Promoting Non-Motorized Transport in Asian Cities: Policymakers' Toolbox

December 2013

UN HABITAT
FOR A BETTER URBAN FUTURE

CLEAN AIR ASIA

SHAKTI
SUSTAINABLE ENERGY FOUNDATION

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1. Motivations for Promoting NMT in Asian Cities

"Globally, only 68 countries have national or sub national policies to promote walking and cycling."

- WHO Global Road Safety Status Report 2013

1.1 Asia Urbanizing and Motorizing Fast

By 2011, 52% of the global population has lived in cities and by middle of this century it would have increased to almost 67%.[1] Asia will continue to have half of the world's mega cities. In 1975, eighty cities in Asia had a population greater than one million. By 2025, it is estimated that this will rise to 332 cities (United Nations, 2007). Parallel to urbanization, Asia is undergoing rapid motorization. Asia is now home to around **half a billion vehicles**. It has been estimated that by 2035, both the vehicle population and motorization index[2] will at least double in the Association of Southeast Asian Nations (ASEAN)[3] region, China and India from current levels (2012). In many countries, vehicle growth rates are higher than gross domestic product (GDP) growth rates. Despite projected high number of vehicles for 2035, the projected motorization index for Asia will still be considerably lower than the current motorization index of the developed world. As such, a further rise in motorization levels can be expected beyond 2035 as Asian economies continue to grow. It is important to note that the motorization phenomenon is much more intensive in cities as compared to countries as the wealth of Asia's economies is concentrated in its cities. Apart from rising income levels, growing dissatisfaction with available transport options is forcing as well as attracting people towards the use of personalized, motorized vehicles. In many Asian cities, the motorization levels have reached double the national values.

To cater to this increase in number of vehicles, countries like China and India are rapidly building more roads. Latest estimates from IEA[4] suggest that China nearly tripled its paved roadway network since 2000 and India added one million paved lane kilometers in the past decade. However, building more roads is a solution that creates a vicious cycle of further inducing travel demand, increasing car use and again, the need for roads (Litman, 2013). Unfortunately, land is limited: A lot of Asian cities can't support more roads and even if they can, the construction of roads takes a long time to be approved and constructed by responsible agencies.

In terms of personal expenditure, transport costs comprise a large proportion of the expenditures of many poor people. For instance, the low income population in Shanghai paid as much on transport as on healthcare (5% of income), clothing (5% of income) and rental (0.8% of income) combined in 2003.[5] A similar situation, although of varying scales, can be found in other Asian cities, and rising fuel prices and fuel security issues will further exacerbate this situation in the future.

At a macroeconomic level, negative externalities from transport (i.e. air pollution, traffic congestion, accidents) already amount to 6-10% of GDP in many Asian cities (Partnership on Sustainable Low Carbon Transport, 2013).

1. http://esa.un.org/unup/pdf/WUP2011_Highlights.pdf
2. Motorization index/motorization rate = number of vehicles per 1000 population, http://data.worldbank.org/indicator/IS.VEH.NVEH.P3
3. ASEAN = Association of Southeast Asian Nations; ASEAN countries included are Indonesia, Malaysia, Philippines, Singapore, Thailand and Viet Nam.
4. http://www.iea.org/publications/freepublications/publication/TransportInfrastructureInsights_FINAL_WEB.pdf
5. Per Capita Consumption Expenditures Urban Household In Main Years http://www.statssh.gov.cn/2003shtj/tjnj/nje07.htm?d1=2007tjnje/e0919.htm

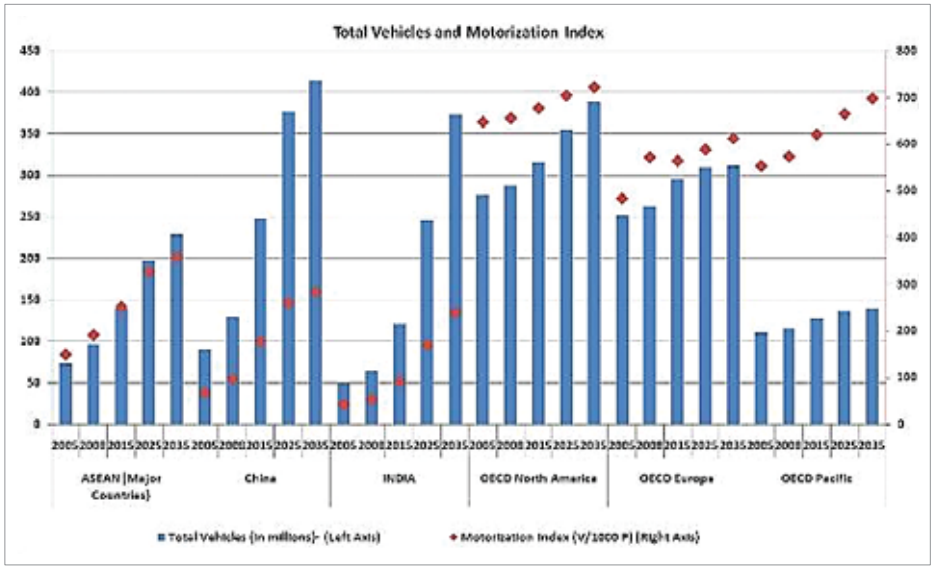


Figure 1: Vehicle Count and Motorization Index in Asia vs OECD

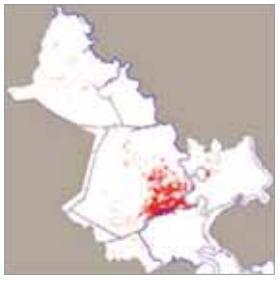
Source: Asian Development Bank and Clean Air Initiative for Asian Cities. 2009

1.2 Decline of Walking and Cycling in Asia

It is no longer pleasant to walk and cycle in many Asian cities and in fact for some cities it is becoming almost impossible. The rapid increase in motorization in Asia combined with limited attention to pedestrian, cycling and public transport facilities have resulted in a decrease in the overall non-motorized transport trip mode share. However, it needs to be highlighted that walking and cycling still provide mobility to a large percentage of people in many cities (Figure 5). Short distance non-motorized transport trips are very common in Asian cities which are characterized by very high population densities and mixed land-use development. But this trend is changing fast. Rapid urbanization and migration of people is causing population growth in city areas with new development being sprawled in the absence of more public and non-motorized transport modes, especially along massive ring road networks. This "steroid effect" results in higher trip lengths causing an increase in motorized trips.

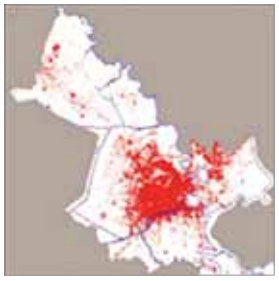
Consider Ho Chi Minh City (HCMC) as an example for the above discussion. The following geographic information system (GIS) images show the growth patterns that occurred in the development of HCMC from 1989 to 2006.

Massive migration and development activities have led to the rapid expansion of Ho Chi Minh City. In the absence of policy support, investment and prioritization for public and non-motorized modes, Ho Chi Minh City has a very high vehicle ownership (especially motorcycles). At the end of June 2010, there were 4.7 million motorcycles registered in HCMC.[6] This equates to 1.5 motorcycles



1989

1998



2006

Figure 2: Growth in Urban Built-up Area of HCMC, 1989 – 2006

Source: Tran et al (2008)

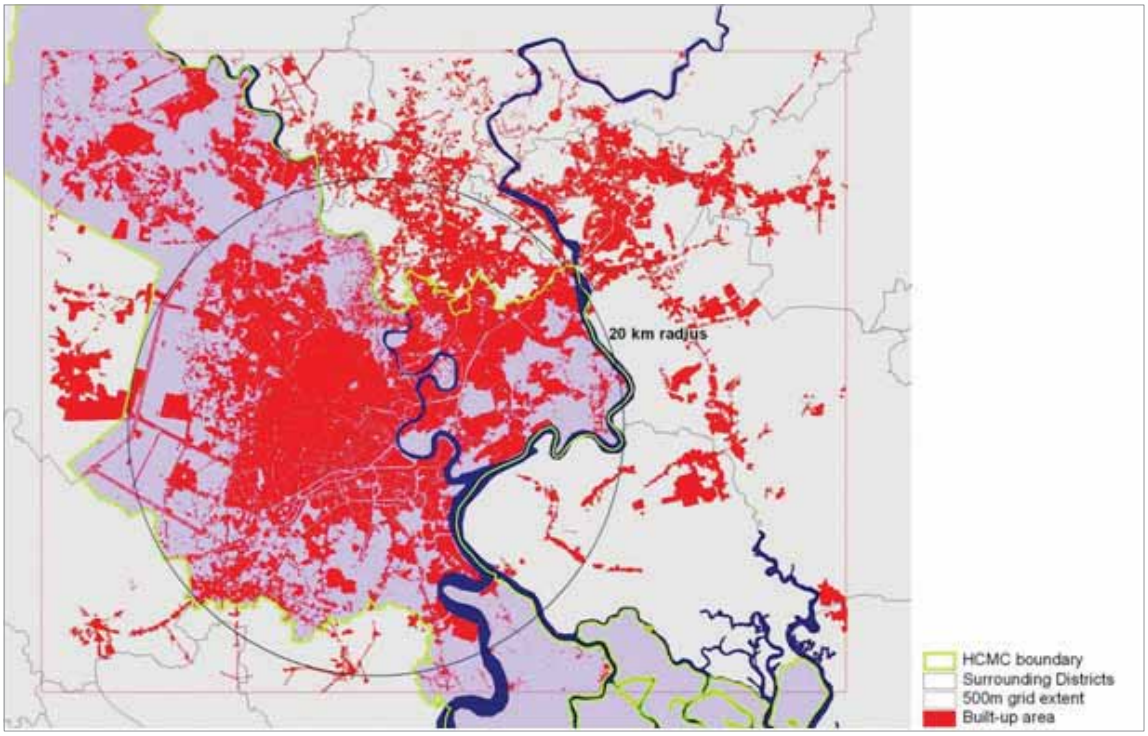


Figure 3: HCMC Metropolitan Region Urban Built-up Area, 2011

Source: Clean Air Asia, ADB and Chreod

per capita. This shows that as the city expands and non-motorized transport space shrinks, average trip lengths for the general population increase, forcing travelers to use motorized forms of transport even more. Non-motorized trips which were 61% in 1995 reduced to 33% in 2002.[7] HCMC now has one of the highest motorcycle ownership per land area in the world.

A significant number of bicycles do exist but are not reflected in transport statistics

Source: Gota, Sudhir 2010

In many Asian cities, a significant share of the population owns bicycles but it is not reflected in trip mode share data (Figure 4). In India, there is a large number of households owning bicycles compared to those that own motorized vehicles but this is not reflected in statistics, policies, strategies and investments. The traditional transport demand models usually take into account only motor vehicle ownership and motor vehicle trips and not the non-motorized modes, which results in recommendations that are strong in terms of improving the level of service for motorized travel.

6. Phi (2011)

7. The Master Plan of Urban Transportation for Hanoi City (1997), JICA and ADB-TA - 6416 (REG) : A Development Framework for Sustainable Urban Transport

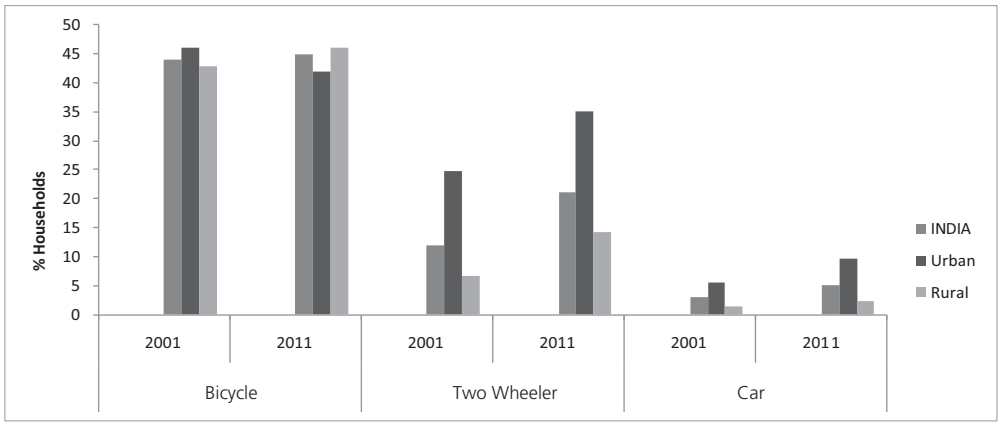


Figure 4: Vehicle ownership in India between 2001 and 2011[8]

