fundamentally built upon the following characteristics - density, diversity, design which includes safety, coherence, directness, attractiveness and comfort and destination accessibility.

[48] Available at www.cleanairnet.org/psuta
[49] Available at www.cleanairnet.org/psuta

5.3.1 Infrastructure for pedestrians

The provision of continuous footpaths creating barrier-free access both at footpaths and intersections is important for enabling comfortable movement of pedestrians on roads (UTTIPEC 2010).While designing footpaths, it is necessary to understand that a walk space not only provides space for walking but also supports many street activities. In Indian cities footpaths must be well shaded with trees, and amenities like seating and standing areas for hawkers are provided. Footpaths should be wide enough to support existing and future demands, and be well lit, safe and secure to walk on. They should be free from both obstructions and barriers hampering the free movement of pedestrians. A footpath must be appropriately separated from motorised vehicle traffic using kerbstone and buffer zone, in order to avoid pedestrian accidents. Since the physical distance of pedestrians is an important aspect, the provision of Foot Over Bridge and subways leads to detours and increased distance. Thus, for pedestrians, both at intersections and mid-block, it is required to provide at-grade raised/level crossings with pedestrian accentuated signals. Wherever there is an important point of interest or activity and the intersection crossing is farther, midblock crossing is provided. Also, it is necessary that at intersections the footpaths meet the marked pedestrian crossing to provide continuous movement of pedestrians. At entry points for both properties and intersections, it is required to provide traffic-calming measures like stop line or speed breakers for motorized vehicles. A complete walkway system is essential for providing access to PT systems. PT stops must be clearly marked and highlighted, and accessible to all including the physically disabled. Placement of bus stops, with respect to intersections, also plays an important role in determining the safety and comfort level of pedestrians accessing it.

5.3.2 Design of NMT infrastructure

Bicyclists require a complete network, which may consist of bicycle tracks (physically segregated from motorised traffic), bicycle lanes (painted segregation on lower speed roads), and mixed facilities where speeds can be kept below 30 km/hr by traffic-calming measures. The type of segregation depends on the speed of motorised vehicles. In Indian cities bicycle lanes also need to allow movement of cycle rickshaws. Accordingly, the width of the lane/track must be at least 2.5m. Socially safe, lively and well-lit routes are preferred for riding. Routes across parks and leisure routes can further attract ridership of recreational bicyclists. Other facilities for cyclists can also be provided, especially in Indian cities that include bicycle repair shops, kiosks for drinking water and space for street vendors along the bicycle routes. Both for cyclists and pedestrians it is preferable that the cycle/pedestrian lanes are shaded to cope up with the summer heat.

5.3.3 Policy recommendations

Diagnosis of the city yields sufficient information to develop targeted NMT policies, strategies and projects. Such NMT policies, strategies and projects should build upon the existing national sustainable transport policy and state/region level directives and strategies. Entrusting responsibility of pedestrians and cyclists to dedicated institutions to safeguard their interest, provide adequate facilities and coordinate with various agencies can create a significant change in the entire transport system. It will also create a healthy communication mechanism between the dedicated institutions and NMT users thus creating transparency in the transport sector decision making. Surveys done for data collection at the city level need to account for all trips, including walking, bicycling and cycle rickshaws. Also, reporting needs to be done for access and egress trips made to use public transportation in a city. Safety data needs to be collected appropriately by the relevant authority, accounting for victims as type of user affected during accidents. Investments made for improving NMT infrastructure in cities needs to be accounted separately in annual city budgets, and the needs of NMT users should be considered in all

transport infrastructure improvement projects. Transport plans should integrate improvements of NMT infrastructures along with the public transport system of a city.

5.4 Best practices of NMT in Europe and Asia

Given below are some of the case studies. In addition, a set of best practice case studies from cities in Asia and Europe and other countries are given in Annexure B.

5.4.1 EcoBici Bike Sharing Scheme: A case study of Mexico City.

Mobility in Mexico City is one of the most challenging and important urban environmental challenges. Mexico City, with more than 9 million people and more than five million vehicles, is one of the most congested cities in the world. In Mexico City, 45% of the trips are made by public transport, 32% are made by walking, 20% are made by private car and only 2% are made by bicycles. To lessen the impact of a high population density coupled with the harmful effects of air pollution on the streets, the city government decided to promote cycling as an alternative to the use of motorized vehicles.

EcoBici (Eco-bike) bike sharing programme was launched by Mexico City Government (Department of Environmental Protection) in 2010 to increase cycling while simultaneously reducing traffic congestion and transport related greenhouse gas emissions within the city. The total capital cost incurred was $13.4 million USD, with Mexican Government's initial investment of $39, 35,787 USD (75 million Mexican Peso). Now, 80% of the operations are paid from the public budget while 20% is incurred from the user fee.

The creation of EcoBici is one of the pieces in the puzzle of transforming urban mobility in the city and it represents a significant growth in the technical, institutional, political and cultural domain. The system was conceived as a complement to public transport that would provide a practical solution. Today, EcoBici, after going through a complex planning and management process, has been embraced as a successful mobility alternative.

Since the programme's introduction in 2010, user demand has grown rapidly in tandem with an extension of bike and bike station infrastructure, which is currently spanning over an area of about 35km². The programme started with about 84 bike stations and 1,200 bikes. Now under this initiative, bike stations had increased to 444, hosting more than 6,000 bikes, which is used by over 100,000 commuters. Mexico City has also constructed about 300 km of new bike paths throughout the federal district.

However, despite the interest, implementation EcoBici scheme faced a host of barriers, which can be categorized as institutional, physical, and socio-cultural lock-in mechanisms that tend to maintain the status quo. Some of the lock in mechanisms are: a car is perceived as a status symbol, while bikes are associated with poverty, priority is given to cars in allocating streets and parking spaces, majority of city transport budget is dedicated towards motorized infrastructure rather than non-motorized infrastructure etc.

Key learnings

Several factors are seen as important in implementing a bike sharing system. Besides careful planning and integrating public participation in the project's implementation, affordability is extremely important. Affordability is crucial in Mexico City as the city has a high portion of "poor"

residents. The distribution of poor residents in Mexico City may be similar to many other emerging cities in the world, which makes this project potentially applicable to other cities. To implement a successful bike sharing project, it is also important to have the proper infrastructure such as bike paths or strategically placing the bike stations. The successes of EcoBici could inspire other cities to believe that a transition towards BSS is possible, including in emerging-economy mega-cities.

5.4.2 Bogota – Ciclo Ruta Network

Bogota came to be known in the planning world for its exceptional transformation from being an ill-governed and chaotic city to a model of visionary policies and progressive urban planning. While the city is primarily known for its model Bus Rapid Transit project under the leadership of Mr. Enrique Penalosa, Mayor, (1998-2001), interventions supporting non-motorised transport were initiated in the mid 90's and integrated with the Transit Planning.

The flagship "CicloRutas" program is one such successful initiative which provided impetus to rebrand and inaugurate a modern form of Ciclovia. CicloRutas refers to a network of now over 376 km of cycle ways, which were in large part built following construction of a few cycleway pilot projects in the late 1990s. The design and construction happened quickly, from 1998 to 2003, initially as a key project of then mayor Enrique Peñalosa. Much of the success in Bogota can be attributed to the continuity of the chain of policies that supported an improved urban environment across multiple political administrations from the mid 90's onwards. Reported figures vary, but stats reveal that the city's cycling mode share during the early period of network construction was 0.6%, but it had peaked at 4.4% by 2003.

Further confirming the importance of proximity to a cycling network as a factor that encourages more cycling, a study by Cervero et al (2004) specifically conducted in Bogotá reports an association between proximity to a CicloRuta cycleway and use of the cycleway at least once per month, while also reporting that high traffic volumes in Bogotá are shown to impede utilitarian cycling. The fact that the project was initiated in the absence of either a land use or mobility master plan is a clear indication of the level of influence a political administration has in building exemplary models to enhance liveability.

Key learnings

The case of Bogota illustrates the importance of consistent policies and committed leadership. The CicloRutas, which in some ways traded off cycle path quality for network coverage in order to quickly implement a connected set of cycle ways, inspired similar NMT networks in many other big cities internationally. This is an important lesson for Indian cities, especially where new public transit corridors are coming up. An integrated NMT network widens the scope and reach of public transportation, thus increasing the attractiveness of public transit. It is also worth

noting that the design quality of the CicloRuta cycle ways and adjoining pedestrian paths is mostly consistent, even while the quality of vehicular roadways is inconsistent.

5.4.3 Non-motorized transport in Copenhagen.

Copenhagen is home to nearly 600,000 inhabitants. The Scandinavian city serves as the country's political and economic hub, and has set ambitious goals to become the first carbon-neutral capital in the world by 2025. The bicycle has been a mode of transport in Copenhagen since the early 1900s and was highly popular until the 1960s.

Beginning in the mid-1960s, eminent urban designer Jan Gehl studied public life in detail, examining the conditions, patterns and rhythms of life in the city center of Copenhagen. Gehl's findings and the pragmatic solutions he devised to improve livability proved to be a significant influence on government authorities and city planners and provided a fresh perspective on urban design.

The new policies supported the development of bicycles as a viable mode of transport and included a gradual removal of car parking space in the city centre by 2-3% a year, increasing the cost of parking as well as restricting parking to only residents. Roads were gradually narrowed down to create space for more bicycle lanes, and car purchases were heavily taxed at 180%.

Yet despite its considerable cycling culture and remarkable policy changes, thoroughfares such as the Nørrebrogade road were heavily congested with traffic from private vehicles. As of 2008, the two-kilometer Nørrebrogade road, which connects the center of Copenhagen to its suburban periphery, was used by an average of 30,345 cyclists, 15,120 cars, 30,000 bus passengers and 6,525 pedestrians per day. Additionally, the limited sidewalk space had negative economic and social effects, as the lack of pedestrian space was not favorable for residents and tourists.

In 2006, to address these challenges, Copenhagen initiated the development of the Nørrebrogade Plan as part of its "Eco-Metropolis" program. In 2007, the Technical and Environmental Administration, which is comprised of the departments for Building, Urban Design, Traffic, Cleaning, Parks and Nature, Urban Development, and the City of Copenhagen's Business Services division, determined the following goals for the Nørrebrogade Plan:

1. Increasing the attractiveness of urban space to improve urban quality of life.
2. Improving cycling conditions on congested sections of the road.
3. Strengthening public transportation by reducing journey times and improving the punctuality of services.

Using these goals for guidance, the City developed a Master Plan for Nørrebrogade: reducing private vehicle use by 50 percent and promoting Nørrebrogade as a shopping street and an arterial roadway for non-motorized transportation.

The first phase of the Nørrebrogade project elicited inspiring results, including:

An increase in public transportation efficiency and ridership. Bus travel time decreased by an average of 10 percent and bus services improved their punctuality. Reduced automobile use and improved commuter safety. The car traffic was reduced by 45 percent. This decreased the ambient noise level by 50 percent, and also limited the CO2 emissions produced by private car use. The total number of cyclists increased. The combination of new bicycle parking areas, along with improved safety and less private vehicle traffic resulted in a 10 percent boost in bicycle ridership.

Key learnings

Several factors are important for implementation of a NMT project. A project monitoring group should be created across various departments. The Traffic Department to conduct counts of car

and cycling traffic, number of pedestrians and time spent in the city center. Opinion polls and provides us with a variety of opportunities for public participation and input, including from residents, local businesses, cyclists, and local stakeholder committees and associations, in order to assess the success of the pilot initiatives.

5.4.4 Implementation of sustainable transportation in Seoul: Cheonggyecheon Case Study

The South Korean capital of Seoul underwent rapid economic development since the 1960s with car ownership rising in tandem with income growth in the 1970s and 1980s. With the recognition of the need for more mobility options, the first subway line was introduced in 1974; it was further expanded in the 1990s and early 2000s.

In the 1940s, the Cheonggyecheon River had deteriorated into an open sewer and was thus paved over with concrete for sanitation reasons. Thirty years later, an elevated freeway was built overtop the channelized river, further removing it from the public. Like many of the world's underpasses, the area beneath the freeway was mostly avoided by the public, which increased congestion.

At the turn of the millennium however, then Mayor, Lee Myung-Bak successfully campaigned on a promise to remove the freeway and restore the Cheonggyecheon. From 2002 to 2005, the Seoul Metropolitan Government decided to dismantle the 10-lane roadway and the 4-lane elevated highway that carried over 170,000 vehicles daily along the Cheonggyecheon stream. The transformed street encourages transit use over private car use, and more environmentally sustainable, pedestrian oriented public space. The project contributed to a 15.1% increase in bus ridership and a 3.3% increase in subway ridership between 2003 and 2008. The project initially faced public concerns on an intensification of traffic due to the removal of the highway. However, the opposite proved to be true. To alleviate fears of traffic congestion, the government also invested heavily in public transportation, such as a dedicated bus lane increased subway capacity, raised parking charges, campaigns for reduced car usage, and downtown shuttle buses. Significant efforts were made by the authorities to engage and involve the local communities in the planning of the project represents a concerted effort by the government to reduce the city's reliance on cars and enhance liveability. The total cost of the project was $360 million. The social sustainability as a result was improved through an increase in quality of life: citizens now have green public spaces where they can interact as equals, exercise, participate in traditional festivals and enjoy cultural events.With the success of this project in regards to sustainable transport, Seoul aims to double its sidewalks in downtown areas by reclaiming road space, enhancing road safety by setting a 30km/h speed limit in residential areas and increasing the combined take-up of public transport, walking, cycling, and green vehicles to 80% by 2030.