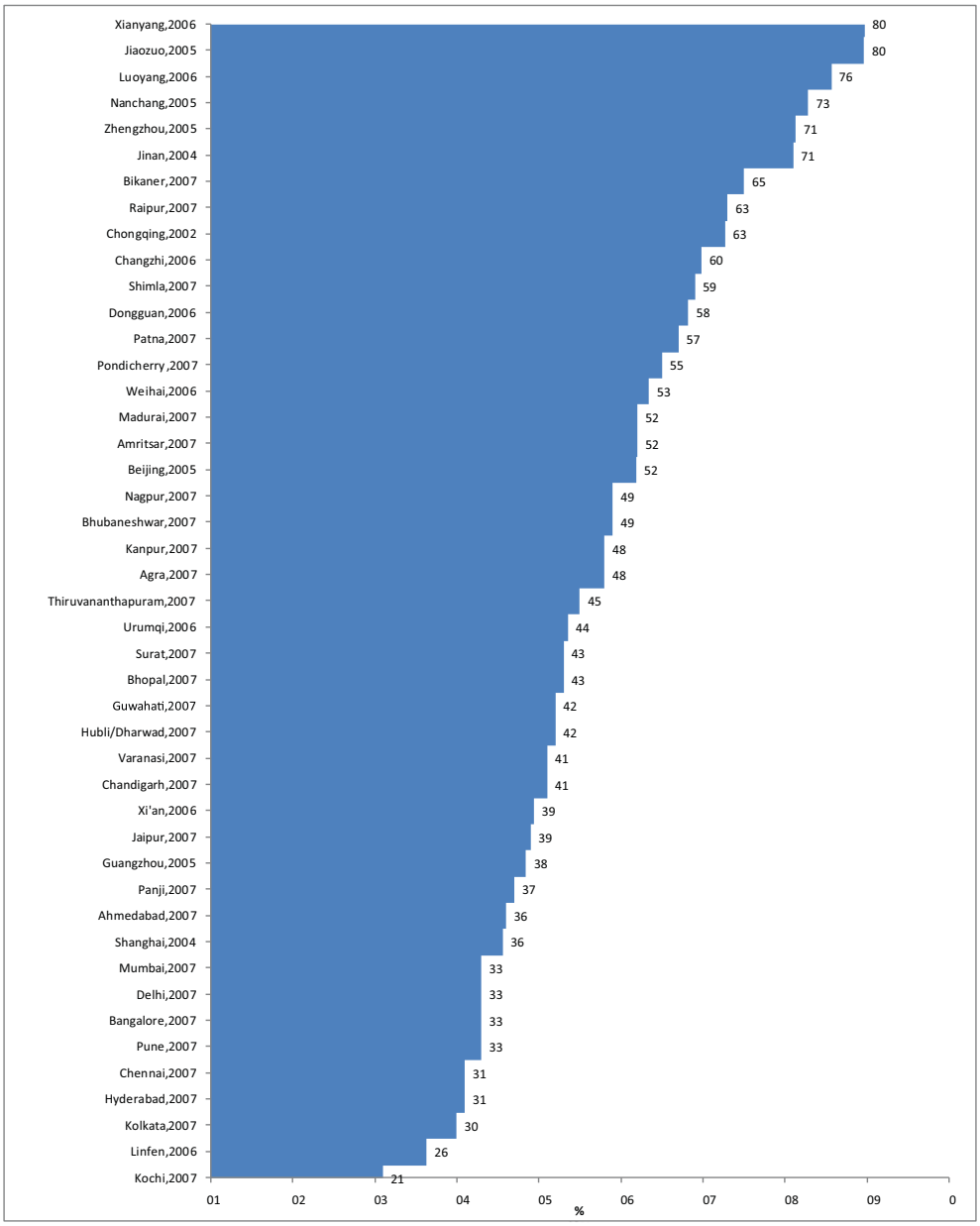


Figure 5: NMT Mode Share in Selected Asian Cities

Sources: Ministry of Urban Development in China, World Bank, Clean air Asia and ADB

8. http://censusindia.gov.in/

A recent study conducted by the World Health Organization (WHO, 2013) on global road safety concluded that *"Only 68 countries in the world have national or local level policies that promote walking and cycling."* The absence of such policies will contribute to the continued decline of NMT trips and shifts to private motorized modes. In Asia, motorized congestion facilitated the shrinking of space allocated to pedestrians and cyclists. Considering the deterioration of facilities and shift of people to motorized modes, it would be apt to say that *pedestrians and cyclists are victims of policy neglect.*

Pedestrian perception surveys were carried out by Clean Air Asia across thirteen cities in Asia, reaching a total of 4,644 pedestrians (Leather, et al., 2011).Survey results reveal that if the walking environment is not improved, 81% voiced that they will shift to other modes when they can afford to; 25% to cars and 13% to two-wheelers. This means that policy makers have a short window of opportunity to reclaim the streets and translate the existing transport network to more sustainable forms.

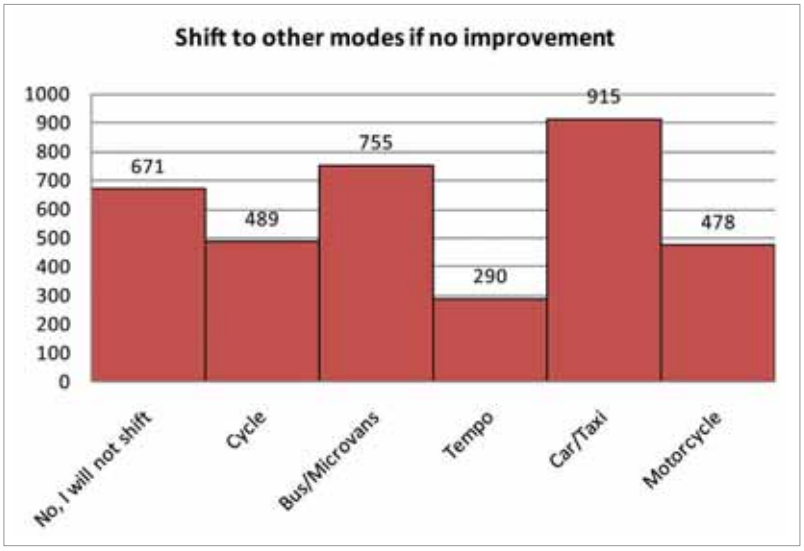


Figure 6: Shift to Other Modes if No Improvement is Done on the Walking Facilities

Sources: Clean Air Asia

bike sharing station in Hangzou

Source: Clean Air Asia

"It is a paradox that walking and cycling provide mobility to a large segment of the society and generally the poor who are the most vulnerable in the transport system rely on use of walking with cycling and bus for daily transport. However the current infrastructure which supports walking and cycling is very poor. Reports suggest that the percentage of roads with pedestrian footpaths runs to hardly 30% in most cities. Loss of accessibility due to poor infrastructure allows victimizing the vulnerable in the transport system. There is an urgent need to change this paradigm. It is clear that non-motorized transport should become the first step in an enlightened urban transport policy. It is important to know what pedestrians/cyclists need from the government and what the infrastructure actually provides so as to understand the implications and plan for the future."

- Prof Madhav Badami

1.3 NMT Accidents and Fatalities

A recent publication from WHO suggests that 27% of all traffic fatalities globally are pedestrians and cyclists. Almost half of the world's road traffic fatalities of approximately 1.3 million people are pedestrians, cyclists and motorcyclists, and more than 90% occur in developing countries (WHO, 2009). The WHO study which analyzed policies around the world related to road safety suggested that:

"Our roads are particularly unsafe for pedestrians, cyclists and motorcyclists who, without the protective shell of a car around them, are more vulnerable. These road users need to be given increased attention. While progress has been made towards protecting people in cars, the needs of these vulnerable groups of road users are not being met."

Missing links in infrastructure aiding pedestrian injury and death in Bangalore

Source: Clean Air Asia

It is interesting to note that pedestrians and cyclists constitute a higher share of total fatalities in cities where facilities do not match the needs of users nor meet the demand. For example, although the national pedestrian fatality share in India is 13% of road accidents, metropolitan cities like New Delhi, Bangalore and Kolkata have pedestrian fatality shares greater than 40%. Similarly, in Kathmandu, pedestrians represent 40% of all road accident fatalities in the city in 2001 (KVMP, 2001). In Ulaanbaatar, Mongolia, 80% of the reported traffic fatalities are pedestrians (Government of Mongolia, 2007).[9] The problem is even more severe when the impact on most vulnerable groups in society, such as children and the elderly, is assessed. For example, in Bangalore, elderly people and school children comprise 23% of the fatalities and 25% of the injuries. It is also worth noting that injuries for traffic accidents are typically under-reported. The actual values are likely to be higher than the reported ones.

9. From 2000 to 2007

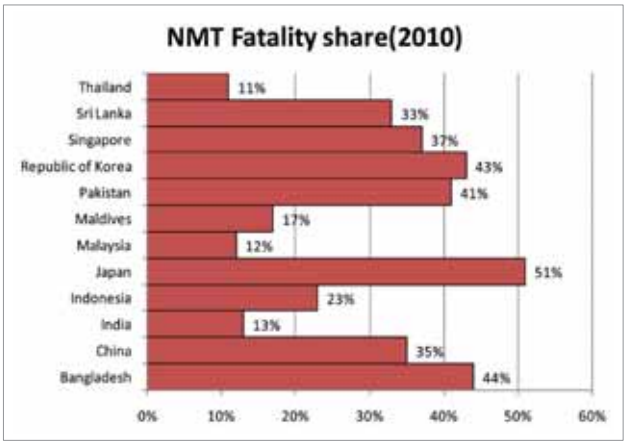


Figure 7: NMT Fatality Share of Road Accident Fatalities in Selected Asian Countries

Sources: World Health Organization. Global Status Report on Road Safety

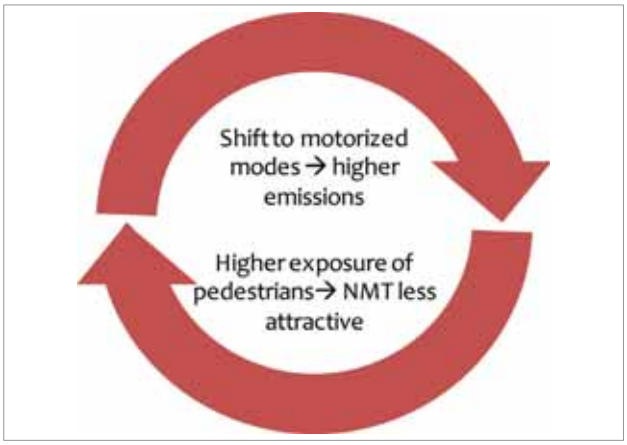


Figure 8: How Lack of NMT Facilities Induce Increased Exposure of NMT Facilities and Vice-versa

Source: Clean Air Asia

1.4 Air Pollution Exposure

The 2010 Global Burden of Disease (IHME, 2013) states that most countries experienced an increase in disease burden due to non-communicable diseases from 1990 to 2010. Exposure to air pollution such as particulate matter, contribute to those non-communicable diseases as well. Outdoor air pollution is one of the leading causes of deaths globally and ranks fourth in China with 1.2 million estimated premature deaths and 25 million healthy years of life lost, which is a 33% increase in the burden of disease attributable to ambient air pollution in China over the past twenty years.[10] Road injuries are also one of the dominant and rising causes of premature death and disability in countries such as India.

The figure below shows how the lack of appropriate non-motorized facilities can spur a vicious cycle of making people want to shift to motorized modes and increasing the exposure of pedestrians and cyclists to pollution and vehicular accidents.

A special report of the Health Effects Institute (HEI, 2010) synthesizes the best available evidence on the assessment of exposure to traffic-related air pollution. *It concluded that the high exposure zone to traffic emissions stretches up to 300 to 500 meters from highways or major roads* (the range reflects the variable influence of background pollution concentrations, meteorological conditions, and season). The study also estimated that 30% to 45% of people living in large North American cities live within such zones (HEI, 2010). Estimates made for Delhi and Beijing show 55% and 76% of the population within 500 meters of a freeway and 50 meters of a major road likely exposed to high levels of traffic-related air pollution (HEI, 2010). Considering the high density in many Asian cities, the percentage of people walking, living or working within high exposure zones is likely to be higher. Pedestrians are exposed to very high levels of air pollution when they walk along these busy roads, very close to the emissions from vehicle tailpipes. In a study conducted by the East-West Center (2007) in Hanoi, pedestrians were found to be exposed to 495 µg/m3 of PM10, motorcyclists to 580µg/m3, and car drivers to 408µg/m3 and bus passengers to 262µg/m3; all of which are way above the WHO guidelines for levels of PM10 of 20 µg/m3 (World Health Organization, 2006).

Pedestrians walk beside the vehicle tailpipe, travel at slow speeds and have high exposure rates to pollution

Source: Clean Air Asia

10. http://www.healtheffects.org/International/HEI-China-GBD-PressRelease033113.pdf

1.5 Transport Energy Consumption and Emissions

Transport accounts for 62% (2011) of global oil consumption and nearly 26% of world energy use (International Energy Agency, 2013). The latest IEA projections suggest that CO2 emissions from transport are expected to rise by 70% by 2050 compared to 2010 levels and majority of this growth to occur in developing countries despite ongoing vehicle technology and fuel-economy improvements. It has been established that transport CO2 emissions in Asia have increased at a higher rate compared to Gross Domestic Product (GDP) growth and that transport in developing countries is responsible for up to 70% of air pollution in some cities in Asia.

1.6 Impact of Improved Walking and Cycling Facilities

A large body of literature concentrates on the benefits of walking and cycling for users, stressing that it is not just a means of mobility but also a physical activity. The World Health Organization estimates that physical inactivity is responsible for the following global disease burdens: 27% of diabetes, 30% of ischemic heart disease, and 21 to 25% of breast and colon cancers. Users of bicycles and people who walk are indeed reported to be fitter, less obese with reduced risks of cardiovascular diseases compared to users of motorized transports(Reynolds, Winters, Ries, & Gouge, 2010).