Key Learnings

Innovative governance and interagency coordination are critical to the process of implementing NMT in any city. Public engagement, with residents, local merchants, and entrepreneurs and reducing travel-lane capacity resulted in a decrease in vehicle traffic.

Evaluation

There was a 76% increase in pedestrian activity and 4.5% reduction in the urban heat island effect. After the successful implementation of the project, there was 45% reduction in vehicular volume and 10.3% reduction in country's air pollution.

5.4.5 Delft, The Netherlands - Cycle network

In the late 1970s, the first National Traffic and Transport Structure Scheme and the following Programme for Personal Transport (1980-84) gave high priority to the encouragement of bicycle use and the improvement of traffic safety by providing better facilities for cyclists. Within this policy strategy, the municipality of Deft was selected as a model city for probicycle traffic planning. Delft was the first Dutch city to have developed and implemented a bicycle (and pedestrian) network in accordance with an officially adopted Bicycle Plan.

The Delft Bicycle Plan, launched in 1979, was aimed at developing a coherent bicycle network that would (1) incorporate existing bicycle routes, and (2) propose additional projects to close the gaps in the existing network. The Plan defined a hierarchical network with three sub-networks: an urban network, a district network, and a neighbourhood network. Each network was envisioned with its own characteristics. The urban network designed as a subset of the plan includes high capacity bicycle routes for inter-district travel, and connects important destinations such as the train station, library, and main shopping centre. The urban network would connect cyclists to the regional cycle network. The approximate distance between these routes would be 400 – 600 m. The Plantageburg was one of the expensive projects carried out along a main urban network corridor. The district network works as a distributor or collector network. Placed every 200–300 m, the bicycle routes in the network would enable intra-district travel providing connections between the local neighbourhood routes with the urban routes. The Plan proposed less intrusive treatments for the district network, including creation of bicycle lanes, smaller bridges and improved intersection design. The neighbourhood network includes the fine grained network of local streets or paths which would provide access from residences to the district network.

Main focus of the plan was on the articulated network to have greater impact than the sum of the effects from individual measures. The Plan was a useful exercise in identifying gaps in the network and closing them. Another concept of woonerf originated in Delft in the 1960s and was made popular in the Netherlands in the 1970s. Woonerf is a Dutch word that means 'residential yard'. It refers to a residential street that is used cooperatively by all types of users without any segregation. The woonerf concept was used to de-emphasize the presence of vehicular traffic in the street system. The intent of this approach was not to make cars disappear, but rather to integrate them with other users of the street to create a shared space.

Key learnings

A major qualitative benefit was the improvement in the perception towards cycling. The case of Delft illustrates the three stages of NMT planning – creating the vision and master plan; implementing the specific recommendations, and finally evaluating and monitoring the impacts of the changes made. This process helps in identifying key issues and gaps, as well as in identifying successes, both of which become crucial in developing further plans. Such a process is extremely relevant from an Asian context, as it allows identification of issues, common or unique, as it helps in identifying smaller successes. NMT planning is still new in Asia except for some cities and such an iterative process will help pave the way for future plans to become more and more foolproof. The Delft master plan was based on the concept of completing the NMT network by filling in existing gaps. The emphasis was on effecting a greater impact through an

articulated network. This is an important lesson in the Indian context, especially when considering the impact of pilot projects.

5.4.6 Non-motorized transport: A case study of Pune city.

Pune is a flourishing green city of 5 million people in the western state of Maharashtra. In the lieu of sustainable transportation, Pune has devoted significant resources in making its streets people friendly. In 2009, under the JNNURM Mission city-modernization scheme, Pune began improving connectivity by creating a better network of roads equipped with infrastructure for non-motorized transport (NMT), such as footpaths and cycle tracks. The Pune Municipal Corporation (PMC) created a proposal for a pilot public bicycle scheme, which was to be developed on the DBOOT (Design, Build, Own, Operate and Transfer) model. As part of the scheme, the agency was going to provide 300 cycles, which would be made available at 25 cycle stations.

Figure 5.1 and 5.2: Cycle track (Left); Footpaths merged with shop frontage in DP Road (Right)

In 2016, Pune was selected as one of 20 "Lighthouse Cities" under the nationwide urban renewal program, the Smart Cities Mission. Under smart cities mission safety of non-motorized stakeholders is ensured. By redesigning 27 km of streets with RoW > 18 m, it was ensured that adequate footpath space and demarcated bicycle lanes are present. The streets have demarcated zones: for commercial activities, pedestrians, bicycles and vehicles, so that a sustainable mobile ecosystem is created. Another key objective of the Smart Cities mission was to engage the community in the urban renewal process at all stages. Most importantly, the Pune Municipal Corporation (PMC) , with technical assistance from ITDP, has developed a unique set of Urban Street Design Guidelines that prioritize walking and cycling, leaving no doubt of Pune's direction of development. ITDP is assisting PMC by reviewing proposed guidelines and ensuring adherence with best practices. PMC has initiated Pune Streets Programme to make Pune a model city for complete streets and under this program, a street network of 100 kilometers has been identified for redesign. ITDP India's assistance, empaneled four nationally acclaimed design firms and allocated each 25 kilometers from the network. The first phase of construction has begun with Jangli Maharaj Road, a busy 1.5 km-Long Street being redesigned by Oasis Designs, Inc. A 300-meter stretch along this street now sports a cycle track and a much wider footpath, made possible by streamlining the old haphazard parking. Green spaces serve as buffers to segregate the two modes of walking and cycling. The proposed budget for planning and redesigning of footpaths and cycle tracks across the city for the time period (2016-2020) is Rs. 525 crore.

Key learnings

Traffic signals on adjacent roads need to be aligned and signals needs to be clearer. There should be a designated mechanism to spread the word to a large number of citizens so all are informed in time. In the lieu of sustainable transportation, Chennai is keen on expanding its complete streets into a network and setting up a BRT system, learning from Pune's journey so far. The future of this journey looks bright and green for all of India, having already transformed people's lives for the better in Pune, with a promise of more across the whole country.

5.4.7 Car-Free movement and Ecocabs in Fazilka and Vizag

Cycle rickshaws have always been the primary mode of transport in Fazilka but service levels were poor: rickshaw drivers frequently overcharged and maintenance was variable. In June 2008, social activist Navdeep Asija introduced Ecocabs as a social enterprise dedicated to improve their service levels by organizing rickshaw drivers in a self-regulated scheme. An additional rationale was to promote non-motorised transport to reduce growth in pollution. Within three years, Eco Cabs won the Indian government's Rs 500,000-award for the Best Urban Non-Motorised Transport model in the country. Concept of Ecocabs is now working successfully in 22 cities of Punjab. Car free movement Fazilka implemented a pilot project in 2006, through one week long "Fazilka Heritage Festival". The initiative was a part of case study conducted by Graduates Welfare Association Fazilka (GWAF) by pedestrianizing a stretch of 300 meters, not far from the current car free zone.

Source: www.ecocabes.org

The study revealed that, this experiment had not just improved the quality of social life but also improved the law and order, environment through less air pollution emitted, economy and road safety of the residents. Influenced the pilot project, many activities were planned to promote non-motorised transport within the city. The main market area around the Ghanta Ghar or clock tower was closed for cars between 10 am when most of the shops are open to 7 pm till shops close. Entry is restricted for two-wheelers but the town plans to ban them gradually. The City constructed the car free areas by placing special emphasis on traffic calming devices, installing permanent barriers and positioning police for enforcing the car free zones at few locations. In addition to the alternative ways like Eco cabs enforcing and helping the city to be more sustainable, pedestrian and cycle friendly. Similarly, at the Beach Road in Vizag, a 3.50 km.stretch has been declared as Vehicle free zone since 1st November, 2011 from 5.30 to 7.30 a.m. Only pedestrian and cyclists were allowed in this space. Police officials play a very important role in enforcing the car free zone.

Key learnings

The success of Ecocabs demonstrates the need for investment in research and development of technologies in order to upgrade the quality of NMV-based transit services. The coverage area and positioning of stations is planned so as to serve maximum trips. The use of technologies, such as dial-a-rickshaw service, a web portal and an android app has encouraged more people to use the service. Community participation in operating and managing the call centres was successful in creating ownership and awareness. The additional benefits extended to the rickshaw pullers and to their families and facilitated the use of non-motorised transport. Ecocabs associated with BSNL as telecom partner to provide free pre-paid mobile connections with life time validity to the rickshaw pullers through which they can talk to each other for no cost. The project was implemented in phases and with each phase the scheme was improved and expanded.

5.4.8 Public bike sharing system: A case study of Hyderabad.

Hyderabad is the second largest city in India in terms of area with a population of 8.75 million (Census 2011). It struggles with high levels of air pollution and congestion, caused mainly by local motorized traffic. An average of 100 bicycles, including e-bikes, are placed at each metro

station – customers are able to use the bicycles using swipe-card technology. The e-bikes are charged with solar power, the first of its kind in India. The whole project is eco-friendly and aimed at considerably reducing the vehicular pollution, GHG emissions and congestion presently threatening Hyderabad.

Last-mile connectivity to Hyderabad Metro through bicycles is a unique opportunity to demonstrate a new model for urban commuting for the following reasons: Substantially improve the urban air quality by reducing the vehicular pollution and CO2 emissions; Promote active mobility through bicycles – health benefits for the population Reduce the overall commute time; Reduce the traffic congestion on the roads Reduce reliance on fossil-fuels by providing an alternative to motorized transport; Solar-powered charging for electric bicycles will reduce carbon intensity of the electricity used for charging the bicycles Reduce the carbon footprint of each commuter.

A MoU has been signed between the Hyderabad Bicycling Club, Hyderabad Metro Rail Limited and the United Nations Human Settlements Programme to setup solar charged bike stations to provide last mile connectivity to Hyderabad metro rail project. This initiative will provide last-mile connectivity to the Hyderabad Metro with bicycles. HBC already operates two bicycle stations with a total of 600 bicycles in partnership with the City Municipal Corporation. The project will set up 300 bike stations at metro stations in Hyderabad and in total HBC plans to construct nearly 100 bicycle stations with a total inventory of 10000 bikes in 63 metro stations along with feeder stations in 200 different residential and commercial clusters. The length of the Hyderabad Metro Rail (HMR) currently under construction is 72km – creating a high-density commuter service corridor served by 63 metro stations. The total project cost is US$ 2.25 billion. HBC and HMR already work closely together to promote cycling and with this MOU, they commit to work together to provide last mile connectivity to the Hyderabad Metro passengers by creating the required infrastructure of bike stations and e-bikes in all the upcoming 63 metro stations.

This project is presently in its implementation phase with HBC setting up 5 bike stations in Hitec city area in March 2017 as a curtain raiser for this project, so the potential for scaling up is not yet known. However, the feasibility study and DPR are in progress and model/demo bike stations were commissioned in October, 2016. This project has been inspired by the tremendous growth in bicycle share schemes globally from a handful of bike share schemes to over 500 schemes in cities around the world. Bikes and bike-sharing have a huge potential to shift behavior and transport mode choice towards active mobility by providing last-mile connectivity to public transportation hubs or other modes of transportation.

Figure 5.3 Demo station at Nagole Metro Station in Hyderabad.

5.4.9 Public Bicycle Sharing Scheme: A case study of Delhi Metro Rail Corporation

The Delhi Metro Rail Corporation has launched a Public Bicycle Sharing (PBS) scheme at selected metro stations to promote the use of non-motorized transport for sustainable transportation across the city. This initiative was launched with an objective to provide last mile connectivity to the commuters with added benefits of decongestion, pollution control, physical fitness and non-dependence on private transport. In supply chain management, it usually refers to getting people from a transportation hub like a bus depot or a metro station to their final destination or vice versa. To make this experience more convenient, automation software has also been put in place as per which, the bicycle users will be able to use bicycles at multiple destinations with the help of a rechargeable smart card. The cycle rental facility is provided only after thorough verification of the commuters. Interested commuters can collect a form, from all cycle shelters or can download from: www.greenolution.in and the charge for using the cycle facility is Rs.10/- per hour of part thereof. The Delhi Metro Rail Corporation has engaged 3 private actors to operate these bicycle stands.

Launched in 2015, the bicycle sharing facility is available only at 3 metro stations while bicycle renting facility is available at 14 metro stations across the city. The cycle rental schemes was first launched in 2006 at the Delhi University metro station and except for that it failed to attract users in other areas due to limited system coverage, unavailability of cycles, and poor quality equipment. The bicycle renting scheme has not picked up as expected and the possible reasons for this might be that a cycle rented from a station has to be returned to the same station, whereas in the bicycle sharing scheme, a user can pick up a cycle from on station and drop it off at another. Stations are only located adjacent to BRT/metro stations but not in adjoining areas. Often, the station attendants deny access to cycles because they are held personally responsible if a user steals a cycle as no technology is used to track status of users and bicycles.