In a recent article in *The Lancet*[11] on health impact, alternate transport scenarios were estimated in London and Delhi. It was found that for Delhi, the cleaner motor vehicles and increased active travel scenarios (walking and cycling) resulted in a greater health gain from reduced air pollution than for London. Authors estimated that the reduction in CO2 emissions through an increase in active travel and less use of motor vehicles had larger health benefits per million population (7,332 disability-adjusted life-years [DALYs] in London, and 12,516 in Delhi in 1 year) than from the increased use of lower-emission motor vehicles (160 DALYs in London, and 1,696 in Delhi). Maximum benefits can also be gained with a combination of active travel and lower-emission motor vehicles notably from a reduction in the number of years of life lost from ischemic heart disease (10-19% in London,11-25% in Delhi).A recent publication of the Asian Development Bank showed that NMT projects would be economically feasible even if the emissions benefits are quantified and converted to economic terms (Asian Development Bank, 2010). In most transport assessment frameworks, however, many of the benefits of NMT are considered as indirect and hence not considered in the evaluations.

Benefits	Co-Benefits
Improved NMT Conditions	• Improved user convenience and comfort • Improved accessibility for non-drivers, which supports equity objectives • Higher property values
Increased NMT Transport Activity	• User enjoyment • Improved public fitness and health • Increased community cohesion (positive interactions among neighbors due to more people walking on local streets) which tends to increase local security
Reduced Automobile Travel	• Reduced traffic congestion • Road and parking facility cost savings • Consumer savings • Reduced chauffeuring burdens • Increased traffic safety • Energy conservation • Pollution reductions • Economic development
More Compact Communities	• Improved accessibility, particularly for non-drivers • Transport cost savings • Reduced sprawl costs • Open space preservation • More livable communities • Higher property values

Table 1: Benefits of Walking and Cycling

Source: Litman, 2013

1.7 Growth of Public Bike Share Schemes

There has been an explosive growth in the number of bike share schemes (Midgely 2011, Larsen 2013). This massive interest in bike share schemes can translate to a *bike revolution* if Asian cities support this initiative with the right planning and a bold vision. Bike share systems with the latest technology and branding are transforming mobility in many cities (Beroud and Anaya 2012). Bike share systems have evolved in last four decades - from

11. Public health benefits of strategies to reduce greenhouse-gas emissions: urban land transport

simple, differently painted, free-to-use bicycles to coin-operated locking to third generation systems using card reading technology (Shaheen, Guzman, Zhang 2010). By 2013, about 500 cities are facilitating bike share schemes with over 500,000 bicycles (Larsen, 2013).

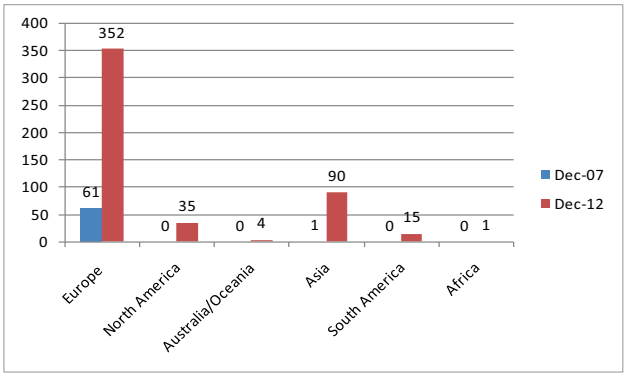


Figure 9: Number of bike sharing schemes implemented per continent

Source: http://bike-sharing.blogspot.in/

The recent schemes are formulated with the philosophy of collaborative consumption and are attractive because they work best for short trip lengths, help reduce congestion and improve the health of citizens. Many believe that like the Bus Rapid Transit System (BRTS), these systems have the potential to transform public transport and also help in evolving public acceptability of bicycles as a means of active transport.

Statistics (Shansan & Schroeder, 2010) reveal that while the bike-share programs bring substantial numbers of new bicycle riders, such schemes do not have a significant impact in reducing congestion. The evaluation of different schemes suggests that a substantial number of public bicycle riders earlier made bus trips (46%).

The approximate shift from cars, two-wheelers and taxis is found to be only 12%. However, one also needs to consider the future growth of vehicles, subsequent congestion and future infrastructure investment required to realize the impact of such systems. To understand the scale of growth, the Hangzhou system alone operates 697,000 public bicycles and 2,962 service stations across the city, with an average of 257,500 trips per day. The highest rental record is 378,500 trips in a day (Yiqi, Lin, & Jingxi, 2013).

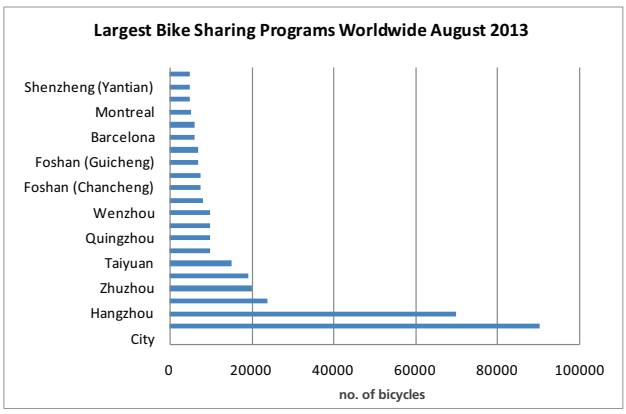


Figure 10: Bike Population in Bike Sharing Programs Worldwide

Source: Earth Policy Institute

Bike Sharing Station in Hangzhou

1.8 Summary

This chapter introduced the motivations for promoting non-motorized transport in Asia. **Section 1.1** discussed urbanization and transport in Asia. The region is growing fast and more than half of the Asian population will live in urban areas within the next fifty years. Demand for mobility is increasing as population is also increasing. **Section 1.2** discussed the effects of unplanned urbanization on mobility: People have stopped walking and have depended on cars for mobility needs. A large fraction of Asian cities have been designed to support motorized transport, becoming increasingly fuel-dependent, increasing pollution exposure and road risk, and dissuading people from using more sustainable forms of transport. These issues were discussed in detail in **Sections 1.3 to 1.5.**

In **Sections 1.6 and 1.7** co-benefits of NMT are outlined to emphasize the efficacy of NMT as a remedy to transport problems. Section1.7 provides an example of an implemented and growing NMT program: the public bike-sharing scheme. This has been successfully implemented in various Asian cities such as Hangzhou, China.

Chapter 2 will present the transportation planning process and how to incorporate NMT into the process. Visioning will also be introduced as an important step for ensuring public participation. Tools will be provided for assessing walkability and cyclability. These tools are intended for planners, policy makers and decision makers alike. Finally, this chapter will share some experiences about the implementation of NMT strategies in various cities in Asia to establish a range of city and country perspectives.

2. How to Improve NMT in Asian Cities?

2.1 The Transportation Planning Process

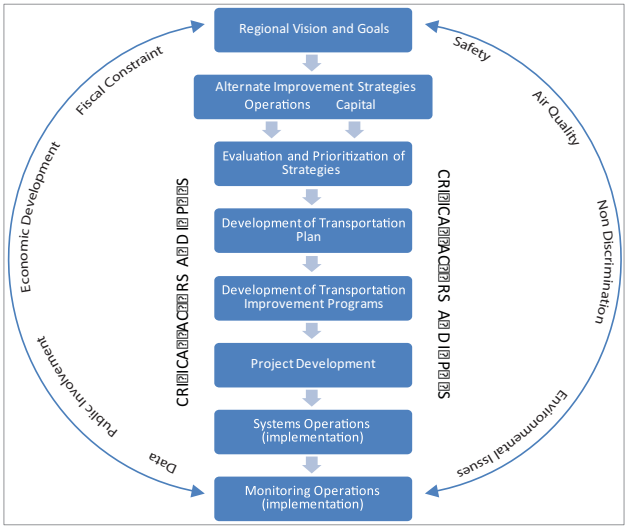


Figure 11: The transportation planning process

Source: Transportation Planning Capacity Building Program, 2007

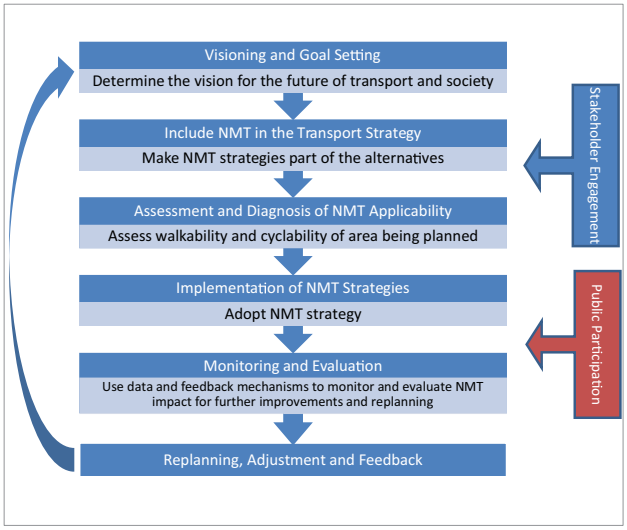


Figure 12: A hypothetical integration of NMT into the transportation planning process

Source: Clean Air Asia

Part of an effective adoption of NMT is integrating the concept into transportation planning.

Planning in general is an iterative thought process for creating future development scenarios. There is no single model that solely describes the transportation planning process. However, the key steps are similar across all models. Figure 11 shows an example transportation planning process used by the United States Transportation Planning Capacity Building Program.

The basic parts of transportation planning process are as follows:

1) Visioning and Goal Setting
2) Generation of Alternatives
3) Evaluation, Diagnosis and Assessment of Strategies
4) Implementation of Strategy
5) Monitoring and Evaluation

NMT can be integrated into the transportation planning process. Figure 12 shows a hypothetical integration of NMT into the transportation planning process.

The importance of stakeholder engagement and public participation into any planning process cannot be emphasized enough. NMT cannot succeed without involving important sectors of society and without raising awareness and cooperation from the people.

2.2 Visioning

Visioning is just as important as technical assessment and evaluation: What kind of society do the people see for themselves in the future? Will people walk or drive cars in the long term? Do the people want to have enough bike lanes and pedestrian lanes? It is important to visualize the future, ensuring that the vision is from the people. Visioning is a process that ensures that the application of any strategy is socially inclusive and that public interest is upheld.

A vision of a compact and healthy city does not equate to a car-based city.[12] A clear vision of what the city should look like in the future is needed. What a livable city constitutes is determined by what type of city its citizens want to live in. To understand that perspective, consultations have to

12. CAI-Asia (Clean Air Asia) Sustainable Urban Mobility in Asia(SUMA) Programhttp://cleanairinitiative.org/portal/whatwedo/projects/SUMA

be conducted with relevant government agencies and stakeholder groups that influence their decisions, such as community groups, residential welfare associations, private sector, non-government organizations (NGOs), academic and research institutions, and development agencies. The engagement process is helpful as it brings together groups who would otherwise not meet. This helps develop an understanding of each stakeholder's specific limits, needs, and difficulties and defuses conflicts.

Carless day in Manila: The activity allows for public participation, engagement and awareness about NMT

Source: Clean Air Asia

The aim of this consultation is to determine what the people desire as the characteristics of a livable city they want to live in. These will vary between cities, however, common characteristics are: accessibility of all citizens to work, education, healthcare and other places of importance to them, sufficient public spaces for relaxation and recreation, security and safety, a green environment and clean air. This vision has consequences on land use planning, covering amongst others, office buildings, public spaces, residential areas and the transport system that connects them. Consequently, it will help in identifying relevant transport policies and projects that should be given priority in terms of NMT promotion. It is essential to involve a diverse set of stakeholders for consultation and dialogues in obtaining feedback on policies and projects. The feedback will in turn be used for further feasibility analysis.

While planning and promoting NMT in cities, consultations with stakeholders should not end with the visioning process but needs to be continued while designing, constructing and monitoring projects to develop a continuous stakeholder engagement.

2.3 Diagnosis - How to Assess Walkability

Several methodologies are available to assess walkability and they vary in several respects: the emphasis in qualitative or quantitative assessment, components covered in the assessment, sampling and scoring methods. For example, *the Ministry of Urban Development (MoUD) of the Government of India* uses a walkability index that is a function of the availability of footpaths and rating of pedestrian facilities (Ministry of Urban Development, 2008). Using this walkability index, MoUD assessed the quality of pedestrian infrastructure of thirty cities in 2008 and found an average index of 0.52 (out of 1). The facility rating is determined with an urban transport benchmarking tool that uses three indicators: signalized intersection delay(seconds) per pedestrian, street lighting levels (Lux) and percentage of the city covered with footpaths wider than 1.2 meters. The limitation of this methodology is that it is difficult to assess what parameter needs improvement, such as safety, security, amenities, disability infrastructure, among others.

Figure 13: Snapshot of Walk Score Application and Ratings in Asia

Similarly, a popular website, *"walkscore.com"* calculates an area's walkability based on the distance of residents' houses to nearby amenities (Walk Score, 2013). Using this scoring system, Pune in India is considered a walker's paradise whereas Bangkok, Beijing and Cebu are considered car-dependent cities. Although walkscore.com measures how easy it is to live a car-free lifestyle and considers how dense the land use is (which can reduce trip lengths), it does not include a qualitative assessment of pedestrian facilities like street width, block length, street design, traffic and crime safety, among others. As a result, many Asian cities can have high scores in walkscore.com because of the traditionally mixed-use character of the cities and high density, but this does not mean that these cities are easy to walk in.