An audit conducted by Samarthyam (an NGO) revealed that the track meant for cycles was being used for car-parking comfortably. But cycles could not use these tracks as the tracks were poorly designed. MCD engineers and traffic police not involved in construction of these tracks said that they were not aware that the track constructed was for cycles. MCD engineers were also not aware of the UTTIPEC or IRC design standards for footpaths & cycle tracks. In Delhi, 35% people do own cycles, but only 4% of the trips are by cycle because it is felt that it is unsafe and dangerous to use them. It is essential that new cycle sharing systems in Delhi make use of the lessons learnt from these rental schemes. Under the cycle sharing scheme, there are only 155 cycles in use with 792 registered commuters. Learning from the drawbacks of the cycle renting scheme, there is RFID based tracking of cycles and users in the cycle sharing system. Moving forward, a number of agencies have begun efforts to plan for cycle sharing systems in the city. The Unified Traffic and Transportation Infrastructure (Planning & Engineering) Centre (UTTIPEC) has prepared and adopted a cycle sharing policy, and local-area cycle sharing plans have been developed. SmartBike, India's largest and fastest public bicycle sharing company has won exclusive public bike sharing mandates to set up 50 bike stations in New Delhi and 500 bike stations in Chennai.

Key learnings

The case demonstrates that to achieve better results, planners should retrofit/redesign existing stretches to provide continuous tracks. The cycle tracks should be clearly demarcated and separate from carriageway. They should be free of encroachments such as utilities, parking, pedestrian and street vendors. The cycle tracks should have smooth surface material, sufficient shade from trees, and a clear buffer of 0.5 m between the track and carriageway. To ensure smooth and unobstructed flow of cyclists, street vending activities, parking and utilities such as drain covers shall be placed in the furniture/ buffer zones of the footpath. On streets that are too narrow for separate cycle tracks, traffic calming measures should be introduced. NMT networks should be expanded to cover the entire city to provide a safe, convenient, and attractive.

Chapter 6
Conclusions and Recommendations

Functioning transportation networks are a key element for cities and towns across the globe and are a precondition for economic activity and social participation. In addition to its importance as an urban service in terms of moving people and goods, the transport infrastructure and service sector itself is a significant generator of wealth and employment. However, the economic and social benefits of urban transport are frequently accompanied by negative side effects such as congestion, social exclusion, accidents, air pollution and energy consumption. Since the mid-20th century, the negative side-effects of urban transportation have become particularly apparent in the metropolitan areas of developed countries. Rising car traffic volumes are increasingly causing loss of economic productivity, environmental degradation and affect overall quality of life in cities. In developing countries, rapid urbanization and motorization in combination with insufficient investment in infrastructure have led to similar problems, often exacerbated by urban poverty and social exclusion. In the face of a rising global population, continuing urbanization and the emergence of megacities, there is heightened urgency to apply solutions in the urban transport sector that contribute to sustainable urban development and to provide a comprehensive response to the issue of global warming[50].

As the United Nations agency, UNCRD promotes policies and models to achieve sustainable urban transportation systems across the Asia-Pacific region. Urban transport policy all over the world has to substantially contribute to solutions addressing global warming. The central task is to encourage transport policies and investments that contribute to improved urban productivity, living and working conditions for urban residents by catering for their mobility needs in an economically efficient, environmentally sustainable and socially inclusive manner. To work towards sustainable urban transport systems, five key thematic areas can be identified (i) Linking transportation to urban planning to reduce motorized trips, (ii) Non- motorized transport infrastructure, (iii) Public transport systems (iv) Car traffic demand management – moderating the car use and (v) Vehicle and fuel technologies and efficiency.

6.1 Effective strategies for sustainable urban transport - Policy options for National and Local Governments

The world currently experiences a variance in urban growth. In the North, almost half of the cities have been declining in population size. The South, however, faces a situation where almost half of the cities are growing very fast. More precisely, cities in the developing world grow ten times faster than cities in the North. Parallel to this urbanization process, motorized transport is growing rapidly in the developing countries resulting in a huge demand for oil and fossil energy. Here, low-income residents are excluded from access to high quality, safe and healthy urban transport options. Traffic congestion in urban areas leads to increased fuel consumption and loss of productive time. The road safety situation in many cities is currently a more serious issue than crime. Working towards sustainable urban mobility UNCRD focuses on five key areas of intervention: linking transportation to urban planning to reduce motorized trips, promoting non-motorized transport infrastructure, promoting public transport systems and services, car traffic demand management/parking and vehicle and fuel technologies and efficiency. In the face of rising motorization, models for sustainable transport in developed and developing countries will

[50] People and Mobility: Promoting non-motorised transport options and compact cities as complements to public transport

only be successful if they surpass the mainstream by providing higher quality of life, energy savings and economic efficiency and opportunities.

Box 6.1: ADB's strategy to address five emerging urban transport trends and challenges:

1. control urbanization and motorization through holistic approaches to urban land use, public transport, and non-motorized transport infrastructures, such as pedestrian zones, walkways, and cycle paths;
2. mitigate climate change through the "avoid-shift-improve" approach and clean energy, including improving energy efficiency and the developing renewable energy supplies;
3. promote intraregional cooperation and integration by expanding regional road networks and competitive regional railway networks as economies are becoming more closely intertwined with each other and the rest of the world;
4. improve road safety and mitigate emerging social issues, including HIV/AIDS and human trafficking risks, by effectively addressing the social dimensions of transport (among the member countries of the ASEAN alone, road accidents are estimated to cost $15 billion each year); and
5. use financing mechanisms and partnerships more effectively, including various ADB financial instruments. Further, ADB estimates that an integrated Asia and Pacific region, connected by world-class environmentally friendly infrastructure, will generate $13 trillion in increased income for Asia over the next ten years and through its Sustainable Transport Initiative, ADB will continue to assist in bringing about changes towards creating a more sustainable transport pathway in the coming decade.

Source: Chair's Summary-Fifth Regional EST Forum, 2015, Nepal

Many cities in India and other Asian countries are currently investing a considerable amount of resources into road-related projects. These projects serve mainly the personal automobile user, while disadvantaging the non-motorized user. Creation of safe non-motorized routes for bicycling and walking require a multi-pronged strategy

Non-motorized transport (NMT) is environment and health friendly and encouraging its use would be necessary to achieve the goals set by the Bangkok 2020 Declaration. The concerns of NMT regarding safety and receiving due share need to be addressed by segregating its right of way, coupled with supporting infrastructure such as safe and dedicated parking places. Priority needs to be given to the construction of footpaths and cycle tracks as part of the design and construction of roads. There is a need to protect NMT infrastructures against encroachment through strict enforcement and community participation measure.

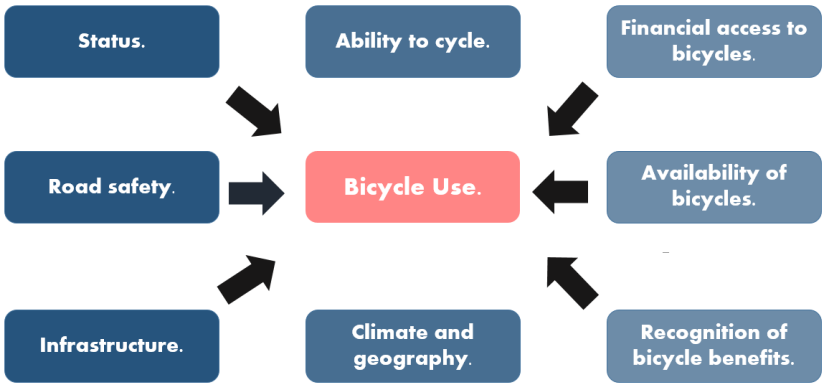
6.2 Key areas of intervention for the promotion of non-motorized transport infrastructure[51].

The promotion of bicycle use consists of a complex set of parameters, including technical know-how of planners, behavior of road users, infrastructure, etc. Unfortunately, in Asia the issue of the status of bicycle users is an additional component affecting the use of bicycles. Bicycles are

[51] People and Mobility
Promoting non-motorised transport options and
compact cities as complements to public transport

often referred to as the 'poor man's' mode of transport. Successful campaigning for bicycle use has to include all aspects indicated in Figure 13.

Figure 6.1: Factors affecting bicycle use



Source: Cycling out of Poverty

6.2.1 Infrastructure

Well-trained planners in the field of bicycle infrastructure designs are of crucial importance. City planners in Asia have been trained to plan and design cities for cars, hardly taking non-motorized transport into consideration.

6.2.2 Recognition of benefits of bicycles

Detailed information on the benefits of non-motorized transport is limited, making research in this field important. Furthermore, awareness creation seems crucial to gain recognition of the benefits of cycling. It is generally felt that people tend to stick to car use since they are not aware of alternatives. The campaign message that needs to be carried on should not be anti-car, but rather pro- cycling and pro other non-motorized transport means. Manchester can serve as a best practice for a behavior change, where the attitude of road users and planners shifted from pro-car to pro-non-motorized transport.

6.2.3 Road safety

Capacity building and education of road users in regard to road safety is essential, especially with regards to bicycle use.

6.2.4 Status

In many countries of Asia, NMT still has only modest priority. The enabling environment for NMT is missing. For achieving sustainable development, there is a need to pursue an integrated approach that includes, among other things, land-use planning as well as planning of non-motorized and public transport options in both urban and rural areas,

Strategies to Shift towards more sustainable modes require Non-Motorized Transport (NMT) components in transport master plans and also improve public transport services.

'Bangkok 2020 Declaration adopted at the Fifth Regional EST in 2010 was one of the first regional efforts to address a number of goals around the Avoid-Shift-Improve approach. The Bangkok 2020 Declaration on EST, based on the Avoid–Shift–Improve paradigm, is an important step in achieving global sustainable development because it defined strategies for achieving transport sustainability. There is a need for institutional coordination at the national level to allow strategic consideration of how the delivery of the outcomes proposed in the Bangkok Declaration fits in with the contribution to the various global agreements.

'To meet Bangkok 2020 declaration targets, additional financing, capacity building, and technology sharing are needed to moving forward and strengthening rural-urban linkages. Tremendous progress has been made by all reporting countries in nearly all of the 20 goals of the Bangkok 2020 Declaration, which has proven a useful framework for the systematic review of sustainable transport efforts of EST member countries. While each member country is moving forward with various plans and strategies, common challenges to further progress have remained an issue, notably in terms of the lack of finance and resource support, and the need for capacity building. Bangkok 2020 goals have been important for Mongolia as guidance to achieve SDGs up to 2030. In Singapore, most actions proposed under the Bangkok 2020 Declaration are either under progress or largely in place. The 2013 Singapore Land Transport Master Plan combines multiple EST elements with the primary objective to develop public transport as a choice mode. The 2015 public transport mode share in peak hours was 66% and is targeted to increase to 70% by 2020. The National Cycling Plan has targeted construction of 700 km of off-road cycling paths to be implemented island-wide by 2030. The Bangkok 2020 Declaration is recognized to have been prescient in its systematic approach to sustainable transport in Asia. However, there is a limited progress among Asian countries in pursuing the goal 4 relating to NMT'[52]. (Annexure-I gives the progress in various countries of Asia)

Most countries are implementing NMT policies and programs with EST Forum support and encouragement. For example, Indonesia is developing pedestrian and bicycle facilities in cities. Strategies to Shift towards more sustainable modes (Goal 4)[53] require Non-Motorized Transport (NMT) components in transport master plans in all major cities and prioritize transport infrastructure investments to NMT, including wide-scale improvements to pedestrian and bicycle facilities, development of facilities for intermodal connectivity, and adoption of complete street design standards, wherever feasible.

The image of bicycle use in Asia needs to be improved urgently. Cycling should not be looked down upon as an activity only conducted because limited financial resources do not allow the use of public or private transport means. In China the negative image of bicycling (the use of bicycles is associated with poverty) has led to an increase of cars (owning a car means wealth). Bringing the people (especially the wealthier people) back to cycling is very challenging. Non-motorized transport and compact cities complementing public transport systems are essential components when planning for sustainable transport solutions. Most trips in Asian cities are still undertaken by non- motorized transport. Consequently, interventions in the transport sector should seek to maintain the modal share of non-motorized transport while improving quality and safety for pedestrians and cyclists. Successful initiatives improving the quality of non-motorized transport infrastructure are on the rise and case studies presented in chapter 5 provide insights in achievements accomplished so far. Nevertheless, awareness raising and lobbying for the benefits of implementing non-motorized transport design needs to continue.

There is a need for a strategy to motivate public transport stakeholders to attend to non-motorized transport interests and recognize the added value of combining the two. It is necessary for the non-motorized transport lobby and advocacy groups to make efforts to create a bigger interest among policy makers and public transport officials. It is time to "join hands" to lobby for non-motorized transport to create a more sustainable mobility path. Lobbying with policy makers needs to continue while statements placed on NMT benefits need to be enforced by accurate research material and statistics. Furthermore, the involvement of civil society organizations in

[52] Address by Ms. Chikako Takase, Director, United Nations Centre for Regional Development (UNCRD) at the Tenth Regional EST in Lao PDR

[53] Bangkok Declaration 2020

campaigning for an increased use of bicycles needs to continue and increase. These organizations should forward their knowledge and experiences regarding non-motorized transport.

Walking and cycling are not only highly effective and convenient forms of mobility, but also encompass a wide spectrum of benefits for all stakeholders in the city. These benefits range from health and livability benefits to economic and environmental contributions. The affordability of walking and cycling also makes it highly inclusive and accessible to all sectors of society. With adequate investment and good design, cycling and walking can provide attractive mobility options for all.

A strategy to improve the quality and safety of walking could include new pedestrian links to create a network of convenient routes; better footways (paving, landscaping, lighting, street furniture); streets and public areas that create interest for pedestrians (building frontages, signs, and advertisements scaled for the pedestrian rather than the vehicle); priority for pedestrians on residential and local streets and central areas; better crossing facilities, including reduced speed and volume of traffic and increased crossing pedestrians[54].

Cycling has several benefits to the individual, to the environment, and to cities and can be a major contributor to making urbanization sustainable in our cities. After walk, cycle is the second most accessible mode of transport for urban poor. Urban middle class and rich are discouraged from cycling because it is perceived as being uncomfortable, dangerous, and low in status. Non-motorised transport (NMT) has been a neglected subject in terms of transport investment and planning. Walking will reduce people's health complaints, such as obesity and heart disease. Fewer vehicles on the road will also reduce traffic accidents and people's exposure to toxic air pollutant and traffic noise at the roadside. Innovative behaviour change campaigns can encourage people to favor non-motorised transport over motorised transport. A new "WALK" campaign was launched at the Integrated Conference that aims to nudge people to drive less and walk more; it involves the dissemination of signs that remind people of the benefits of walking. Ninth Regional Environmentally Sustainable Transport (EST) Forum in Asia also recommended for prioritizing public and non-motorized transport and encouraging use of public transport and Non-Motorised Transport (NMT) modes and improve quality of public transport and NMT infrastructure, such as walkways and bicycle tracks, in order to reduce dependency on private transport modes.

However, making piecemeal improvements to the walkways or cycle ways is not good enough. Transport planners have to take a holistic approach to taking care of issues such as safety, security, priority, accessibility, comfort and enforcement to improve walkability of a city. The long term, transit and non-motorised transport development could be less costly to build and maintain than conventional personal car-oriented development patterns[55].

6.3 Cycling should be encouraged because:

- **Reach and effectiveness of Public Transport can be improved:** Since cycling as a feeder mode can be 3 to 4 times faster than walking, the catchment area of public transport stops thus can become 9 to 16 times larger. By smart planning one can build an integrated cycling and public transport system.

[54] People and Mobility: Promoting non-motorized transport options and compact cities as complements to public transport

[55] Chair's Summary: Eighth Regional Environmentally Sustainable Transport (EST) Forum in Asia.

- **Cycling can counter congestion:** In urban conditions, bicycles use between a third to fifth of the space occupied by a motor-car; Attractive cycling conditions will help to moderate people's aspirations to own and use a private car and current car owners may be tempted to substitute a part of their trips by bicycles.

- **Cycling can improve road safety:** Arguably, cyclists are vulnerable road users. But enhancing the cycling conditions, including taking measures to mitigate the number and speed of motor vehicles and to reduce risk at intersections, combined with a substantial increase of bicycle use will improve cyclists' road safety. 'Cycling promotion' and 'improving road safety' can result in a self-reinforcing interaction of these two policies; the so-called 'safety by numbers' effect.

- **Cycling can make cities more attractive.** Cycling is often a preferred mode to enjoy the city, especially by tourists. The slower pace than motor vehicles and ease with which one can stop and start allows people to enjoy various facets of the city. The promotion of cycling can help in a paradigm shift from motor-vehicle oriented to people-oriented transport planning.

- **Cycling contributes to improving air quality and mitigating climate change:** Motorized trips contribute substantially to air quality problems (like SO2, NOx, PM) and the climate problem (CO2). Higher use of bicycles will result in reduced pollution and climate change, thereby providing better living environment for all.

- **Noise reduction.** Motorized transport is also the cause of the noisy environment in large parts of our cities and it remains worthwhile to try and prevent this problem by promoting the use of non-motorized modes of transport like cycling, and measures to discourage and restrict car use in sensitive urban areas.

- Improved physical health. One of the (many) downsides of motorized transport is its enhancement of a sedentary lifestyle. Cycling commuters have (on average) a substantial better physical health than commuters using other modes[56].

6.4 Barriers to NMT - The key challenges in promoting walking and cycling[57].

In the late 20th century, roads and motorized transport were closely and conventionally associated with the notion of development. This priority permeates policy and infrastructural design, reinforcing mindsets and defining culture. Effectively, consideration of other mobility options had been often overlooked.

The various challenges for non-motorized transport are embedded in the current transport paradigm which creates urban environments that often prioritize motorized vehicles over other means of transportation. This then often leads to an unsafe and inconvenient environment for pedestrians and cyclists.

6.4.1 Institutional frameworks and development policies[58]

Is your city built for cars or for people? The car has enabled people to move across long distances with minimal time and little physical effort. However, as urban populations increase and population densities of land-scarce cities rise, the greater demands on mobility are increasingly

[56] According to a Lancet study "Public health benefits of strategies to reduce greenhouse-gas emissions: urban land transport" by James Woodcock, Prof. Mohan and Dr. Tiwari, 2009, shifting to more active travel modes by 2030 would decrease the burden of heart diseases by 25%, diabetes by 17%, road fatalities by 69% and depression by 7% in the city of Delhi.
[57] Creating Healthy Places through Active Mobility, Centre for Liveable Cities, Singapore. Page. 37
[58] Creating Healthy Places through Active Mobility, Centre for Liveable Cities, Singapore. Page 37

unmet by systems focused on private motorized transport. In spite of this, motorized transport continues to be viewed as a fundamental and key development indicator.

The prioritizing of road infrastructure building in overall city development is reflected in public funding evaluations, road transport authorities' core visions, policy analysis criteria and measurement-indicators of mobility. There is much less focus on other mobility options such as walking and cycling. For example, route connectivity of paths for pedestrians and cyclists are usually not well planned for or monitored to the same standards as for roads.

Consequently, non-motorized transport options are less studied and their comparative effectiveness and benefits to the whole society are less apparent. With less focus, negative aspects such as deficient safety standards are also neglected. Collision rates for pedestrians and cyclists are much less accurately measured than those for motorised vehicles. The lack of visibility in policy and institutional frameworks also leads to an almost systemic exclusion from planning. In turn, making improvements for the safety and convenience of active mobility is difficult.

Need for strong legislative support

Traffic accident liability laws often do not provide commensurate protection for pedestrians and cyclists even if they are more vulnerable road-users compared to motorists. Relatively light punitive measures severely undermine the importance of all road-users' responsibility in ensuring safety for fellow road-users, with vulnerable road- users often having to suffer the damages

City Champions for NMT

Champions are needed in taking the first steps of introducing policies and measures to improve the conditions for active mobility. The demonstration of commitment through initiatives by these champions can create momentum and help gain support from the wider public and institutions such as schools and private companies. Implementing NMT involves many different stakeholders, from policy and place-making through to implementation, maintenance and enforcement. This requires leadership with the ability to organise a high level of coordination. A champion can provide a macro view of the trade-offs involved, space constraints and other competing infrastructural needs that need to be factored in to achieve community- wide benefits.

6.4.2 Infrastructure development and design - The planning framework support for NMT

Urban planning plays as important a role as transport planning in factoring in active mobility options from the start. Without development control to prevent urban sprawl or promote compact and mix-used developments, towns and districts risk being built to suit only motorized transport that can cater to longer journeys, reducing the convenience and viability of active modes of travel. Many modern western cities built in the mid-20th century now face problems of low density and a high urban sprawl, necessitating motorized transport. Reconfiguring routes at a later stage for connectivity and safety will involve much higher costs.

The infrastructure designed should be for moving people and not cars

- Transport infrastructure that prioritizes motorized transport
  Road systems that are planned and managed primarily for the convenience of motorized vehicles create many challenges for pedestrians and cyclists. Such problematic design features include narrow slip roads, non-grade crossings, long waiting times for pedestrian crossings, and low-visibility zones. These greatly affect the safety and convenience of pedestrians and cyclists.
- Lack of seamless multi-mode journeys
  As walking and cycling are most viable if trips are kept to mostly under 20 minutes for persons of average fitness, the lack of a good public transport system for longer journeys

also poses a challenge to developing a seamless system which involves NMT requiring more than one mode of transport.

- Complementary facilities

Insufficient, inconvenient and insecure parking facilities pose significant disincentives for the adoption of cycling, due to the risk of theft. The lack of end-user facilities such as showers, lockers and a laundry at or near workplaces also makes it more inconvenient for work commuters to cycle to work.

6.4.3 Culture, behavior and perceptions[59]

Perceptions and behaviors that discourage NMT

Cars are a status symbol in most societies and many still aspire to own one. By contrast, walking and cycling are stigmatized by a cultural bias and are usually seen as poorer forms of mobility. Stemming from such perceptions, many drivers have developed a lack of consideration for other road-users. Road infrastructure which prioritize motorized transport, space constraints and the absence of an established code of conduct for space-sharing contributes to the number of conflicts between user groups. Pedestrians and cyclists are also sometimes viewed by drivers as annoying encumbrances on the roads. This sentiment poses a formidable challenge to changing the status quo.

"I would never let my child ride their bike to school – it's too dangerous!"

While lacking safety standards are a concern, inaccurate perceptions of safety also further stigmatize cycling as a highly dangerous form of commuting. Safety is often compromised by car-centric road designs that affect a driver's visibility of cyclists and pedestrians. Furthermore, cyclists in cities with low cycling rates tend to be less visible amidst motorized traffic. This also perpetuates the notion of a lack in safety standards. Such perceptions are therefore attributable to external factors particularly infrastructural design, rather than the nature of walking and cycling as forms of commuting.

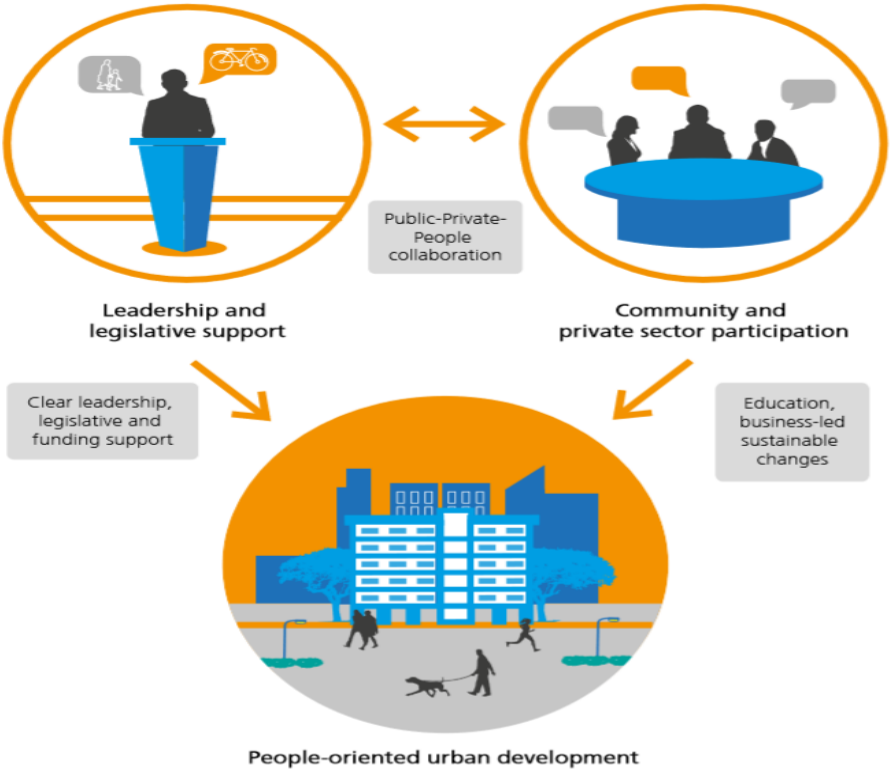
"The perception that the weather is not conducive to walking or cycling as a mode of transport often deters people from even taking the first step towards NMT. In a survey on perceptions of cycling in Singapore conducted by Nanyang Technological University, almost half of the respondents consisting of cyclists and non-cyclists agreed that cycling is hot and tiring.

According to Professor Marilyn Taylor, tropical weather should not be taken as a limiting factor for promoting cycling in Singapore; active measures can be taken to enhance cyclist and pedestrian comfort in the tropics by growing trees on both sides of the pedestrian and cycling paths thus providing shades.

[59] Creating Healthy Places through Active Mobility, Centre for Liveable Cities, Singapore. Page. 42

6.5 Public-private-people partnership for NMT[60]

Figure 6.2: Strategy for NMT



6.5.1 A paradigm shift towards creating cities for people

Creating walkable and bikeable cities requires a fundamental change in how our cities are designed. This involves a paradigm shift away from motorist-centric urban planning prevalent in the last century. A new design ethos that prioritizes the safety and needs of more vulnerable groups of road-users – pedestrians and cyclists – needs to be established[61]. But giving greater priority to more vulnerable road-users does not mean that drivers should be subjugated by the needs of pedestrians and cyclists throughout the city. The level of priority for road-users should be varied according to the context of the street. The 'soft traffic' created by pedestrians and cyclists on residential or downtown streets should be given priority over motorized traffic. In situations of fast-moving traffic on highways, motorized traffic may take precedence. This will allow for a greater diversity of mobility options.