An example for more in-depth methodology is Transport for *London's Pedestrian Comfort Guidance 2010*. The assessment comprises of a 3-step process:

1. Assess footway comfort which is sub-divided into:
    a) Site selection, site visit and selection of location,
    b) Categorization of area type,
    c) Activity data (measurement) collection,
    d) Spreadsheet assessment,
    e) Review and interpretation of results,
2. Assess crossing comfort, and
3. Review impact scheme.

The survey, however, does not consider the qualitative parameters such as maintenance, cleanliness and others. It is an in-depth assessment of streets, sites, looking into pedestrian volume, width, obstructions, among others aspects, in different land use types such as i) high street, ii) office and retail, iii) residential, iv) tourist attraction, and v) transport interchange. The data collected from the field is entered into specially-designed excel spreadsheets which provide outputs in the form of scores of A, B, C, D, E with A being the most comfortable walkway. The main objective of the assessment is to influence and bring about changes in the design of walkway and crossings alike, such as increasing the signal timing, providing a larger island, increasing the width of the walkway, among others, and to open dialogues with authorities.

The Institute for Transportation and Development Policies's (ITDP) Better streets, better cities is a guide to street design using the concept of complete streets, providing equitable space to all road users. A prerequisite for the design process is comprehensive data collection and assessment. It involves a topographic survey of the street to identify physical entities such as buildings, roads, trees, electric posts and with the help of the pedestrian activity survey collects information on usage of walkways and crossings, presence of vendors and other activities that occur on the street and influence design.

Source: Clean Air Asia

A good example for a comprehensive yet simple methodology is the Global Walkability Index developed by H. Krambeck for the World Bank which provides a qualitative analysis of the walking conditions including safety, security, and convenience of the pedestrian environment. It consists of a field walkability survey to assess pedestrian infrastructure in four areas: commercial, residential, educational, and public transport terminals. The survey identifies pedestrian preferences, and analyzes government policies and institutional setup in support of walking. The methodology is qualitative but because it encompasses several key parameters, provides a good insight into the current state of the walkability environment, and enables the identification of areas for improvement.

The Clean Air Asia Walkability Index is the Global Walkability Index modified to suit the Asian context. In this assessment, areas with high pedestrian volume are selected based on preparatory surveys and consultation with local partners. Complete route assessments are conducted by following logical pedestrian routes in the specific areas linking origins to destinations. Complete route assessments are also conducted to provide a holistic overview that links design and execution to user perception and the built environment. In order to facilitate comparisons among cities, the field survey uses a uniform rating system for all nine qualitative parameters (Table 2).

The Clean Air Asia Walkability Index method of deriving a "Walkability Rating" differs from the Global Walkability Index (GWI). The GWI takes into account the number of people walking (pedestrian count) during the time of the survey and the length of the stretch being surveyed. While the Clean Air Asia Walkability Index methodology documents street lengths and pedestrian counts, it excludes these two factors from the rating to eliminate the inherent bias generated by the number of people walking on a certain stretch and its length. For example, a stretch with adequate infrastructure and very high pedestrian traffic should not receive a higher rating than a high-quality stretch with low pedestrian traffic. Utilization by itself should not be a parameter to assess the walkability of a certain area because it penalizes good areas with lower utilization rates. Current levels of pedestrian traffic are more useful in identifying priority areas for improvement (e.g. areas with high pedestrian traffic but with low walkability ratings). This argument also holds true for distance. A relatively short but high quality stretch of footpath should not be penalized because it is shorter.

A good example for a comprehensive yet simple methodology is the Global Walkability Index developed by H. Krambeck for the World Bank which provides a qualitative analysis of the walking conditions including safety, security, and convenience of the pedestrian environment.[13] It consists of a field walkability survey to assess pedestrian infrastructure in four areas: commercial, residential, educational, and public transport terminals. The survey identifies pedestrian preferences, and analyzes government policies and institutional setup in support of walking. The methodology is qualitative but because it encompasses several key parameters, provides a good insight into the current state of the walkability environment, and enables the identification of areas for improvement.

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Parameter	Description
1. Walking Path Modal Conflict	The extent of conflict between pedestrians and other modes on the road, such as bicycles, motorcycles and cars
2. Availability of Walking Paths	The need, availability and condition of walking paths. This parameter is amended from the parameter "Maintenance and Cleanliness" in the Global Walkability Index
3. Availability of Crossings	The availability and length of crossings to describe whether pedestrians tend to jaywalk when there are no crossings or when crossings are too far apart
4. Grade Crossing Safety	The exposure to other modes when crossing roads, time spent waiting and crossing the street and the amount of time given to pedestrians to cross intersections with signals
5. Motorist Behavior	The behavior of motorists towards pedestrians as an indication of the kind of pedestrian environment
6. Amenities	The availability of pedestrian amenities, such as benches, street lights, public toilets, and trees, which greatly enhance the attractiveness and convenience of the pedestrian environment, and in turn, the surrounding area
7. Disability Infrastructure	The availability of, positioning of and maintenance of infrastructure for the disabled
8. Obstructions	The presence of permanent and temporary obstructions on pedestrian pathways. These ultimately affect the effective width of the pedestrian pathway and may cause inconvenience to pedestrians
9. Security from Crime	The general feeling of security from crime on a certain stretch of road

Table 2: Field Walkability Survey Parameters

13. More information on the Global Walkability Index is available at http://www.cleanairnet.org/caiasia/1412/article-60499.html

Field surveyors rate the selected road stretches from 1 to 5 for each parameter (1 being the lowest, 5 being the highest) in each of the area types. The averages for each of the parameters are translated into a rating system from 0 (lowest score) to 100 (highest score). Walkability ratings in the different area types in each city are derived by taking the average of the individual parameters' averages. The final city walkability ratings are derived by averaging the walkability ratings in the different area types in each city (see Annex B).

Despite making the most trips, cyclists and pedestrians are marginalized on the streets

Source: Clean Air Asia

One of the limitations of the field surveys is the subjectivity of responses as it influenced by the surveyor, especially in the initial study of thirteen Asian cities that involved different organizations and individuals to carry out the surveys. There needs to be a balance between accuracy, simplicity and resources availability. The methodology adopted for the thirteen cities' study is very economical and simple but less accurate when compared to many quantitative methodologies. The objective is that the results need to give a clear enough indication about the weak areas in the current pedestrian infrastructure, facilities, supporting policies and institutional set up, so that actions for improvement can be taken.

A pedestrian preference survey was also prepared to capture the views of pedestrians. The survey consists of a series of questions on age, income, travel patterns, improvement preferences among others. The responses will help supplement the findings of the index survey. The questionnaire is present as Annex E.

2.4 Diagnosis - How to Assess Cyclability

Similar to walkability indices/assessment tool, diverse cyclability assessment tools and indices are available with different degrees of development and sophistication. While some use only a handful of criteria, others follow an exhaustive list of indicators. While some rely on subjective assessment (general impressions), others rely more on objective measurements (presence of bike lanes, of traffic signals and so on).

Bike crossings are as important as bike lanes

Source: Clean Air Asia

The *Copenhagenize Index* (http://copenhagenize.eu/) is an interesting ranking system developed jointly with James Schwartz of the Urban Country (a bicycle transportation blog). It focuses on major cities of all continents, from New York to Rio de Janeiro, and from Tokyo to Dublin. Cities were given between 0 and 4 points in 13 different categories by volunteers.

In addition, it uses a concept of bonus score (maximum 12 points) to reward cities for extra efforts. In total a maximum of 64 points are awarded which are later scaled to 100 points to determine the index. The parameters used are: advocacy, bicycle culture, bicycle facilities, bicycle infrastructure, bike share programme, gender split, modal share for bicycles, and modal share increase since 2006, perception of safety, politics, social acceptance, urban planning and traffic calming. The Copenhagenize considers the current use of bicycles as a criteria for cyclability ("percentage of modal share made up by cyclists"), while this may be redundant with all other categories that may already explain the poor/high current use of bikes in the city. The repetition may then exaggerate the scores of the city in focus.

The US Department of Transportation checklist[14] is a widely used toolkit to rate communities for biking infrastructure. It was developed by the US Department of Transportation in collaboration with the National Highway Traffic Safety Administration and the Pedestrian and Bicycle Information Center. The primary objective of this checklist is to help cyclists evaluate the cyclability of their communities with minimal resources. It is a tool

for evaluation of and improvement of existing bike infrastructure rather than a reflection of how to get non-bicycle users on the road, or on the relationship between the spatial pattern of the city and bike use.

The document basically consists of seven groups of multiple answer questions which give a final score to rate cyclability in the community (the scale is not specified), and a set of advice for bike users to improve cyclability.

The main questions posed are:

- Did you have a place to bicycle safely?
- How was the surface that you rode on?
- How were the intersections you rode through?
- Did drivers behave well?
- Was it easy for you to use your bike?
- What did you do to make your ride safer?
- Tell us a little about yourself.

The TravelSmart Toolkit was developed by the Bicycle Federation of Australia (BFA) for the Australian Greenhouse Office in the Department of the Environment and Heritage, with the endorsement of the Australian Bicycle Council. This cyclability index can be understood as an improved version of the US Department of Transportation checklist, being more extensive and functioning as a guide for cyclability assessment.

The objectives of the toolkit are:

To provide a simple, easy-to-use checklist that identifies barriers and opportunities to create physical environments which encourage cycling, and provides further resources

- To allow local government to assess its strengths and identify areas where improvement can be made to encourage and promote cycling
- To provide ideas and 'easy-to-access' resources for further information

The resource materials include references, guidelines and other resources to assist in the implementation of local cyclability audits and actions. The target audience comprises four kinds of actors: local government, state government, developers and community. The TravelSmart Toolkit consists of two main checklist documents to evaluate either the cyclability of the local government area (LGA) or the cyclability of a specific route. Both come in short and detailed versions.

The LGA checklist is divided into five sections (158 criteria):

- Strategy and Planning
- Level of service
- Comfort and Attractiveness
- Safety
- Environment and Health

The Route Based Checklist is divided into seven sections (63 criteria):

- Coherence
- Directness
- Comfort and Convenience
- Safety
- Intersections
- Off-Road Paths (if applicable)
- End of trip facilities

This toolkit is very comprehensive and it focuses not only on infrastructure but also on the governance aspect of cyclability, such as involvement of the civil society and budgeting. The guide however does not propose to include any mapped data analyses to combine these results with the land use context of the city, so there is a lack of visual outcome.

University of British Columbia's *Cyclability* Index was developed as a result of an academic exercise. This tool is not a simple tool but a GIS-based extensive tool which links the physical environment data analyses and opinion survey findings. The first phase of the study consisted of an opinion survey in the Greater Vancouver region. Data was collected from 2,149 adults from phone interviews in which origins, destinations and modes of travel per weekly trips were reported for each individual. Results from this opinion survey were jointly analyzed with the built environment and helped identify features of the built environment associated with a higher likelihood of cycling, versus driving. The survey also determined which components are deemed important to cyclists for cyclable neighbourhoods, and these results were further explored at focus group discussions that considered each type of bike user separately (regular cyclists, occasional cyclists and potential cyclists).

14. http://www.nhtsa.gov/people/injury/pedbimot/bike/cyclability/checklist.htm

A cyclability index was created out of the findings and 5 main criteria were central:

- Bicycle route density
- Bicycle route separation
- Connectivity of bicycle-friendly streets
- Topography
- Destination density

Cyclability maps of Metro Vancouver were made out of this index and confirmed by the objective findings of the matching between GIS analysis and trip details.

In the *BikeScore* approach, the philosophy of walkscore is reflected in the bikescore concept(Walk Score, 2013). Bikescore measures biking quality of a location on a scale of 0 to 100 based on four equally weighted components:

- Bike lanes
- Hills
- Destinations and road connectivity
- Bike commuting mode share

The score is derived based on the analysis of parameters as described earlier based on GIS data provided by the city authorities.

Source: Clean Air Asia

Another interesting approach is the San Jose Index which is different from the approaches previously discussed. This index, developed in 2004 by transportation consultants Fehr & Peers for the Bicycle Master Plan Process of San Jose, California, mainly focuses on the bicycle potential of future bike lanes or paths. Using GIS software programs, developers used demographic and social data to determine the bicycle potential of roads. The main indicators chosen are:

- **University Locations:** Universities and colleges are important bicycle destinations and trip generators. College students, those that live within three miles of campuses, are more likely to use bicycles for transportation and leisure activities.
- **Population Density:** The population density factor corresponds to the relative population density within the city. Areas with more people but with more mixed use per square mile have a great potential for bike riding and a greater need for bike facilities.
- **Employment Density:** Areas with high employment density typical have high activity levels and closely spaced destinations for cycling trips.
- **Job Housing Balance:** This factor is related to employment density but captures the bicycle potential of areas with mixed use.
- **Auto Access:** Households with access to an automobile are less likely to use bicycles as their primary form of transportation.
- **Proximity to Transit:** Bicycle routes that connect housing and job locations to transit stops may encourage transit ridership (Bernheim, 2004).