6.5.2 Walkable and bikeable cities are more than just bicycle lanes and footpaths

Most people would equate the notion of walkable and bikeable cities with the provision of ample bicycle lanes and wider sidewalks. However, a comparison of cycling rates and total cycling network in cities across the world shows that the provision of infrastructure does not always result in a higher incidence of NMT. For instance, while the leading cycling cities of the world, Copenhagen and Amsterdam, do enjoy a generous provision of dedicated cycling infrastructure

[60] Creating Healthy Places through Active Mobility, Centre for Liveable Cities, Singapore. Page no. 73
[61] Creating Healthy Places through Active Mobility, Centre for Liveable Cities, Singapore. Page 75.

and high cycling rates, the popularity of cycling despite the lack of infrastructure in cities such as Tokyo suggests that there are other factors just as important in contributing to a successful cycling culture.

NMT i.e. walk, bicycle and cycle rickshaw modes are green modes of transport that belong to the low carbon path, do not consume energy or cause pollution and in addition provide social equity besides employment. Presently these modes are neglected in the planning process. Facilities for NMT i.e. footpaths and dedicated cycle lanes should be developed on priority. These should be citywide to assure the commuter that he can complete his journey all the way by walk or bicycle if he so chooses. Funds allocation for major transport infrastructure should be linked to achieving targets for creating facilities for NMT. NMT should get first priority in infrastructure development and funding

Walking is the most universal form of transport. All trips, especially public transport trips, begin and end with walk trips, however short or long they may me. Walking is a zero-emission mode of transport that needs to be the primary focus of a sustainable habitat[62].

Walking needs emphasis because:

Walking is critical for success of public transport: Each public transport trip requires two walk trips. If investments made in developing high quality public transport systems are to be efficiently utilized, pedestrian access to public transport has to be prioritized. Good walking environment encourages people to walk longer to reach public transport. This enhances the feasibility of mass rapid transit like BRT and Metro Rail. Pedestrian connections play a fundamental role of modal integration. Footpaths form important linkage needed for effective transfers between different modes of public transport.

Walking will reduce vehicle use for short distance commuting: A significant number of trips are short distance trips that are less than 2-3 km. These include trips to access essential services like education, local shopping, leisure trips within neighbourhoods and job centres. Good pedestrian facilities with appropriate design based on weather conditions reduce dependence on motor-vehicles for such short trips.

Walking and urban poor: Urban poor in many developing countries of Asia including India are too poor to even afford a bus ride for daily commuting. Often the only option for them is to walk. Many others are captive public transport/para transit users who are dependent on walk to access public transport. This poses a serious equity challenge. Mobility of more than half of the people in all of our cities can be severely compromised if walkways lose viability.

Walking enhances urbanity, lifestyle, and health: The World Health Organization (WHO) is now making an explicit link between walking and health status of the community. Walking for at least 30 minutes each day reduces health risks associated with sedentary lifestyle. Streets bind people and communities. Walking is the best way of enjoying street level activity. This is why high streets across the world have great walking environment to encourage economic activity.

Walking demands safe environment: Road injuries/fatalities are not accidents (unfortunate incident that happens unexpectedly and unintentionally) but the results of individual and institutional negligence and, primarily, of a system of neglect of vulnerable users. Mobility networks need to be built in a way that people are able to move around cities freely without the risks of being killed incidentally. It is a harrowing experience to walk in an Indian city. Road crashes in the country claim more than 150,000 lives every year, mostly pedestrians, cyclists or pavement dwellers. The pedestrian's right to safe and free passage has become a casualty.

[62] Changing Course in Urban Transport An Illustrated Guide

Walking and cycling are more than low-carbon modes of transport that enhance urban quality and facilitate social cohesion; they are cheap, flexible, personal modes without which the majority of people in low- and middle-income countries are unable to participate in the economy and community, or access education, health-care and other urban services.

At the same time, many low- and middle-income countries are undergoing rapid, debilitating and unconstrained urbanisation, and local and national authorities are buckling under severe pressure to plan, guide development, provide services, and manage their cities. One consequence is that cities and rural areas exhibit poor accessibility and mobility, and the needs of people remain unmet.

Better walking and cycling environments can change this. Access and mobility are key not only to sustainable mobility but to sustainable development. NMT, primarily walking and cycling, is the most sustainable form of movement, whether as a local access or an arterial or mobility mode. Yet NMT only often recieves marginal recognition in many low- and middle-income countries – whether in policy and legislation, or in budget, resource and space allocation. These same countries have the worst global road safety rates (between 40-80% of fatalities in low-income countries are NMT users), and the highest rates of poverty, unemployment and associated ill-health and limited life opportunities.

There is an urgent need to improve this environment and significantly reduce the risks of injury or death and facilitate a shift to lower carbon modes. Even where governments are resource-constrained, a solid commitment to NMT can change the experiences of millions of pedestrians and cyclists every day.

The countries in Asia have certainly made a start in the policy development; every participating country has at least one national transport commitment that recognises the value of non-motorised modes in their country, cities and rural regions. However, the implementation of NMT policies to date has not yet led to substantive changes in the reality for pedestrians and cyclists; road fatalities, discomfort and risk remain unacceptably high.

6.6 Recommendations to increase the impact of emerging and valuable commitment to non-motorized transport modes in low- and middle-income countries of Asia.

We undertook a literature review to better understand the essential components of an NMT policy, and the core actions required in order to create an enabling environment for better walking, cycling and other NMT modes. The literature suggests that a combination of both standalone and integrated NMT policies; political will; clear, measurable goal-setting as part of local strategies; a variety of supporting policies; and traffic calming or speed and vehicle-reduction interventions; will produce cities and countries where walking, cycling and other NMT modes is significantly more safe, attractive, comfortable and desirable.

Despite the multiple benefits it generates for both users and society as a whole, NMT is often marginalized and receives minimal priority in urban mobility planning and investments, both in developed and developing countries. It constitutes the principal and often only accessible means of transport for the majority of residents in developing-country cities with most who opt for this mode doing so out of a lack of choice. Yet, in most cities, NMT conditions are extremely hostile. Investing in NMT to enhance the safety and security of walking and cycling constitutes a key pillar of planning and design for accessible mobility in cities. Innovative experiences from both developed and developing-country cities that have elevated NMT as a foundation for urban sustainability offer valuable insights to inform planning and investments elsewhere.

Many Asian cities are lacking "Complete streets"[63] or streets which provide mobility, safety and accessibility to all people regardless of age and ability. The available road design guidelines are often ambiguous, with little or no priority given for pedestrians and cyclists; and where guidelines do set aside space for pedestrians and cyclists, these guidelines are often not enforced. Traffic experts still rely on speed as a basis of performance measurement (e.g., Highway Capacity Manual) in urban areas and thus put all emphasis on improving speeds rather than planning for streets which promote accessibility by all users. Cycle rickshaws are discouraged, restricted, or banned in many Asian cities including in Manila, Dhaka, New Delhi, Jakarta, Hanoi, and Bangkok. The main reason often cited is that these non-motorized modes cause congestion. In the absence of sympathetic design codes favoring and promoting slow non-motorized modes, this mode is disappearing from many Asian streets. It has been observed that banning cycle rickshaws on roads other than limited access freeways as a traffic mitigation measure is unlikely to be successful.[64] Guidelines in China recommend a network of segregated bicycle lanes. These guidelines include a density of one bicycle road every 1 to 3 kilometers, one segregated bicycle lane every 400 to 600 meters, and one painted bike lane or branch road and path to residential apartment buildings every 150 to 200 meters. Singapore's Land Transport Master Plan is a "people centered" plan that aims to achieve efficiency through multi modal integration. The Master Plan includes the following measures:

Pedestrian walkways

Pedestrian crossings would include • Removing the slight drop (25 mm) from the footpath to the road and providing tactile to indicate the edge of the road for the visually impaired • Thickening road crossing lines to guide the visually impaired to walk within the designated crossings • Installing vibrating push button (with audio alert) at traffic signal posts to help the visually impaired • Providing at grade road level crossings where traffic conditions permit

In Hong Kong, the provision of pedestrian facilities and the prioritization of pedestrians have both been integrated in the determination of the scale, location and site requirements of various land uses and facilities. Design codes should match the transport policy and protect and prioritize vulnerable sectors of society in the transport system. The India pedestrian design code developed in 1988 was revised recently to prioritize pedestrian movement and to be consistent with the national Urban Transport Policy 2006.

Implementing NMT Policies, Strategies and Projects

It is not that Asian cities do not know how to create good pedestrian and cycling infrastructure but such infrastructure is often available in only a few areas where only the elite reside. There is an urgent need to change the mindset with regards to NMT.

Diagnosis of the city yields sufficient information to develop targeted NMT policies, strategies and projects. Such NMT policies, strategies and projects should build upon the existing national sustainable transport policy and state/region level directives and strategies. Entrusting responsibility of pedestrians and cyclists to dedicated institutions to safeguard their interest, provide adequate facilities and coordinate with various agencies can create a significant change in the entire transport system. It will also create a healthy communication mechanism between the dedicated institutions and NMT users thus creating transparency in the transport sector decision making. Any NMT improvement policy, strategy and project should be fundamentally built upon the following characteristics - density, diversity, design which includes safety, coherence, directness, attractiveness and comfort and destination accessibility.[65] In order to

[63] . The road space is judiciously divided among pedestrians, cyclists, motorists, public transport users rather than traditional way of fast dominating the slow user

[64] Regulating Two and Three Wheelers - ITDP, Clean Air Asia

[65] 5 D's of Urban Planning and Transport

realize and influence a paradigm shift in improving the quality of non-motorized transport facilities and as well as developing on-the-ground projects, some strategies are:

1. Improving institutional arrangements and creating dedicated institutional support for non-motorized transport

2. Using technology to promote NMT and build partnerships

3. Prioritizing NMT in planning.

4. Prioritizing funding and setting stringent walkability and cyclability improvement targets including pedestrian trip mode share, cycling trip mode share, and pedestrian and cyclist fatality reduction, etc.

5. Designing for NMT

6. Making allies for improving NMT

7. Assessing the impacts of NMT

Tools for Impact Assessment of NMT Projects

Tools such as Transport Emissions Evaluation Model for Projects (TEEMP), International Road Assessment Programme (IRAP) and Harmonized Emissions Analysis Tool (HEAT) can be used to assess the benefits (i.e., emission reduction, road safety, health, economic benefits) of NMT projects. Transport Emissions Evaluation Model for Projects (TEEMP) has been developed by Clean Air Asia, together with other partners such as ITDP, Asian Development Bank and the United Nations Environment Programme (UNEP) – Global Environment Facility (GEF).

Policies/Planning/Design to integrate NMT with public transport.

The built environment has big impact on transport especially on NMT. This can be understood by analyzing the impact of 5D's of transport. These D's are: Density, Diversity, Design, Destination accessibility and Distance to transit. Density is considered as activity level per unit area. The activity can be population and employment. 2. Diversity is measured as availability and intensity of different types of land use. 3. Design refers to the type of local street design in the neighborhood. 4. Destination accessibility is measure of the access to trip attractions. 5. Distance to transit is a measure of public transport accessibility.

The planners must use walkability survey guide that should help understanding the extent of conflict between pedestrians and other modes such as bicycles, motorcycles and cars on the road which reflects the need for availability and condition for walking paths. There are also other important parameters which should be taken into account. These are availability of crossings, grid crossing safety, and motorist behavior. In fact the behavior of motorist towards pedestrians may well indicate the kind of pedestrian environment in that area. Similarly, other parameters include infrastructure, obstructions, security from crime etc.

Planners must undertake cyclability index survey, to understand parameters of conflict, availability of lighting and feeling of security etc. Equally important are other parameters such as availability of cycle lanes, riding surface, street connectivity etc. Behavior of motorist towards cyclist and pedestrians reflects the rod-traffic culture and the priority that needs to be accorded to the active transport users.

Stakeholder engagement and public participation are keys to successful adoption and integration of NMT. There are various means of engaging with stakeholders. The most important considerations for design and implementation of NMT policies and infrastructure underlying the need for a well-defined improvement policy and adoption of standards for the bicyclists and pedestrians.

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Annexure-A

Bangkok Declaration, 2020: Progress towards achieving Goal 4 relating to NMT

Country	Sixth Regional EST, 2011, Delhi	Seventh Regional EST, 2013, Bali	Eighth Regional DST 2014, Colombo	Ninth Regional EST 2015, Kathmandu
Afghanistan			Not yet	Some progress
Bangladesh	Includes Non-Motorized Transport components in transport master plan	Design standards with provision of NMT is in place	Some progress. Various NMT Policies, plans and projects.	Some progress. Design standards with provision of NMT is in place.
Bhutan		Largely in place. "Pedestrian Day" observed every month		Non-Motorized Transport slowly picking up
Brunei Darussalam		Providing footpath and bike lanes		
Cambodia	People and environmentally friendly transport infrastructure			
India	Pedestrian Guidelines	Developing a National Cycling Policy, street design practices, and other NMT programs	Plans to improve NMT infrastructure	Many Indian cities introducing dedicated NMT lanes and bike Sharing systems.
Indonesia	Improvement pedestrian and cycling facilities. Jakarta started city's first dedicated bicycle lane (1.5 Km).	Improve and encourage use of non-motorized transport	Development of pedestrian and cycling facilities	Development of pedestrian and bicycle facilities in cities.
Japan		Fully completed	Fully completed	Largely in Place.
Lao PDR	Improving urban walking conditions	Non- Motorized Transport (NMT) in EST Strategy		
Malaysia		Some progress	Some progress	Largely in place. Putrajaya Green City 2025
Maldives		Since islands are small, 90% of transport is walking		Various pedestrian and cycling improvements, including pedestrian zones and bikeways
Mongolia		Some progress	Some progress. Ulaanbaatar bikes project	
Myanmar		Some progress	Some progress	Construction of separate roads and bridges for pedestrians and cyclists in Yangon City, Mandalay City and Nay Pyi Taw City

Nepal	Historical Areas Pedestrianization			Improving walkability. Provision of cycle lanes along major intra-urban roads
Pakistan	Adequate pedestrian facilities	Largely in Place	Some progress. All planned housing schemes have foot path network	
People Rep. of China		Largely in Place		
Philippines		Bikeways and Walkways Program	Bikeways and walkways, greenways, LRT bike accommodation	Some greenways completed. Promoting walkability and non-motorized transportation and interconnectivity with MRT in Metro Manila
Rep. of Korea	Extensive programs to improve and encourage NMT	Largely in Place. Promotion of human-centered cities	Promote nation-wide bicycle networks and linear parks.	Many programs to promote walking and cycling
Singapore	Mentions this goal		Largely in Place	
Sri Lanka	Mentions this goal	Walkways and dedicated Cycle Lanes in main cities		Improving walkability by providing foot walks, planting trees along walk ways shade pedestrians, and bicycle lanes.
Thailand	Thailand planned for longest bike lane in Asia, 184-km crossing 5 provinces to be completed by 2017.	Some progress	Non-Motorized Transport Master plan	Promotion of "Bicycle use in daily life"
Timor Leste		3 ZEROs Vision		Not yet. Low current automobile ownership.
Vietnam		Some progress. Pedestrianized streets	Some progress. Pilot project to promote public bicycle in 5 major cities	Some progress. Project to promote public bicycle in major cities.
Counts	**10**	**19**	**15**	**14**

Annexure B

NMT related case studies in Asia (Cycling)

1. Singapore - first/last mile connectivity

Singapore, a sovereign city-state, gained independence in 1965. In 2012, Singapore's population stood at 5.3 million at an average density of 7421 pp/sq. km. Transportation in Singapore is planned and managed by the Land Transport Authority (LTA), a statutory board under the Government Ministry of Transport. The LTA has not only developed a state of the art Mass Rapid Transit System (MRT), but has also pioneered the Congestion Pricing system, whereby private vehicles are made to pay higher tolls for entering the congested city centre during peak hours. Other public transport modes in Singapore include the Automated People Mover systems, buses and taxis. These combined efforts in providing a high quality public transport system and discouraging car travel within the city have enabled Singapore's public transport system to make up more than 50% of the modal share of all work trips. The LTA has been quick to realise the importance of NMT in providing first/ last mile connectivity to public transport. Accordingly, it is constantly upgrading the pedestrian and cycling infrastructure around transit stations.

Bicycle Parking at MRT Station in Singapore. Source: Karl Fjellstrom, ITDP, China

Through a recent effort, LTA has incorporated barrier-free measures along all public streets and pedestrian link ways accessing transit stations. By March 2011, almost 95% of the access routes within 400 m of transit stations were barrier-free. The LTA is also working to decrease pedestrian crossing times at almost 500 traffic signals, especially those leading to public transit stations. Recognising the growing popularity of cycling the world over, LTA has also introduced several bicycle facilities at MRT and LRT stations and on buses. Bicycle racks and bicycle stations are now provided at almost all key transport nodes. By 2013, the LTA was also expected to install almost 2,500 additional bicycle racks, single and double tier racks to 20 additional MRT stations. Foldable cycles are also allowed on-board buses and trains.

The National Cycling Plan established in 2012 envisions a cycling network that consists of dedicated cycle paths to enhance connectivity from residential nodes to local MRT stations. 6.4 km of cycling paths were completed in 2011, and 38.9 km of cycling paths are currently under construction. These cycling paths will connect residents of seven Housing Development Board (HDB) towns to their nearest MRT station.

2. South Korea

South Korea is a developed country in East Asia with a total population of 50 million people. It is also one of the first Asian countries to actively support NMT through a National Plan for Cycle Use. The impetus for NMT improvements was provided by urban issues of traffic congestion as

well as the looming energy crisis and climate change threats. The chronology of the Cycle Use National Plans is shown in the figure.

Figure A.1: The chronology of the Cycle Use National Plans

Source: National Plan for Cycle Use, South Korea

The first National Plan oversaw construction of 4,419 km of cycling paths and cycle parking for 190,000 cycles. It resulted in a 2.4% increase in bicycle mode share in 5 years. The second National Plan won a 500 billion south Korean won (0.46 billion USD (1 USD = 1093.19 south Korean won)) budget, which was to be used for construction of 4000 km of cycling paths, and cycle parking for 80,000 cycles. The 2nd National Plan also directed a portion of the budget for awareness and advocacy campaigns related to cycling. The 3rd National Plan was influenced by the Lee Myung Bak administration's National Green Growth initiative (2009). The 3rd National Plan called the 'Comprehensive Bicycle Plan for Korea' includes a modal share target of 5% for 2012. The 1.2 trillion South Korean won (1.1 billion USD (1 USD=1093.19 South Korean won)) budget will go towards the construction of up to 17,000 km of cycling paths. The Plan focuses on the following components of infrastructure development: • Utility Bicycle Routes • National Bicycle Network • Bicycle Industries

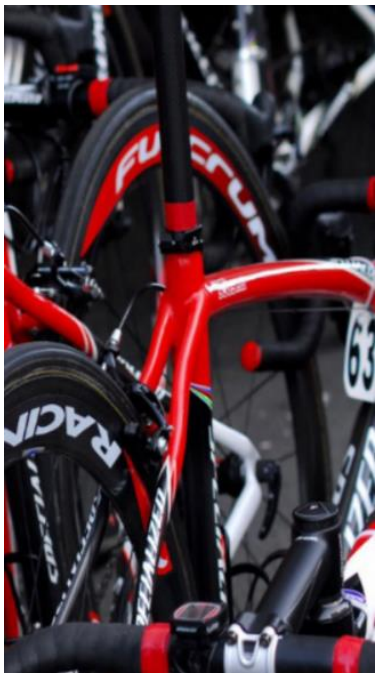
The Comprehensive Bicycle Plan provides guidance on Legal and Institutional matters using the "5 E" framework: Encouragement, Education, Engineering, Evaluation and Enforcement. It identifies the following 5 strategies for infrastructure development: • Contribute to low carbon, green transportation; • Ensure safety through physical and regulatory means; • Increase connectivity of various bicycle paths; • Incorporate regional, historical and cultural traits; • Framework for continuous implementation. The Comprehensive Plan also suggests network link typologies and provides best practices for cycle-oriented transportation planning.

3. Organisation of the Bicycle Manufacturing Industry, Taiwan

Taiwan, once known as the "kingdom of the bicycle" was the largest manufacturer and exporter of bicycles until the 1990s. Even after facing stiff competition from cheaper bicycle manufacturing in China, Taiwan's bicycle manufacturing industry managed to reinvent the industry and now specializes in the manufacturing and export of medium to high priced bicycles. Interestingly, however, Taiwan's domestic bicycle market is insignificant. In fact, bicycle usage

in Taiwan is extremely low. Taiwan's total population is 23 million, and there are 5.7 million cars, 12 million motorcycles and only 1.1 million bicycles in the country. In this scenario, the bicycle manufacturing industry can play an important role in cultivating a national cycling culture, leading to increased use of the mode for commuting and recreational travel. There are two episodes in this context that can serve as best practices for NMT-inclusive planning in India: Organisation of the Bicycle Manufacturing Industry and Bicycle Park: Organisation of the Bicycle Manufacturing Industry At the peak of its bicycle manufacturing days, Taiwan adopted the Original Equipment Manufacturing (OEM) model and maximized profits by increasing manufacturing quantities.

Organization of the Bicycle Manufacturing Industry, Taiwan



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However, in the 1990s, China began to surpass Taiwan in bicycle manufacturing, aided by lower labour costs. Taiwanese manufacturers, unable to compete with Chinese prices, started exploring a new strategic direction in bicycle manufacturing. In 2003, two leading Taiwanese manufacturers, Giant and Merida, created a partnership with 11 bicycle part manufacturers, called the "A-Team". The A-Team invested in strategic research and development to support innovation, enhance quality, and make the supply chain more efficient. This enabled Taiwanese manufacturers to counter the declining profit margins and deteriorating quality and instead created a new market for high quality, high end and specialized bicycles in the medium to high price range. A well-organised bicycle industry can now also invest in promoting cycling within Taiwan.

NMT related case studies in Asia (Pedestrianization)

1. Abu Dhabi Street Design Manual

The Abu Dhabi Urban Street Design Manual (USDM) was commissioned in 2009 by the Abu Dhabi urban planning council to address the needs of a growing population and a need to improve pedestrian facilities and create more walk able and liveable communities. The USDM

was adopted in January 2010 to design all urban streets. The USDM complements the Urban Planning Council's 2030 Development Plan with sustainable land use and transport planning. The USDM is a balanced approach to designing Abu Dhabi's urban streets ensuring the safety of pedestrians, cyclists, transit riders and motor vehicle drivers. The manual directs a transition towards a more multi modal, walk able and low carbon future. The manual for developing new streets and retrofitting the existing ones is organized in the following three parts:

Part I: Context and Process

This section highlights the manual's goals and objectives to achieve complete street design. The design process starts with gathering information, developing and evaluating concept design, concept review and approval and developing a detailed design.

Part II: Design

This chapter establishes street composition for Abu Dhabi, based on various users and always keeping pedestrians as a priority. Land use and climate are also considered. Street design incorporates street composition, junction design and streetscape design such as materials, landscape, furniture, lighting etc.

Part III: Supporting Materials

This chapter demonstrates a sample project, illustrating the street design with reference to the site. It includes two performance measures, first the Level of Service (LOS) to describe their contribution toward the efficiency of the transport network, and second the Quality of Service (QOS) to describe the effectiveness of each mode from the user's perspective. It contains a toolbox to assess the connectivity of urban (and rural) areas. This section also includes various examples of street configuration, good street design elements and standard details.

Abu Dhabi's new urban design guidelines call for greater connectivity and accessibility, especially for pedestrians

Source: http://thecityfix.com/blog/abu-dhabishowcases-sustainable-urban-design/

2. Raahgiri Day – EMBARQ, Gurgaon

Raahgiri Day, inspired by Ciclovia, is a weekly street event begun on 17 Nov 2013 by the founding members EMBARQ India, IAmGurgaon, Pedalyatri, Duplays, and Heritage School. The 11.3 km corridor was supported by the Gurgaon Police, Municipal Corporation of Gurgaon, and DLF (one of Gurgaon's largest private housing, commercial, office and retail developers) along with Schools, RWAs, NGOs, Industry Associations, Active Recreation groups and Active Citizens. MCG and Gurgaon Police have taken the lead organizing role for Raahgiri Day.

Raahgiri day was conceptualized and planned from a school project. Heritage school approached EMBARQ India and Pedal Yatri, a recreational cycling group in Gurgaon, to assist students with a research project- "Making Gurgaon a Bike Friendly City – 2013." The research project culminated with a 12 kilometre (7.5 miles) cycle rally in Gurgaon, held on April 2013. Almost 300 cyclists participated, including students, parents, and teachers from Heritage School; senior government officials from Gurgaon and members from Pedal Yatri and EMBARQ India. The generous public support to decongest the roads from private vehicles instigated the idea of Raahgiri Day.

Key Objectives of Raahgiri Day are: • Promote cycling, walking and use of public transport as envisaged in the national urban transport policy and integrated mobility plan for Gurgaon; • Re-state and remind its citizens that the streets belong to the people; • Promote healthy living by encouraging an active lifestyle; and • Create an inclusive community and promote and facilitate social integration; and Promote and highlight the environmental issues/concerns.

Source: Raahgiri Day

In addition to being open to pedestrians and cyclists during these times, Raahgiri Day organises community leisure activities such as street games, street dancing; yoga, aerobics and Zumba. Raahgiri Day is a cause driven movement and does not aim at earning profits. The events in the Raahgiri day are organized and supported by various sponsors such as Delhi Dance Academy, Times of India, Radio Mirchi, Suburb, Coca Cola, Reebok and many more. From the date of commencement till April2014, Raahgiri Gurgaon has spent INR 41.65 lac (66,884 USD (1 USD = 62.27 INR)) collected from the funds and sponsorships and still have INR 8 lac (12,846 USD (1 USD = 62.27 INR)) as a balance amount.

3. Pedestrian Streets - Hong Kong

With a population of over 7 million in an area of 1,104 sq. km with large green reserves, Hong Kong is one of the most densely populated cities in the world. Hong Kong has an odd geography. Being a compact city, most of the essential services and facilities are located in proximity to residential areas or public transport networks, and are highly accessible. In retrospect, Hong Kong has always placed strong emphasis on pedestrian planning by providing infrastructure like its famous footbridges. However, recent efforts are focused on creating "Pedestrian Streets" that are at-grade.