The outcome of the study is a map of San Jose showing which roads should be prioritized in the Master Plan (and the degree of priority, according to color gradients) for future accommodation of bike users.

2.5 Cyclability Assessment Tool for Asia

Most Asian cities, though naturally built for non-motorized transport, lack infrastructure and rarely use scientific toolkits to create biking or cycling plans and undertake policy and investment interventions to support cycling. Clean Air Asia with support from UN-Habitat and Shakti Sustainable Energy Foundation developed a toolkit for assessing cyclability (Asian Cyclability Index) using a similar approach to that of the Clean Air Asia Walkability Index. The main objective was to develop a simple tool which would aid both cyclists and policy makers.

Based on discussions with various partners, the following philosophy was adopted in developing the Asian Cyclability Index:

"The index would assess the cycling friendliness or 'cyclability' of a street. There are different levels the 'cyclability' can be assessed, such as at the city level, the neighborhood level or the street level. Here, ***the street level is chosen as this is the basic unit at which the assessment can be carried out.*** *A neighborhood score is*

considered as a sum of many streets and a city is a sum of its neighborhoods. Moreover, to look into the facilities aspect, such as cycle tracks, shade, lighting, traffic calming, crossings, perception of security and such others can be assessed better on a street level than at a much larger level. The functional linkage between corridors and network would be captured with a cyclist interview survey."

To arrive at the cyclability index, two survey instruments are to be completed: cyclability index survey (Annex C) and cyclist perception survey (Annex D).

There are sixteen parameters considered in the **Cyclability Index Survey:**

i) Conflict with other modes, ii) Availability of Cycle Tracks, iii) Behavior of motorists, iv) Lighting, v) Quality of Riding surface, vi) Crossing points, vii) Availability of cycle parking, viii) Shaded lanes, ix) Exposure to air pollution, x) Traffic calming measures, xi) Connectivity of street network, xii) Sign boards and marking, xiii) Connectivity with other modes, xiv) Presence of service shops, xv) Priority at junctions, and xvi) Perception of security (see Table 3b for a description of each parameter).The rating system for each parameter is 0 to 4, with 0 being the lowest indicating poor facilities. The total score obtained from all the parameters are summed and converted into a score out of 100.

Apart from the index survey, a **Cyclist Perception Survey** was also developed to understand the needs of the cyclists. The survey is a questionnaire that captures details such as age, origin, destination, travel time, income, travel characteristics, preferences, among others. Completion of the Cyclist Perception Survey is independent of the index survey but will help in providing better insights of what cyclists feel and what improvements they would like to see in cycling facilities. See details in Annex D.

The succeeding paragraphs tell the story of how the Asian Cyclability Index was developed.

Based on the review of various methodologies discussed earlier, an initial list of twenty-two parameters to assess cyclability was arrived at (see Table 3a). An online survey was then conducted to capture insights from respondents in different countries on which parameters they considered most important. Respondents were asked to rate each parameter on a scale of 1 to 5, with 5 being most important and 1 being least important. Almost 250 responses were received, of which 189 were complete responses while others were incomplete with only few parameters being rated. Based on the responses or people's priority which scored low, some of the parameters were dropped and some included in the interview survey. Some of findings of the response survey are:

1. Nearly 37% of responses came from people who do not cycle and 63% responses from people who bike/cycle more than once a week. About 33% of respondents ride the bicycle 5 times or more a week.
2. Responses from Bangalore city were the highest comprising 27%. Metro Manila, Beijing and New Delhi were next with 15%, 11%, 10% respectively. Responses from 21 cities of developed countries and 55 of developing countries were received. Of the 250 responses, 82% of the respondents came from developing cities while the remaining 18% came from developed cities. This represents a good mix as the focus is on promoting cycling in the developing cities, especially in Asia.
3. 76% of respondents were male and 24% were female. While there were not many significant differences in the preferences between men and women, the requirement of lighting scored higher for women (55% rating it 5 than 35% men rating it 5). Conflict with other modes, 71 % women rated it 5, while 60% men did so. This means that safety and security were primary factors for women.
4. Most of the respondents ranged from 20- 35 years of age; 4% of the respondents were 60+ years of age and 2% were less than 20. This means that the survey did not capture schoolchildren who could be a primary group of bike users. It is recommended to consider interviewing school children to get their insights during cycling preference survey.
5. Detailed ratings on several parameters are shown in the chart below. It is interesting to note that top priorities or top parameters which dictate good cyclability in developing cities are - conflict with other modes, availability of cycle tracks, priority at junction, air pollution exposure, motorist behaviour, connection with public transport have received overwhelming majority. In comparison, cyclists in developed cities were concerned about conflict, availability of cycle tracks, behaviour of other motorists, lighting etc.

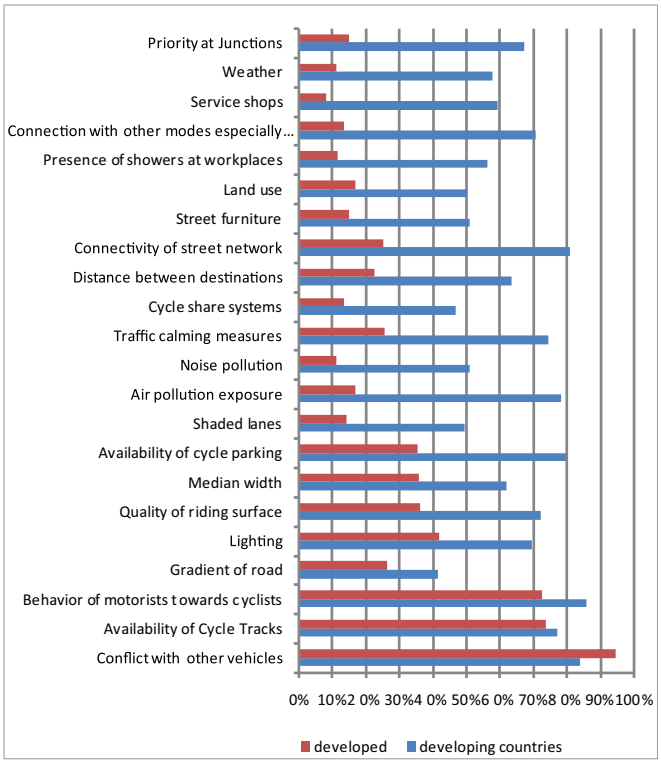


Figure 14: Average Ratings for Important Attributes and Conditions for Cyclability

6. When deciding on index parameters, some parameters though rated important by a few people were neglected in the index ranking, some were included in the preference survey questionnaire and some renamed. The table below gives the list of parameters considered. For example, instead of considering the weather parameter, shaded lanes were considered in the evaluation. It should not happen that if the survey was carried out when it was raining, the corridor is given poor rankings when compared to another corridor evaluated when not raining. Similarly, gradient was neglected. Gradient is very important for biking but it is important to note that corridors should not be rated based on topography as a good biking infrastructure in a hilly terrain can get lower scores than a medium biking infrastructure in a plain terrain. Since the evaluation was more from the corridor aspect, the following parameters were included in the preference survey and not in the actual index – land use, connectivity with public transport, presence of showers at workplaces, presence of service shops, etc.

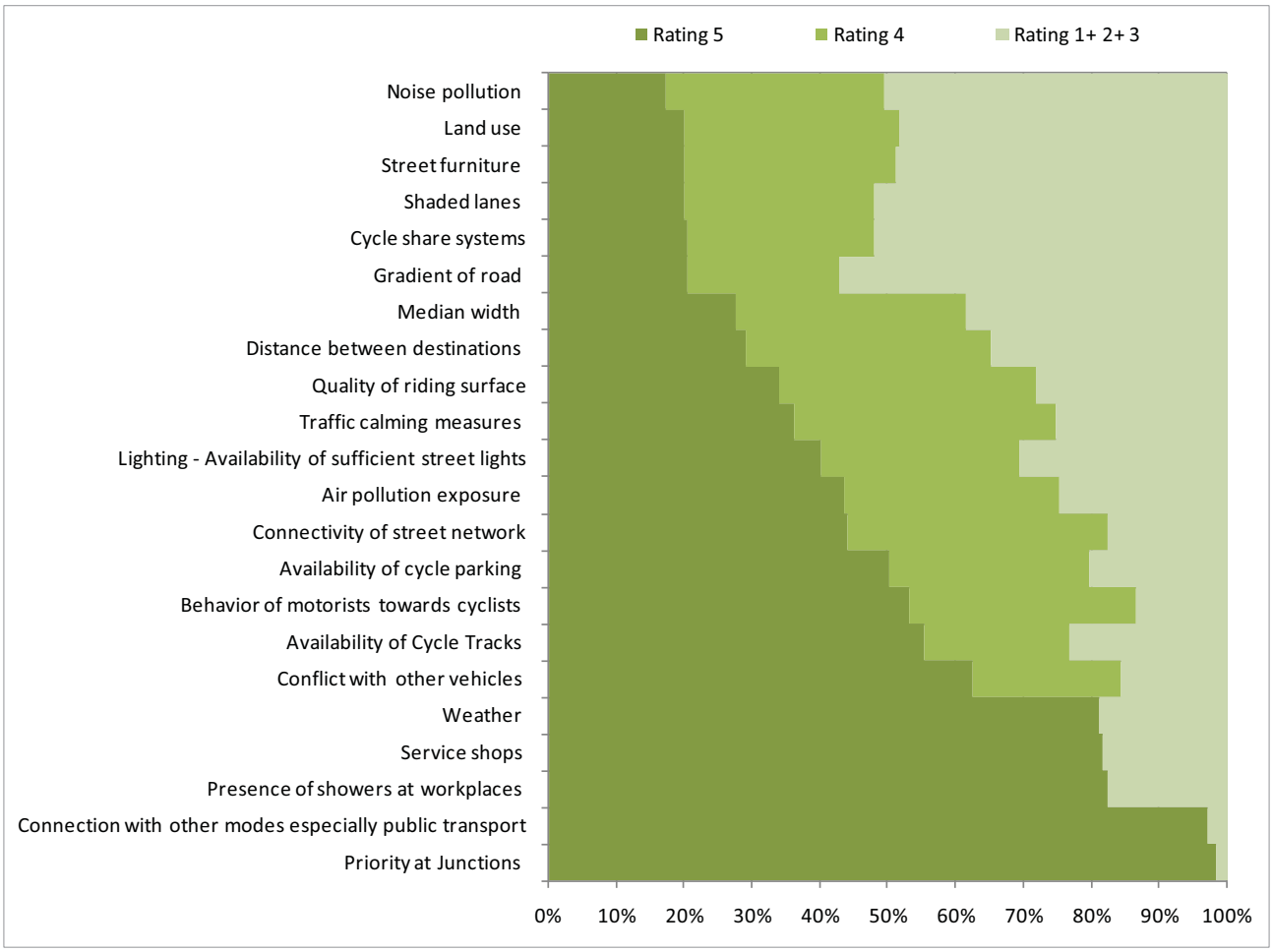


Figure 15: Ratings for Important Attributes and Conditions for Cyclability

7. Based on suggestions from female bikers, the additional parameter of security was included along with lighting parameter. Lighting parameter is considered important by many for people biking during early morning and during night time but it does not essentially cover the aspect of perception of security.

Parameters for Online Survey	**How the parameter is addressed** (Whether the parameter is considered or dropped in the Asia Cyclability Index or whether the parameter is not considered in the Asia Cyclability Index but included in the preference survey)
Conflict with other vehicles	Considered
Availability of Cycle Tracks	Considered
Behaviour of motorists	Considered
Gradient of road	Dropped
Lighting	Considered
Quality of riding surface	Considered
Median width	Considered in preference survey
Availability of cycle parking	Considered
Shaded lanes	Considered
Air pollution exposure	Considered
Noise pollution	Dropped
Traffic calming measures	Considered
Cycle share systems	Considered in preference survey
Distance between destinations	Considered in preference survey
Connectivity of street network	Considered in preference survey
Street furniture	Considered as signages and markings
Land use	Considered in preference survey
Presence of showers at workplaces	Considered in preference survey
Connection with other modes	Considered in preference survey
Service shops	Considered in preference survey
Weather	Dropped
Priority at Junctions	Considered
Perception of Security	Introduced