Segregated cycle tracks (Above) and Pedestrian Street with no vehicular access (Below)
Source: Itdp.org.cn

Following are some of the types of pedestrian streets: 1. Full-time Pedestrian Street: In full-time pedestrian streets, pedestrians have absolute priority. Vehicular access is restricted to emergency services only. Service vehicles may also be allowed in at specific periods for selected locations;

2. Part-time Pedestrian Street: In part-time pedestrian streets, vehicular access is only allowed during specific periods. In order to minimize vehicular access to the area, there is no on-street parking space. However, loading bays are provided for loading and unloading purposes; and

3. Traffic Calmed Street: In traffic calmed streets, footpaths are normally widened and on-street parking spaces are reduced as far as possible. Taxi stands and green minibus stands are only provided if relocation is not practical. There is no restriction to vehicular access. However, vehicles are slowed down through the use of traffic calming measures, such as speed tables, curb build-outs, sharpened corners, road narrowing, gateways, etc. The Transport Department (TD) has laid down detailed guidelines in the Transport Planning and Design Manual (TPDM) for the planning of pedestrian crossing facilities. Crossing facilities include footbridges and subways but are mostly at grade (i.e. at the same level as the road), including the following: • Zebra crossings (where pedestrians have the priority to cross the road); • Signal-controlled crossings (commonly known as "Green Man" crossings); • Cautionary crossings at signal-controlled junctions (with signals for drivers only but not for pedestrians); • Uncontrolled cautionary crossings (no signals for either pedestrians or drivers).

4. Nanjing Street – Shanghai

Nanjing Street is a 5 km premier pedestrian retail street with footfalls of over 1 million people per day. It is named after the city of Nanjing, capital of Jiangsu province, neighbouring Shanghai.

Nanjing Road, located in the city centre, comprises two sections, Nanjing Road East and Nanjing Road West.

The pedestrian shopping street named after the city, Nanjing

Source: Shopping district Nan Jing Lu Bu Xing Jie, Huang Pu Qu, near People's Park and Radisson Blu Hotel in Shanghai, People's Republic of China, Lars Curfs, 2009

In 2000, the local government released funds to renovate Nanjing Road to be a characteristic pedestrian-only street. The width is about 28 meters and the total length is 1,200 meters, which extends from Middle He'nan Road to Middle Xizang Road. There are more than 600 shops on both sides of the walkway. East Nanjing Road is a dedicated commercial zone.

At its eastern end is the central section of the Bund. Immediately west of the Bund precinct was traditionally the hub of European-style restaurants and cafes, although in recent years these have become less of a feature as the demographics of visitors to Nanjing Road have shifted from affluent local residents to visitors from around the country. Close by is the Central Market, a century-old outdoor market today specialising in electronic components and digital media. This area also previously featured a number of large mansions and estates, most of which are today either demolished or used by the government.

Annexure C

NMT Case Studies of Europe and other countries

NMT related case studies around the world (Cycling)

1. NMT-related Regulations in San Francisco (Pedicab Ordinance)

Pedicabs in San Francisco are mainly used to ferry tourists to city sites. These form attractive tourist rides as they give an open ride to tourists. The pedicabs are tricycles and can seat 2 people per pedicab. Such pedicabs have become extremely popular all over the United States in recent years, especially in San Diego and New York, where excessive congestion and accidents have forced the authorities to enforce stricter regulations. The registration of pedicabs in San Francisco follows a similar process as the registration for taxis. Like taxis, fleets of pedicabs are generally owned by a single owner, who leases the vehicle for operation to licensed pedicab operators. Due to the current regulatory requirements, pedicab fares are comparable to taxi fares.

The San Francisco Pedicab Ordinance of 1986 (Article 39) regulates the operation of pedicabs operating in San Francisco. The ordinance requires both the owners and operators of pedicabs operating on public streets to obtain a permit from the Police Department.

2. Shova Kalula (Ride Easy)

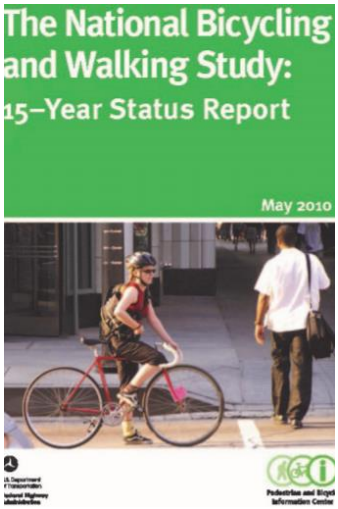
The very first national bicycle initiative launched by the South Africa National Department of Transportation (NDOT) was in the form of a user incentive program, called Shova Kalula (Ride Easy). The purpose of the program was to maximise the use of bicycles to enable communities to access social and economic opportunities at a lower cost. The longer term vision was to bring bicycle transport into the mainstream, as well as develop a network of micro-business enterprises that would manage Shova Kalula shops independently in the future. The program was initially planned to target populations in the rural and peri-urban areas, providing subsidised bicycles to 350,000 secondary school students, 445,000 primary school students, 573,000 urban workers and 472,000 rural workers. The initial impetus for this program came from NGOs, mainly Afribike, who was appointed the service provider for Phase I. Since its launch in 2001, stakeholder involvement among local and provincial governments, businesses, NGOs and foreign organisations has remained consistent. The initial demonstration projects planned for Shova Kaula had to follow the Action Plan shown below: 1. Road show to promote the concept among provincial departments and local authorities; 2. Recruiting interns to participate in different aspects of implementation; 3. Site selection and scoping to identify the communities where the scheme would be launched; 4. Site implementation to establish the bicycle shop and train the manager; 5. Mobile bicycle transport clinic/shop involved procuring a commercial vehicle for the mobile activities; 6. Evaluation of phase 1 and recommendations for phase 2. The first phase of the project, which was the demonstration phase, was centrally operated. In the second phase, the implementation was to be transferred to provincial governments, financed by the central government. In its current form, provincial state governments need to submit a business plan to the NDOT outlining the business model they propose to use, to receive the funding for the program. The program has been quite popular, and

this is evident from the number of provinces who receive funding under the Shova Kalula program. The total number of Shova Kalula shops set up by 2007 was 22 and 2,478 bicycles were distributed in the country. The project resulted in benefits for people lacking mobility options. The subsidised rates for purchasing bicycles made them affordable for many people, providing them with improved access to jobs, education and essential amenities.

3. National Biking and Walking Study 1994

In the early 1990s, US Congress tasked the Federal Highway Administration (FHWA) of the US DOT to look at ways to increase cycling and walking. With a 1 million USD budget and following two years of study, the FHWA produced a National Biking and Walking Study in 1994. In addition to the main study, 24 individual subject area reports were produced. Most of the work was contracted out to NGOs and private consultants, although there were also full-time internal resources dedicated to the project. Through the study, the following two primary Federal transportation goals were developed: 1. Reduce pedestrian and cycling fatalities and serious injuries from traffic accidents by 10%; and 2. Double the percentage of trips taken by walking and cycling from around 7 % to around 15%. While the first goal has been met (and exceeded), the second has been more elusive. Although the total number of trips taken by these modes has doubled, because of the growth in total number of trips, the percentages have not. Trip substitution was a key element in the US goal because it would help meet transportation-related objectives (reduced congestion, improved air quality, reduced emissions, more sustainable transportation, etc.) as well as health-related objectives.

The 15 year status report for the National Bicycling and Walking Study



Source: www.pedbikeinfo.org

A Federal Action Plan with 64 specific action items was developed including objectives at the National, State and Local levels, although the actions outside the national government had to be framed as suggestions as opposed to mandated directions. However, through this initiative, each state was mandated to hire an active transportation coordinator. The study was primarily developed through collaboration within the US DOT (including the National Highway Transportation Safety Administration – NHTSA). The US Environmental Protection Agency (EPA) was also involved to an extent, as was the railroad administration, which was primarily interested in safety. Since this study, the health-related and environmental benefits of walking and cycling have become more widely recognized

4. New Zealand's National NMT Strategy: "Getting there – on Foot, by Cycle"

In 2005, the government released its first national walking and cycling strategy in a document titled Getting There – On Foot, by Cycle. It was released with the announcement of an 1.15 million USD in new funding to be invested in pedestrian and cycling programs in addition to increased NMT infrastructure funding and strategy development support for road controlling authorities though the National Land Transport Fund. The vision is supported by three goals which emphasize creating NMT-supportive communities and transportation systems, increasing walking and cycling and improving safety for pedestrians and cyclists. These goals are further informed by the following six key principles: 1. Walking and cycling face similar issues, but are different modes of transport with different needs; 2. Providing a transport system that works for pedestrians and cyclists means catering for diversity; 3. Walking and cycling are important for all communities, but critical in urban areas; 4. Increasing the use of walking and cycling requires a comprehensive approach; 5. Safety needs to be integrated with promotion; and 6. The needs of current users must be addressed alongside those of new users. The strategy proposes that to achieve its three goals, action is required across ten priorities, under the following four focus areas:

1. Strengthen foundations for action o Encourage action for walking and cycling within an integrated, sustainable approach to land transport; o Expand our knowledge and skill base to address walking and cycling; and o Encourage collaboration and co-ordination of efforts for walking and cycling.

2. Provide supportive environments and systems o Encourage land use, planning and design that supports walking and cycling; o Provide supportive environments for walking and cycling in existing communities; and o Improve networks for long-distance cycling.

3. Influence individual travel choices o Encourage positive attitudes towards and perceptions of walking and cycling as modes of transport; and o Encourage and support individuals in changing their travel choices.

4. Improve safety and security o Improve road safety for pedestrians and cyclists; and o Address crime and personal security concerns around walking and cycling.

All vehicular signals on this intersection in Auckland turn red together for a single phase, when pedestrians' have complete freedom of rout choice and may cross straight or diagonally.

Source: Pedestrian planning and design guide, New Zealand government.

5. Cycle to School Program and Bicycles for Peace – Katakwi, Uganda

The First African Bicycle Information Organisation (FABIO) partners with organizations to provide a variety of social programs. This includes distributing bicycle ambulances, providing

bicycles to young and older people alike, and training youth to work on bicycles. The provision of bicycle ambulances provides a critical increase in access to hospitals and health care for the injured and sick. In particular, FABIO targets lowering maternal mortality rates.

The effort to provide young people with bicycles helps students, particularly girls, who must walk long distances to a small number of schools and who are in danger of being attacked during this trip. The distance and security challenges have discouraged parents from allowing their daughters, in particular, to travel to school, and they are often kept at home instead to do housework.

FABIO has seen an increase in school attendance for those students that were provided with bicycles. FABIO also partnered with a Boston, Massachusetts, USA-based Two Wheeled Foundation to implement a capacity building program to teach un- or under-employed youth in Uganda how to work on bicycles. In addition, they are taught how to ride and use bicycles.

Cycle to School Program and Bicycles for Peace Source: http://malteinjinja.wordpress.com/fabio/

Cycle to Work Scheme - United Kingdom

The UK Government introduced a tax exemption scheme known as the Cycle to Work scheme in the Finance Act 1999. The purpose of the scheme was to promote healthier journeys to work and to reduce environmental pollution. The scheme enables employers to loan cycles and bicycle safety equipment to employees as a tax-free benefit. The scheme was introduced under the Government's Green Transport Plan. The advantage of this scheme is that it does not require the employer to obtain prior approval of Her Majesty's Revenue and Customs (HMRC). The fine print guidelines stipulate that employees will be given the opportunity to buy back their cycles at the end of the scheme duration (12-18 months) for the full market value – a factor that is viewed as a deterrent to the scheme

***6.* Cycling Superhighways - Denmark**

In Denmark, investments in cycle superhighways are aimed at commuters who travel by trains and cars. It is believed that with superior facilities, several train and car commuters will switch to cycling regularly or occasionally. Traffic lights are coordinated for cars, but with the provision of cycle superhighways, cyclists travelling at 20 km/h will benefit from the traffic lights coordinated in their favour at arterial routes thus surfing a wave of green lights through the city at rush hour. The capital region of Copenhagen and twenty two other municipalities have joined

forces to create a network of bicycle superhighways, known as Cykelsuperstier, which will help make Copenhagen the bicycle capital of the world. From the current trips by bike standing at 35%, the government of Denmark plans to raise the number to 50% in the coming couple of years.

The aim of building the bicycle superhighways is to encourage more people to use bicycles over longer distances of travel instead of preferring to use cars, busses or trains. Distant suburbs will benefit very much once the bicycle superhighways are completed. A common secretariat for ensuring proper flow of work is planned with the help of the municipalities. The funding for the planning of cycle superhighways and the secretariat comes from the Danish Road Directorate with additions from the region and municipalities. The idea behind the creation of cycle superhighways is to promote a 'brand' which is recognized by all. A governmental body called Capital Region Denmark, responsible for public hospitals and regional development, provided funds for the superhighway project to the tune of 1.6 million USD. The budget allocated to the cycle superhighways is €55 million which is expected to reduce annual CO2 emissions by 7000 tonnes. The planned network which when completed will have 26 bike-bahns (cycle highways) spanning over 300 km in length, 48 km of which have been completed by the end of 2012. The 17.5 km Copenhagen – Albertslund route is the first route to be constructed. It opened in April 2012. It was estimated that the route will result in a 20% increase in cycling, and a decline of one million vehicle km travelled per year. Even though implementation has faced difficulties in the form of coordination between multiple stakeholders, the plan has taken shape. To put the benefits of this investment into perspective, an annual savings of €40 million has accrued yearly due to the health benefits of cycling – benefits realized on an investment of €389,000 per km of cycle superhighway, in comparison to an investment of €13 million per km of roadway construction

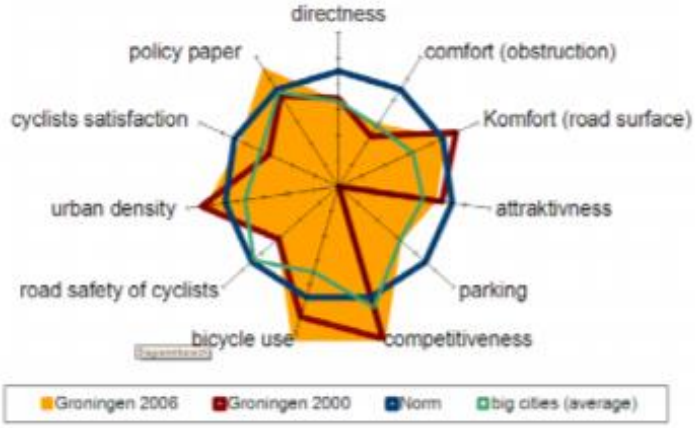
The map of Copenhagen and surrounding regions showing existing cycle superhighways in orange and planned cycle superhighways in purple (left); Cycling Superhighway designed for intercity travel using cycling (right)

Source: Bram van ooijen, itdp.org

7. The Cycle Balance – The Netherlands

The Netherlands uses a system called a Cycle Balance to assess the quality and performance of the cycling infrastructure. It does not include any measure for modal shares. The Cycle Balance is essentially a measure of comparative strengths and weaknesses. It relies heavily on first hand qualitative observations and secondary data sources for statistics. In the first project period between 2000 and 2004, cycle balances were developed for 125 cities and municipalities. Copenhagen Bicycle Account Copenhagen released the first Bicycle Account in 1994. There are two parts to this monitoring report: the first presents the results of information collected through telephone surveys, and the second presents a summary of traffic data, such as vehicle counts, mode split statistics, accident rates etc.

The surveys are conducted annually and the Bicycle Account is published once every 2 years. The results of the survey are published in attractive illustrative brochures to maintain interest among the general public. Street Design projects – New York while the street-redesign projects implemented by NYCDOT have received a great deal of attention, it is the process by which they have been implemented that may be most noteworthy. NYCDOT Commissioner Janette Sadik-Khan, however, has implemented projects on a trial basis, often using inexpensive materials that can be upgraded at a later date. To monitor implementation, performance measures or indicators are also used to link DOT actions to their overall mission and goals. Sustainability performance measures can help DOTs monitor environmental, economic, and social performance – and can help communicate that performance to stakeholders (that is, elected officials and the public). NYSDOT developed the GreenLites certification program to better integrate these principles into practice. GreenLites is a self-certification program that distinguishes transportation projects and operations based on the extent to which they incorporate sustainable choices. This is primarily an internal management program for NYSDOT to measure our performance, recognize good practices, and identify where we need to improve. It also provides the Department with a way to demonstrate to the public how we are advancing sustainable practices. NYSDOT project designs and operations are evaluated for sustainable practices and based on the total credits received; an appropriate certification level is assigned. The rating system recognizes varying certification levels, with the highest level going to designs and operational groups that clearly advance the state of sustainable transportation solutions.



8. National Cycling Policy of Ireland

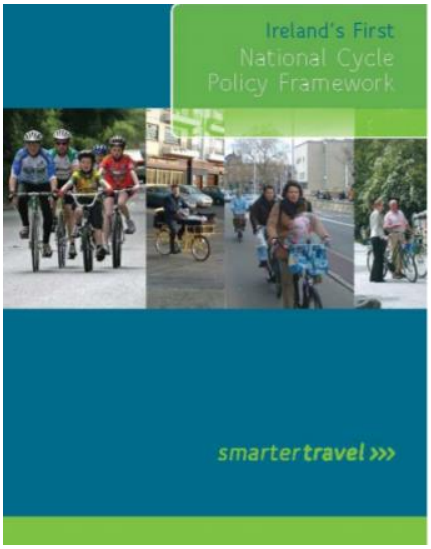
The NCPF gives great importance to coordination and cooperation for smoother implementation. It also encourages capacity building in government departments, government agencies, interdepartmental committees, local authorities, NGOs. Also, implementation involves changing perceptions and deepening knowledge of cycling planning in universities and professional organisations. The policy identifies two alternative models that would be responsible for implementation at the National Level: a new National Agency with a singular mandate of overseeing implementation of the NCPF; or a Cycle Office within an existing national department.

A third model is also identified: that of modifying the remit of an existing government agency to also include implementation of the NCPF. At the local level, the policy suggests creation of local policies and action plans that are consistent with the national policy. These should be entrenched within the Development and Local Area Plans, as well as other plans such as the Integrated Framework Plans, Strategic Development Zones and master plans.

It is advised that every local authority have a Cycling Forum led by a Cycling Officer – similar to the one created by the Dublin City Council. At the local level, the policy strongly subscribes to

the need to involve users and cycling advocacy groups in policy formulation. The policy also goes on to make suggestions of the activities of the Cycling Forum, identifying one of the most important activity being that of building and disseminating knowledge within organisations to promote cycling. Academics are also encouraged to be included in the functioning of organisations at the national and local levels. Universal Design to encourage the concepts of Universal Design, the Government of Ireland created a National Disability Authority (NDA) under the Disability Act 2005. The NDA constituted the Centre for Excellence in Universal Design as a research institution in charge of developing policies and guidelines, capacity building, and raising awareness. The Centre has developed a series of booklets called Building for everyone – a Universal Design Approach containing "practical guidance on the universal design of buildings, places and facilities".

Ireland's National Cycle Policy Framework



Source: National Cycling Policy of Ireland

NMT Case Studies around the world (Pedestrianization)

1. Stroget - Walking Street, Copenhagen

Since it became pedestrian in 1962, Stroget Street in Copenhagen, Denmark has become a major tourist attraction. It has been responsible in reviving the potential of a historic medieval city, by recreating the human scale of its past. It is now also the longest and most successful retail street in the region. In 2000, Stroget attracted over 80,000 visitors per day. The street is about 32 -39 feet wide and about 2/3 of a mile. A mixed-use street, Stroget is lined with buildings that have commercial uses on the ground floor and residences and offices above. In 2010, Colliers reported that the value of commercial rental rates along Stroget Street were at 29th position in the world. The street is provided by access point from all modes. Bicycle and vehicular parking are provided at convenient locations to enable easy and convenient access. Transit access is provided by bus. Stroget Street also includes two historic cathedrals (Nikolaj Kirke and Helligandskirken).

Figure: Stroget Street (Left); Stroget and adjacent areas (Right)

Photo by Michael Labowicz Stroget - Walking Street. Bates K, 'Making pedestrian mall works', June 2013

2. Khayelitsha Township - Cape Town

The case study of Khayelitsha presents the relevance of investing in pedestrian infrastructure in poor neighbourhoods. Such investments enable high economic returns with respect to reducing crime, and creating health and education benefits – both key requirements for development. Urban Upgrade Project According to Khayelitsha Nodal Economic Development Profile some 50% of the residents in Khayelitsha reported that they do not feel safe to move around in their area during the day. This percentage rises to an alarming 94% when residents were asked whether they feel safe to move around at night. The City of Cape Town initiated the Violence Prevention through Urban Upgrading project (VPUU) in 2005 in cooperation with the German Federal Ministry for Economic Cooperation and Development (BMZ), the German Development Bank (KfW) and with the aid of several other stakeholders, aimed at social, situational, and institutional crime prevention while linking urban upgrading with a broad spectrum of social interventions. The total budget of the project is 400 million South African rand ($55.6 million USD). One element of the program is to improve safety on the streets with simple measures. The Active Box is a small three-storey security building that provides offices, caretakers flat and a room for patrollers.

These Active Boxes, manned 24 hours a day, are found along the main pedestrian routes and are painted red. This ensures that if an individual is feeling threatened they can clearly see where they have to go to find help. Safer pedestrian passageways are made available through the use of street lighting and paved walkways; Lights are strategically placed to light up the pedestrian route and are left on until late for kids to play. Citrus fruit trees - Harvestable fruit trees are planned in the courtyard and along the pedestrian walkways to provide shade and comfort state cool down the atmosphere in summer. On a monthly basis, a Patrolling Initiative and Knowledge Management team maps the percentile rank of routes, according to how dangerous they are reported to be and to track changes in the pattern of perceived safety along pedestrian routes in a more accurate way. Red routes are prioritised in terms of patrol deployment. With all these initiatives VPUU measures significant improvements in safety and security: the murder rate dropped by 33%, the best in a low income area in Cape Town.

Figure A.2: Hotspots mapped by VPUU along the Khayelitsha Township where active boxes were installed.

Source: openarchitecturenetwork.org

3. Buenos Aires Pedestrian Priority Program

Buenos Aires, the capital of Argentina is one of the largest cities in the South American continent. Faced with increasing traffic chaos in the city and declining space and safety for pedestrians, the Mayor of Buenos Aires introduced the Pedestrian Priority Program as part of the Healthy Mobility Initiative of the Sustainable Development Policy. The program is aimed at improving pedestrian conditions in the city through strategic street improvement projects. Following are its objectives:

- Improve environmental quality (reduce noise annoyance, air pollution);
- Increase accessibility and connectivity;
- Progressive displacement of public transport to the avenues;
- Enlarge pedestrian space;
- Implement a public bike system;
- Reduce parking areas on roadways;
- Regulation of good loading and unloading;
- Increase and renewal of street furniture;
- Preservation of cultural heritage and identity; and
- Revitalization of commercial and service areas. A number of components have been identified to be part of this program, including the following:
- Street renewal – widening sidewalks, installing lighting and pedestrian traffic signs;
- Dock regulation – consolidating dock loading and unloading positions with the Waste Collection Basin;
- Trees – planting trees to provide shade and add character to public promenades; • Crosswalks – pedestrians priority;

- Equipment - installing street signs to regulate traffic flow and pedestrian circulation; and
- Waste – streamline waste collection by use of centralized waste receptacles on street corners to facilitate the movement of garbage collection vehicles. The overall cost of the program has been estimated at 5.6 million USD. Construction on the street renewals began in 2008 and is still ongoing. Three streets have been completely transformed.

A traffic calmed road at Palmerston North is provided with humps to calm traffic at nonsignalized midblock

Source: Pedestrian planning and design guide, New Zealand Government

4. Medellin, Colombia In 2012

Medellin was named one of the top transport systems in the world by ITDP. This is commendable when considering that, until a couple of decades ago, the city was a hub of drug and gang activity. Medellin's transportation system has not just improved environmental sustainability, but by increasing accessibility, has also brought about social change. The Metro de Medellín, the backbone of the transport network, carries almost half a million passengers every day. The metro cable was connected to the metro to provide better connectivity to the poorer part of the city which were geographical inaccessible. When the first Metrocable line was built in 2004, the station pylons became new centres of activity. These new centres were enhanced with the provision of improved streetscapes, plazas, bridges and promenades that offered higher quality access for pedestrians and cyclists.

Public Electrical Escalators in Medellin

Source:http://www.urbanmobilityindia.in/Upload/Conference/97a28d72-a246-4006-b7ddacdae3be2c6c.pdf

Pedestrian enhancements were not limited to Metrocable station areas. NMT was used to further the Metrocable's agenda – which was to improve accessibility and quality of life by creating well-designed pedestrian spaces. The project that integrated NMT access routes with the local

planning for different areas in the barrios are called Proyecto Urbano Integral (PUI) or local area plans. The PUIs are a result of a participatory planning process involving the municipal Urban Development Wing (EDU) and the resident communities. The PUIs -- 5 in total -- envisioned a network of interconnected public spaces that would not only improve access but also improve residents' quality of life. This network consists of pedestrian links that connect Metrocable stations, public plazas, terraces and amphitheatres with bridges, ramps and stairways. Polluted waterways were remediated and promenades were constructed alongside the renewed streams. People from unstable housing blocks were relocated, but largely minimum alteration was made to the informal fabric of the barrios, and no resident was displaced.

One example that particularly stands out is of Communa 13, a community that regularly suffered from regional conflicts and gang activity. The PUI for Communa 13 seeks to improve mobility and create safe public places for its residents. A new Metrocable line goes through Communa 13 and within its station area a new Library Park activates the public realm and acts as a gateway to the community. In one of the most unsafe areas of the barrio along steep hillsides, a series of six escalators have been built to improve accessibility for residents as well as security. The escalators, ascending nearly 384 m, link open spaces and public terraces. Such investment in infrastructure (nearly 7 million USD), it is believed, will not only vastly reduce pedestrian commute time but also bring peace to the area. Several awareness and advocacy tools have also been used to create ownership among the residents for the infrastructure and ensure that it is not abused.