Table 3a: Initial Parameters Considered based from Cyclability Survey

Parameter	Description
Conflict with other modes	This parameter assesses the level of conflict cyclists face on the streets. Conflict with other modes, especially motorized ones leads to serious injuries and are a major deterrent to cycle
Availability of Cycle Tracks	Availability of dedicated and exclusive cycle tracks is one of the ways to encourage cycling. This again greatly reduces conflict with other modes and increases speed and comfort as well as a sense of safety. But at the same time, a street with relatively low traffic should not be penalized for not having cycle track. Therefore this parameter can be looked at from a network point of view, especially when connecting to public transport terminals or transit points. An obstruction free cycle track is given higher rating.
Behavior of motorists	Behavior of motorists towards cyclists and pedestrians reflects the road/traffic culture and the priority that is accorded to active transport users. Faster modes (motorists) slowing down for active transport users.
Lighting	Since bicycles invariably do not have powerful lights like that of motor vehicles, street lighting plays an important role in cycling beyond daylight hours. Lighting becomes important for a cyclist's visibility and to make the bicycle visible to other road users.
Quality of Riding surface	Quality of the riding surface directly impacts the quality and comfort of the ride. Ideally asphalt or concreted surface are more suitable than tiles as they do not have frequent joints and undulations. The surface should be free from cracks, gaps, undulations.
Crossing points	Crossing points should be wide enough to accommodate many cyclists and keep them safe at the medians. Crossing points should also be available at frequent intervals with sufficient time for crossings.
Availability of cycle parking	Safe and adequate cycle parking is important to encourage both full length as well as last mile connectivity.
Shaded lanes	Tree shade from the heat makes cycling more comfortable and less tiring
Exposure to air pollution	High levels of pollution can be a deterrent to cycle, exposing cyclists to the pollutant. Cyclists tend to inhale at a higher rate than motorists or pedestrians.
Traffic calming measures	To reduce the speed of motorized modes, traffic calming measures should be in place, in the form of design or other external apparatus
Connectivity of street network	Presence of well-connected street network make cycling easier by reducing travel distance and time
Sign boards and marking	Road sign boards and pavement marking help road users to clearly delineate the cycling paths or tracks and provide information to all
Connectivity with other modes	Cycling is a very crucial last mile connector, (apart from being a main mode for some). Therefore integrating cycling with other modes is essential for seamless travel
Presence of service shops	Service shops are essential to fix problems in a cycle, from punctures to other repairs and their presence makes gives a hassle free trip
Priority at junctions	Prioritizing cyclists over motorists at signals, junctions
Perception of security	This parameter assesses the feeling of security from crime as slow modes like walking and cycling are more prone to crime such as mugging
Land use	Considered in preference survey
Presence of showers at workplaceS	Considered in preference survey
	Considered in preference survey
Service shops	Considered in preference survey
Weather	Dropped
Priority at Junctions	Considered
Perception of Security	Introduced

8. Comparison of Asian cyclability index with other tools is provided below. Green boxes indicate consideration of a particular parameter. Comparing the indexes in their original form may not provide the best insights as their developers clearly had different visions of what cyclability means and they are built to serve different purposes. While for BikeBR, the UBC Index and the US Index, cyclability strictly means the current ability and convenience of people to ride bikes in the city, the Australian Index and the Copenhagenize Index also included some kind of anticipation of future cyclability. In this perspective, they consider some indicators which do not necessarily have an influence on the cyclability of the city yet – such as policies, implementation strategies, plans – as relevant criteria to assess the bike-friendliness of a city.

As discussed earlier, different indices compared here are built and used for different purposes.

Parameters	UBC Index	US Index	Australian Index	Bike BR Index	Copen-hagenize Index	Asian Cyclability Index
Topography (hills, steep roads etc.)						
Air pollution						
Noise pollution						
Beauty of the scenery						
Presence of parks and green spaces						
Presence of end-of-trip facilities (racks, bike compounds)						
Availability of maps						
Visibility of end-of-trip facilities						
Amenities for bikes on public transports						
Presence of bike shops around end-of-trip facilities						
Bike-Sharing System						
Segregated bike lanes						
Colored segregated bike lanes						
Signs and markings for bike lanes						
Street lighting						
Quality of roads						
Obstruction to cyclists (bike route density)						
Width of bike lanes						
Intersection issues						
Motorists and drivers' behaviors toward bikes						
Connectivity of bike-friendly routes						
Degree of conflicts with other modes of transport						
Motorists and drivers' behaviors toward bikes						
Bicycle culture						
Vandalism on bike trails and facilities						
Modal Share for Bicycles						

Parameter is considered for index

Parameter is excluded from index

Table 4: Comparison of Various Cyclability Indices

2.6 Involving Stakeholders

Involving stakeholders in any development process is essential to ensure that the approach is inclusive. Stakeholders include government officials from the Municipal Corporations, Planning Agencies, Transport Authorities, Police, NGOs and the general public. Obtaining the view of the stakeholders is important to understand their demands, needs and challenges they feel as users and as administrators. There are various ways in which this can be approached, through one-to-one meetings, large stakeholder discussions, focus group discussions, and others.

Another emerging trend of engaging with stakeholders and collecting data from them is by crowdsourcing. The emergence of smartphones and rapid penetration of internet services in cities has resulted in the development of innovative online tools to capture user perception of walkability and cyclability in an area. An example is a popular walkability rating website - http://www.walkonomics.com/w/. The website's objective is to rate the pedestrian-friendliness of a street. Any personcan rate any street based on their perception. By using computer programs, the ratings are updated based on official datasets where available.

Similar to walkonomics but in the mobile application (app) format is the Clean Air Asia's walkability app which was launched in 2012 http://walkabilityasia.org/2012/10/03/walkability-mobile-app/#. It acts as a crowd-sourcing tool to enable any person to highlight issues with the walking environment. The user rates a street based on the Clean Air Asia walkability Index. This score gets mapped with the help of the user's smartphone (iPhone or Android). The map can be viewed online by anyone at http://www.dotzoo.net/walkability/to identify safe or unsafe areas (black spots), areas with good or bad walkability, and plan their walking trips. The tool through crowdsourcing helps the city governments to identify areas for improvement. Crowdsourcing allows not only data collection but also helps in finding solutions, monitoring improvements and building transparency in implementation.

Other approaches to engage stakeholders in the diagnosis process are through blogs, social and professional networking sites such as Facebook and Linkedin, and sites such as Twitter, YouTube, Flickr, and Instagram.

One of the innovative methods of involving stakeholders in a sustainable transport project is through a mapping exercise. The Sustainable Mobility and Accessibility Research and Transformation (SMART) http://www.um-smart.org/blog/mapping method from the University of Michigan's Transport Research Institute involves the stakeholders in a simple yet effective exercise. A map of a part of a city or a neighborhood is chosen and stakeholders identify the existing networks and transit points as well as identify various drawbacks and propose interventions. The exercise engages participants actively who are divided into teams to ensure a good mix from diverse backgrounds.

The Clean Air Asia Walkability map of India at City level

The app as seen in a mobile device

2.7 Guidelines and Policies: Complete Streets

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. Cities sometimes have as many as ten modes of transportation travelling at four to 100 kilometers per hour, which compete for road space resulting in chaos and increase in injury and deaths of vulnerable users. The geometric design adopted is still based on segregation of space concept as many believe that increasing exposure to vehicles leads to high probability of pedestrian accidents. Lack of amenities force the pedestrians to share the space in the roads with high speed vehicles leading to high incidence of accidents. Many Asian cities are lacking "Complete streets"[15] 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.

To illustrate this, consider a few examples below:

1. The Nepal Road Standards 2027 were developed to ensure consistency in road design and construction. In urban areas, the code recommends that the sidewalk should be provided as per the number of pedestrians estimated in the future. Usually a clear 60 centimeter width should be provided for a pedestrian density of 30 pedestrians per minute, subject to a minimum sidewalk of 2.5meters on each side of the carriageway. The code also recommends that sidewalks should be provided, wherever found necessary, for at least one meter width on both sides on minor and medium bridges, but for a major bridge this can be limited to one side of the structure only. Sidewalks must be provided on all major bridges, if no other way is available for pedestrians to cross the river in the vicinity. However, neither the letter nor the spirit of the provisions is generally followed. A recent walkability survey conducted in Kathmandu gave very poor ratings to the parameter - availability of the walking space - indicating lack of footpaths.
2. 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.[16]
3. 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. The guidelines recommend that a bicycle lane be one meter wide, adding 0.25 meters where such a lane is next to a curb or median. For two-way bicycle roads, the minimum width is 3.5 meters. Where there are other types of non-motorized traffic, the minimum width in one direction shall be 4.5 meters. Planning guidance assumes that a bicycle lane will handle 1500 bicycles per meter of the lane width and 1000 per hour at the intersection, though these parameters are rarely used in the actual bicycle infrastructure design.[17]
4. Singapore's Land Transport Master Plan is a "people-centered" plan that aims to achieve efficiency through multi modal integration. It states that "As a maturing society, we will foster mutual accommodation and graciousness among the public transport commuters, motorists, cyclists and pedestrians who share our road space." The following measures are included in the master plan:
    - Pedestrian walkways: includes ensuring a minimum of one meter to 1.5 meter clearance on walkways by removing obstacles or by widening the path, to provide a clear passageway for wheelchair users

15. The road space is judiciously divided among pedestrians, cyclists, motorists, public transport users rather than traditional way of fast dominating the slow user.
16. Regulating Two and Three Wheelers - ITDP, Clean Air Asia
17. Regulating Two and Three Wheelers - ITDP, Clean Air Asia.

- 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

5. 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. The Hong Kong Planning Standards and Guidelines provide guidance on how pedestrian facilities should be integrated in planning structures, such as industrial estates, science parks, shopping areas, public transport facilities and interchanges, ferry terminals and even roads and highways. These also provide specific guidelines on how to determine the streets suitable for pedestrianization. The guidelines for cycling, vehicle parking and for general urban design are centered on pedestrians.

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 (see table below).

Old Code (IRC103-1988)	Common Practice	New Revised Code IRC 103-2012
Footpaths should have a minimum width of 1.5m on both sides. The LOS (Level of Service) concept dictates the maximum width. The result of such a school of thought is that pedestrians are provided only a minority share of space (most often less than 10% of road space) and in many instances no space at all.		A minimum of 1.8m (width) by 2.2m (height) walking zone should be clear of all obstructions. A minimum width of 1.8m for roads of right of way of 10m and 1.5m for roads with right of way less than 10m. LOS dictates maximum width (LOSB) is recommended.
Dead (unused) width of 0.5m and 1m to be added to sidewalks running alongside houses and commercial areas.		An additional dead width to be added based on landuse stipulations (as mentioned below). For reseden-tial area it is 0.5m, commercial area is 1m. For example a footpath in busy commercial area would have 4+1m = 5m width.

Footpath width to be increased at bus stops and recreational areas		Suggest additional width based on landuse. for example - 3m at bus stops, commercial-mixed landuse - 2.5m, high intensity commercial area - 4m.
Height of footpath to be above that of the carriageway, and supported by an un-mountable kerb.		Height of the kerb at the edge should not exceed 150mm (height of standard public step riser)
Mid-block pedestrian crossings should be provided when the distance between intersections is a minimum of 300m		Mid-block crossing spacing varies with landuse and should match crossing desire lines. for example in resedential areas it should be inbetween 80-250m. In commercial and mixed landuse it is recommended to have 80-150m. In high intensity commercial area it recommends complete pedestrianization if possible.
Controlled mid-block crossings should be provided where peak hour volumes of pedestrians and vehicles are such that PV2 (crossing pedestrians (P) multiplied by vehicles (V)) > 1 million (for undivided carriageway) or 2 million (for divided carriageway);where the stream speed of traffic is greater than 65 km/h; and where the waiting times for pedestrians/vehicles have become inordinately long		Controlled crossings are recommended when peak hour volumes of pedestrians and vehicles are such that PV2 (crossing pedestrians multiplied by vehicles) > 1 million (for undivided carriageway) or 2 million (for divided carriageway); where the approach speed of traffic is greater than 65 km/h; and where the waiting times for pedestrians/vehicles have become inordinately long or accidents record suggests 5 or more accidents.

Table 5: India Design Guidelines for Pedestrians

2.8 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 (See Annex A).[18]

In order to 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

This section provides some examples of the on-the-ground initiatives of each of the strategies recommended.

18. 5 D's of Urban Planning and Transport

19. http://www.uttipec.nic.in/index2.asp?slid=160&sublinkid=58&langid=1

A. Institutional Arrangements - Unified Traffic and Transportation Infrastructure Planning and Engineering Centre

Dedicated institutions with legal and financial resources that support non-motorized transportation are not often found in Asian cities. Improvements for pedestrian facilities are often subsumed in city planning agencies and most often neglected. Oftentimes, non-motorized plans are provided to improve the vehicle traffic flow. The presence of such dedicated institutions is necessary for pushing forward with improving the non-motorized transportation in cities.

The Unified Traffic and Transportation Infrastructure (Planning & Engineering) Centre was set up by Delhi Development Authority. It was made mandatory that all transportation projects in Delhi by any agency having road engineering/infrastructure implication require clearance of the centre (UTTIPEC). This centre was established in 2008 to fast track the rapid developments in infrastructure due to Commonwealth Games and to prevent the coordination mismatch mistakes that occurred in Delhi Bus Rapid Transit System.

The objective of UTTIPEC is[19] :

1. To study and coordinate the norms and standards for Planning and Engineering Practices in Traffic and Transportation
2. Engineering Aspects of Implementation of National Transport Policy 2006 & Master Plan of Delhi 2021 Transportation proposals
3. Traffic Road Safety Audit Guidelines (TRSAG)
4. To coordinate the Engineering and Infrastructure aspects of sustainable public transportation system
5. To evolve a parking policy and evolve parking solutions
6. To inventory corridor-wise Traffic and Transportation issues, Traffic Management Strategies and Enforcement Guidelines
7. To act as a repository for sharing of traffic and transportation plans / database / information / digitization and website development
8. To evolve the Environmental Impact Assessment Guidelines for Traffic & Transportation Projects
9. To promote evaluation - public participation-feedback

10. To take up other related activities as may be considered appropriate by the Traffic and Transportation Centre including co-ordination, capacity building and training
11. To develop protocols and norms for signage, street furniture, lighting, signals, hoardings, trees, roadside landscapes, zebra crossing, pedestrian passages, commuter facilities

UTTIPEC has developed progressive street design and transit oriented development guidelines. This centre comprises representatives of all stakeholders on board: the Public Works Department, Delhi Development Authority, Municipal Corporations of Delhi and Delhi Integrated Multi modal Transport Service among others.

B. Technology and Partnerships - Eco cabs - Fazilka and Chandigarh India

Over the past couple of years, two projects for cycle rickshaws in dial-a-cab format have been launched in India. The projects aim to provide better access of cycle rickshaws to the residents of Fazilka and Chandigarh by means of direct dial-a-rickshaw facility, to support the livelihood of cycle rickshaw operators and to protect the environment. The main priority is to link demand for cycle rickshaws and its supply with latest information technology tools and real time technology. For example, in Fazilka city, five Ecocab call centers are established within the city at strategic locations to provide dial-a-rickshaw facility. Each centre within its zone of influence has around 1500 households. To cut down the time required for providing cycle rickshaws, these centers are strategically placed along with the network of 20 feeder sub centers so that after a phone call within 10 minutes Ecocab shall reach the desired location.[20] With average trip length of three to four kilometers in Fazilka, cycle rickshaws are providing mobility to significant segment of population. The success of the Fazilka initiative led to the Chandigarh (which is a larger city) initiative. This initiative was developed after the Punjab and Haryana High Court directed city officials to introduce eco-cabs in many cities including Chandigarh. The Graduates Welfare Association Fazilka, an NGO, has launched the service in Chandigarh along with a few volunteers from Chandigarh and support of the municipal corporation and Chandigarh administration.

C. Prioritizing NMT - National Cycling Plan - Singapore

Singapore is working towards becoming a bike-friendly city and the initiative started with construction of bike parking facilities in the MRT stations. This led to provision of signalized bike crossing facilities in many junctions. The main objective was to promote bikes as an ingress and egress mode to public transport. With cycling becoming popular again, the city authorities promoted an initiative - Park Connector Network mainly for the

The latest venture in Chandigarh Source: Asija, Navdeep

20. Navdeep Asija, Graduates Welfare Association Fazilka

recreational usage i.e. cycling, jogging, walking and other recreational activities. Building on the Park Connector network, common corridors linking major transport nodes to destinations were identified for improvement to provide cycling facilities and sharing of NMT spaces (footpath sharing). This approach of promoting corridors and legalized sharing of footpaths between pedestrians and cyclists was called the "cycling town approach." Footpaths with only 1.2m clear width were widened to 2m under this initiative and now success of this initiative has led to development of National Cycling Plan (NCP). Under this plan, the first strategic step is to provide off-road dedicated cycle tracks, to facilitate intra town cycling and connectivity to major transport nodes (e.g., MRT stations and bus interchanges). By connecting modes and origin and destinations, cycling is being promoted in Singapore. By 2014, under the NCP, a total of about 50km of intra-town cycling path networks is targeted to be completed in seven Housing and Development Boards (HDB) Towns, and another sixteen kilometers of cycling paths will also be made available within Marina Bay(Koh & Wong, 2012).

D. Prioritizing Funding and Establish Targets - Investment in Cycling in South Korea

In order to promote cycling, the government initiated first national cycling plan in 1993 with an investment of 478 billion won. This initiative was supported by a second national plan with an additional investment of 500 billion won. With increasing investment and facilities, bicycling trip mode share increased from 1.85% in 1995 to 2.4% in 2002. Nearly 1500 kilometers of bikepaths were available in Korea by 2009. In order to further support cycling as a transport mode, authorities under the green growth initiative and its five year plan have targeted an increase in bike trip mode share to 5% by 2013. Under the new bicycle master plan, the following targets for 2019 are proposed (vision 2019 6E):

1. Build a total 17,000 km of bikepath (dedicated lanes) and 30,000 km of bikeways (painted) in Korea by 2019
2. Achieve 10% of bike trip mode share and achieve 30% of commuting ratio
3. Decrease 30% of bike accidents
4. Achieve 15% of bike trip mode share in 10 pilot cities
5. Achieve 20% of bike tourism among total
6. Invest 1 trillion won (approximately 0.8 billion USD) to construct bike infrastructure

Under the new initiative, to promote bicycling, a smart phone application provides bike riders with information on such matters as public bicycles, bike paths, and transfer points is being promoted (Kamal-Chaoui, 2011).

E. Prioritizing NMT in Design - Pedestrianization in Hong Kong

The concept of pedestrianization has been implemented in Hong Kong since the 1990s. Pedestrianization as an active policy measure (and not a random piecemeal solution) was adopted by the authorities only in early 1990's (Cheung Bing-leung, 2013). The third comprehensive transport study completed in 1999 suggested initiating priority measures to improve walking. The policy speech of Chief Executive in 1999 suggested - *"We also intend to expand the pedestrian zones in crowded and more polluted parts of our city so as to reduce pollution caused by vehicle emissions."*

The policy speech resulted in many scientific studies on possible pedestrianization of several streets in Hong Kong. The guiding factor for deciding which streets to pedestrianize is the local design code recommendation. The Transport Planning and Design Manual recommends,

> *"When the design pedestrian volume for footpaths along a principle pedestrian route becomes so large that any widening of footpaths to cope with the demand becomes impractical, consideration should be given to pedestrianization of the streets concerned."*

There are three types of pedestrian streets proposed - full time pedestrian streets, part time pedestrian streets and mixed priority streets. The transport department is responsible for transport planning in Hong Kong and hasthe legal mandate to close roads for vehicles. The Department conducts investigations to assess the traffic congestion and pedestrian problems and decides on pedestrianization. It is also involved in construction and implementation of such schemes. The objectives and criteria for pedestrianization are:

No.	Objectives	Description
1	To resolve or minimize conflicts between pedestrian and vehicles	• Observe conflicts which cannot be resolved and where alternative solutions(like widening of footprints, subways and footbridges) are uneconomical and/or impractical
2	To provide a better environment for pedestrians	• The street is amenable to attractive landscape and street finishes • The street when pedestrianized will complement the existing pedestrian flow network
3	To improve pedestrian flow and to provide a more favorable shopping environment for pedestrians without impeding servicing of buildings	• Existing/anticipated commercial development depends on attracting large number of customers • The street when pedestrianized will improve the environment and may provide additional commercial opportunities • Pedestrianization should enhance retail viability and not bring any reduction in trade • Adequate provision should be made for vehicular servicing to buildings in the pedestrianized street either by an alternative direct access or by providing a limited specific period for vehicular servicing from the pedestrianized street • Adequate measures should be undertaken to cater for traffic diverted as a result of the closure of the street to vehicular traffic

Table 6: Objectives for Pedestrianization

Since its initiation, the Transport Department has implemented more than seventy pedestrianization schemes in various locations in Hong Kong. While the schemes are being supported by the general public, the authorities are facing difficulties due to limited land space availability and objections by district councils.

F. Making Allies - Carfree Days in Jakarta

The Car Free Days (CFD) are held around the world and the objectives vary by location;the short-term objective primarily being to prevent usage of automobiles for a day but long-term goal is to make people aware of livability and benefits of reduced automobile usage. CFD are held in many parts of Asia but they have made a great impact in Jakarta. CFD in Jakarta was started by several NGOs working in clean air sector on September 2002 and was fully supported by city government and similarly in the successive years. Objectives of the CFD in Jakarta were to reduce pollution by vehicles, to improve air quality and raise community awareness. The main corridors for implementing car-free days are selected based on following criteria (Suryani, 2012):

a. The road with circle track

b. The road with alternative route

c. The road with regular public transport

d. The road is suitable for bicycle and other non-motorized vehicles

e. Have wide parking area

f. The road in office areas, trade centerand housing areas

g. The road with high air pollution.

CFD concept gained lot of support from the authorities and finally the government mandated a law to implement CFD to provide a legal basis for continuing it. The Jakarta Municipal By law number 2/2005 on Air Pollution Control (article 27) mandates a CFD to be implemented once a month for air quality recovery to improve urban air quality in assigned location. Now Jakarta observes car free day twice a month. Based on the evaluation conducted by Jakarta's Local Environmental Control Agency (BPLHD) on the quality of air, along 2009, Car Free Day was considered effective to reduce air pollution during CFD implementation. The dust parameter (PM10) reduced by 37 percent while the amount of carbon monoxide (CO) and nitrogen monoxide (NO) reduced by 67 and 75 percent, respectively. CFD success in Jakarta motivated 34 more cities in Indonesia to launch Car Free days (Suryani, 2012).

Car-free day in Jakarta Source: http://taufikariefhasibuan.com/2012/01/02/car-free-day/

G. 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) developed by Clean Air Asia, together with ITDP, Asian Development Bank, Cambridge Systematics and the United Nations Environment Programme (UNEP) – Global Environment Facility (GEF) Scientific and Technical Advisory Panel is a simple excel spreadsheet model. The NMT component looks at walkability improvement projects, bike lanes projects and bike share projects. The NMT TEEMP tools are "sketch" models which enable the estimation of emissions in both "project" and "no-project" scenarios and can be used for evaluating short to long term impacts of transport projects. TEEMP primarily evaluates the impacts of transport projects on CO_2 emissions and to some extent air pollutant emissions (PM and NOx) using data gathered during project feasibility and actual operations. The TEEMP tools are based on data which is essentially required during project economic evaluation and thus does not require lot of resources in justifying the impact of projects.

The **IRAP Road Safety Toolkit**[21] provides information on the causes and prevention of road accidents. Implementation of various NMT strategies impact on accidents can be assessed using this toolkit. This toolkit is developed as a result of collaboration between the International Road Assessment Programme (iRAP), the Global Transport Knowledge Partnership (gTKP), ARRB Group, TRL and the World Bank Global Road Safety Facility. The International Road Assessment Programme (iRAP) safety assessments use the road inspection/audit data to provide star ratings for roads, with five-star roads indicating the highest performance and lowest risk for injury.

HEAT is a tool which provides economic assessments of the health effects (a) from cycling and (b) from walking. The development of this tool was led by WHO. The tool estimates the maximum and the mean annual benefit in terms of reduced mortality as a result of walking or cycling. This tool can be used when planning a new piece

21. http://toolkit.irap.org/default.asp?page=about

of cycling or walking infrastructure, or helping to make the case; to value the reduced mortality from past and/or current levels of cycling or walking; or to provide input into more comprehensive economic appraisal exercises or prospective health impact assessments (World Health Organization).[22]

Bikeways to reduce Emissions -Marikina Bikeways[23]

World Bank Global Environment Facility (WB-GEF) with active support of local government initiated Marikina bikeways project in 2001 to reduce air pollution, greenhouse gas emissions and traffic congestion problems in the Marikina city. The network was increased from initial 19 km to around 66 km. The modal share of bicycle ridership in Marikina city increased from 4.2% in 2001 to 7.9% in 2010. The construction of bikeways has led to improved liveability of the area (which is predominantly low and middle income) and the Marikina Bikeways was awarded in 2008 in the category of "Climate change and health in cities" by WHO. The increase in biking trips has led to reduction in emissions. An ADB publication which evaluated the impact of Marikina Bikeways has quantified the impact of bikeways in reducing fuel consumption, CO_2, PM and NOx emissions. The project provides substantial annual savings of 250 tons/km of CO_2, 0.02 tons of PM and 0.13 tons of NOx. The project over its entire lifetime saves around 0.2 to 0.3 million tons of CO_2 emissions which is equivalent to 100 million litres of diesel. Considering that the total cost of investment was only 1.51 million USD, the NMT lanes can be an effective way of sustaining eco-friendly transport system.

2.9 Summary

This chapter presented and discussed the tools for assessment and evaluation of NMT applicability for Asian cities, a means for implementation, and several city and country experiences. In **Section 2.1**, this chapter shows one model of the transportation planning process to create the foundation that integrates all the tools that promote cycling and walking in the succeeding sections.

Section 2.2 was about visioning and its importance to integrating NMT into transportation planning. This section emphasized the importance of an inclusive vision of society; that a "livable city" is what the people see as their city, and such vision includes the future of transportation. Stakeholder engagement and public participation are keys to this process; these should continue in the choice of a strategy, implementation, monitoring and evaluation within the planning process.

Sections2.3, **2.4**and **2.5**presented the prime considerations for NMT assessment. Three indices were presented: the Clean Air Asia Walkability Index, the Copenhagenize Index and the Cyclability Index are tools for assessing walkability and cyclability, and the methodology and considerations for each were provided in their respective sections.

As mentioned repeatedly in this section, stakeholder engagement and public participation are keys to successfuladoption and integration of NMT. **Section 2.6** discussed various means of engaging with stakeholders, such as the walkability rating website (walkonomics.com), Clean Air Asia's own walkability app (walkabilityasia.org), and the Sustainable Mobility and Accessibility Research and Transformation mapping method (SMART).

Section 2.7 on Complete Streets discussed issues with design codes, and how "bad" design codes (those that do not incorporate or consider pedestrian safety and convenience) create problems for the people. The Indian Design Guidelines were included in the section to show how pedestrianization can be incorporated into design codes.

Finally, **Section 2.8** provided the most important considerations for design and implementation of NMT policies and infrastructure. As mentioned in this section, 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. At the end of the section, some examples of various experiences were shared to build on various perspectives about NMT.

22. http://www.euro.who.int/__data/assets/pdf_file/0003/155631/E96097rev.pdf

23. http://www.adb.org/documents/reducing-carbon-emissions-transport-projects

Annexes

Annex A: 5 D's of Transport

The impact of the built environment on transport especially on non-motorized transport can be understood from analyzing the impact of variables "D" in landuse. The first attempt was by Cervero and Kockelman (1997) who coined original three D's i.e. density, diversity, and design. Researchers have expanded this initial – three D's and added destination accessibility and distance to transit (Ewing and Cervero 2001; Ewing et al. 2009) to comprise the 5 D's.

1. **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 neighbourhood.
4. **Destination accessibility** is measure of the access to trip attractions.
5. **Distance to transit** is a measure of public transport accessibility.

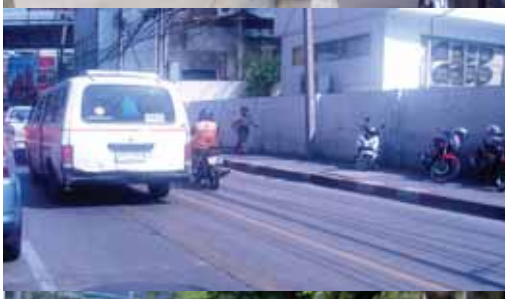
Attribute	Impact on	Outcome
Density	Number of Trips	High impact on vehicle trips as more people walk, cycle or use public transport.
	Trip Length	Research indicates that higher population and employment densities results in closer trip origins and destinations, on average, and thus in shorter trip lengths, on average.
	Trip frequency	Little impact. There are chances that reduced trip lengths can increase trip frequencies, but empirical evidence suggests that the increase is not enough to offset the reduction in VMT that comes from reduced trip length alone
	Mode Share	High density makes public transport viable and improves the mode share of non motorized users
Diversity	Number of Trips	High impact as diverse built environment constitutes accessibility to different types of land use which has a high impact on trip-chaining and trip internalization reducing inter-zonal motorized trips.
	Trip Length	High impact as it brings origin and destination very close.
	Trip frequency	Little impact
	Mode Share	High Impact on improving non motorized transport
Design	Number of Trips	High impact on reducing motorized trips as it impacts sidewalk coverage, block size and accessibility
	Trip Length	High impact as type of design has an influence on trip lengths. For example, superblocks have higher trip lengths than traditional urban forms. Shorter block lengths help in improving NMT trips
	Trip frequency	Little impact.
	Mode Share	High impact as it can promote non motorized modes through attractive positioning of public space.
Destination accessibility	Number of Trips	Little impact
	Trip Length	High impact as it brings origin and destination very close improving NMT usage
	Trip frequency	Little impact
	Mode Share	High impact on improving non motorized transport
Distance to Transit	Number of Trips	Shorter access to public transport improves NMT usage as an ingress and egress modes
	Trip Length	No major impact
	Trip frequency	No major impact
	Mode Share	High impact on public transport and NMT mode share

Annex B: Walkability Survey Guide

Parameter 1: Walking Path Modal Conflict

Description: The extent of conflict between pedestrians and other modes, such as bicycles, motorcycles and cars on the road.

Rating Guide:

Rating	Description	Example
1	Significant conflict that makes walking impossible	
2	Significant conflict that makes walking possible, but dangerous and inconvenient.	
3	Some conflict – walking is possible, but not convenient	
4	Minimal conflict, mostly between pedestrians and non-motorized vehicles	
5	No conflict between pedestrians and other modes	

Parameter 2: Availability of Walking Paths
(with Maintenance and Cleanliness)

Description: It reflects the need for, availability and condition of walking paths.

Rating Guide:

Rating	Description	Example
1	Pedestrian Walkways required but not available	
2	Pedestrians Walkways available but highly congested , badly maintained and not clean	
3	Pedestrians Walkways available but congested , needs better maintenance and cleanliness	
4	Pedestrians Walkways available which are sometimes congested and are clean and well maintained	
5	Pedestrian Walkways not required as people can safely walk on roads	

Parameter 3: Availability of Crossings (Count the number of crossings available per stretch)

Description: The availability and distances of crossings to describe whether pedestrians tend to jaywalk when there are no crossings or when crossings are too far in between.

Rating Guide:

Rating	Description	Example
1	Average distance of controlled crossings is greater than 500m and average speed is high	
2	Average distance of controlled crossings is between 500-300m and average speed is around 40 Kmph	
3	Average distance of controlled crossings is between 200-300m and average speed is 20-40 Kmph	
4	Average distance of controlled crossings is between 100-200m and average speed is 20-40 Kmph	
5	There is no need of controlled crossings as pedestrians are safe to cross wherever they like and vehicles and pedestrians co-exist	

Parameter 4: Grade Crossing Safety

Description: This refers to the exposure of pedestrians to other modes while crossing, the time spent waiting and crossing the street and the sufficiency of time given to pedestrians to cross signalized intersections.

Rating Guide:

Rating	Description	Example
1	Very high Probability of Accident with very high crossing time	
2	Dangerous- pedestrian faces some risk of being hurt by other modes and crossing time is high	
3	Difficult to ascertain dangers posed to pedestrians but the time available for crossing is less and people have to hurry	
4	Safe – pedestrian is mostly safe from accident with other modes and exposure time is less and time available for crossing more.	
5	Very safe – other modes present no danger to pedestrians	

Parameter 5: Motorist Behavior

Description: The behavior of motorists towards pedestrians which may well indicate the kind of pedestrian environment there is in that area.

Rating Guide:

Rating	Description	Example
1	High Traffic disrespect to pedestrians	
2	Traffic Disrespect and rarely Pedestrians get priority	
3	Motorists sometimes yield	
4	Motorists usually obey traffic laws and sometimes yield to pedestrians	
5	Motorists obey traffic laws and almost always yield to pedestrians	

Parameter 6: Amenities

Description: The availability of pedestrian amenities such as benches, street lights, public toilets and trees. These amenities greatly enhance the attractiveness and convenience of the pedestrian environment and in turn, the city itself.

Rating Guide:

Rating	Description	Example
1	No Amenities	
2	Little Amenities at some locations	
3	Limited number of provisions for pedestrians	
4	Pedestrians provided some good amenities for major length	
5	Pedestrians have excellent amenities such as lighting, cover from sun and rain making walking a pleasant experience	

Parameter 7: Disability Infrastructure

Description: The availability, positioning and maintenance of infrastructure for the disabled.

Rating Guide:

Rating	Description	Example
1	No infrastructure for disabled people is available	
2	Limited infrastructure for disabled persons is available, but is not in usable condition.	
3	Infrastructure for disabled persons is present but in poor condition and not well placed	
4	Infrastructure for disabled persons is present, in good condition, but poorly placed.	
5	Infrastructure for disabled persons is present, in good condition, and well placed.	

Parameter 8: Obstructions

Description: The presence of permanent and temporary obstructions on the pedestrian pathways. These ultimately affect the effective width of the pedestrian pathway and may cause inconvenience to the pedestrians.

Rating Guide:

Rating	Description	Example
1	Pedestrian infrastructure is completely blocked by permanent obstructions	
2	Pedestrians are significantly inconvenienced. Effective width <1m.	
3	Pedestrian traffic is mildly inconvenienced; effective width is < or = 1 meter.	
4	Obstacle presents minor inconvenience. Effective width is > 1m	
5	There are no obstructions	

Parameter 9: Security from Crime

Description: general feeling of security against crime in the street.

Rating Guide:

Rating Guide:

Rating	Subjective Description
1	Environment feels very dangerous – pedestrians are highly susceptible to crime
2	Environment feels dangerous – pedestrians are at some risk of crime
3	Difficult to ascertain perceived degree of security for pedestrians
4	Environment feels secure – pedestrians at minimal crime risk
5	Environment feels very secure – pedestrians at virtually no risk of crime

Annex C: Cyclability Index Survey

The cyclability survey can be carried out at anytime, but it is preferable to do it during the evening peak hours to understand parameters of conflict, availability of lighting, feeling of security etc. Other parameters such as availability of cycle tracks or lanes, riding surface, street connectivity are time independent. But factors such as availability of parking could be time dependent as parking may be available during working hours and may not be available at other times.

Parameter 1: Conflict with other vehicles

Description: This parameter assesses the level of conflict cyclists face on the streets. Conflict with other modes, especially motorized ones leads to serious injuries and are a major deterrent to cycle.

Rating Guide:

Rating	Description	Example
0	High level of conflict making cycling very dangerous	 24
1	Conflict with fast moving vehicles making cycling difficult	 25
2	Conflict present but to lesser extent and slower vehicle speeds	 26
3	Low level of conflict with other NMT and slow moving vehicles	 27
4	No conflict making cycling safe	 28

24. http://graphics8.nytimes.com/images/2013/04/03/nyregion/Y-CROSS/Y-CROSS-articleLarge.jpg
25. http://motherhoodisbeautiful.com/wp-content/uploads/2012/02/travel-bicyclist-white-lining.jpg
26. http://www.straitstimes.com/sites/straitstimes.com/files/imagecache/story-gallery-featured/ST_20120823_LJCYCLE233763_3266306e.jpg
27. http://www.activedrivingsolutions.com/blog/wp-content/uploads/2010/11/overtaking-cyclist-300x199.jpg
28. http://lavidaesloca.files.wordpress.com/2008/05/cicloruta.jpg

Parameter 2: Availability of Cycle Tracks

Description: Availability of dedicated and exclusive cycle tracks is one of the ways to encourage cycling. This again greatly reduces conflict with other modes and increases speed and comfort as well as a sense of safety. But at the same time, a street with relatively low traffic should not be penalized for not having cycle track. Therefore this parameter can be looked at from a network point of view, especially when connecting to public transport terminals or transit points. An obstruction free cycle track is given higher rating.

Rating Guide:

Rating	Description	Example
0	No cycle tracks	 29
1	Cycle tracks available but not usable	 30
2	Cycle tracks available with significant obstructions	 31
3	Available with minimal or temporary obstructions	 32
4	Pleasure to use cycle tracks	 33

29. http://motherhoodisbeautiful.com/wp-content/uploads/2012/02/travel-bicyclist-white-lining.jpg
30. http://3.bp.blogspot.com/_CFaWFwKkBYM/RsdCkD3R5NI/AAAAAAAAABU/fAsi37PJ9Gw/s400/leyton+gn+rd+1.jpg
31. http://bostonbiker.org/files/2009/09/bike-lane.JPG
32. https://encrypted-tbn1.gstatic.com/images?q=tbn:ANd9GcRP1gsNo47v3otlAvjYf4rBUkrJokTeRi1AwKzpemt-dOmvrZN8Xw
33. http://lavidaesloca.files.wordpress.com/2008/05/cicloruta.jpg

Parameter 3: Motorists behavior

Description: Behavior of motorists towards cyclists and pedestrians reflects the road/traffic culture and the priority that is accorded to active transport users. Faster modes (motorists) slowing down for active transport users.

Rating Guide:

Rating	Description	Example
0	Motorists highly disrespect cyclists which makes cycling impossible	 [34]
1	Motorists drive very close to cyclists or use the horn	 [35]
2	Motorists sometimes yield to cyclists	 [36]
3	Motorist obey traffic rules and sometimes yield to cyclists	 [37]
4	Motorists respect cyclists and give way to them	 [38]

34. https://encrypted-tbn0.gstatic.com/images?q=tbn:ANd9GcR3eTbX-07pWyklGHf_1bohHEhjiTORcMjjL3YriPQQBo5jQ3-V
35. http://www.minnpost.com/sites/default/files/imagecache/article_detail/images/articles/cyclist-motorist-interaction_main.jpg
36. http://4.bp.blogspot.com/--yvGN1awef8/UITltkhqtel/AAAAAAAACRQ/Ctqh4UEG2wY/s1600/Dublin+Non-Mandatory+Bike+Lane+from+Bus.JPG
37. http://www.wired.com/images_blogs/autopia/2010/03/bike-in-traffic.jpg
38. http://static.guim.co.uk/sys-images/Guardian/About/General/2012/2/19/1329665987813/cyclists-traffic-007.jpg

Parameter 4: Lighting

Description: Since cycles invariably do not have powerful lights like that of motor vehicles, street lighting plays an important role if in cycling beyond light hours. Lighting becomes important for a cyclist's visibility and to make the cycle visible to other road users.

Rating Guide:

Rating	Description	Example
0	No lighting available making it dangerous for cyclists	
1	Lighting available but poor	 39
2	Lighting available but not at sufficient intervals with few dark spots	 40
3	Lighting available but can be better	 41
4	Excellent lighting available	 42

39. http://assets.dornob.com/wp-content/uploads/2009/08/lightlane-laser-bike-lane.jpg
40. http://enpundit.com/wp-content/uploads/2012/10/bicycle-lane-laser-tail-light-1.jpg
41. http://gearjunkie.com/images/9757.jpg
42. http://i1.treklens.com/photos/4499/lonelycyclist.jpg

Parameter 5: Quality of riding surface

Description: Quality of the riding surface directly impacts the quality and comfort of the ride. Ideally asphalt or concreted surface are more suitable than tiles as they do not have frequent joints and undulations. The surface should be free from cracks, gaps, undulations.

Rating Guide:

Rating	Description	Example
0	Surface totally unpaved and unrideable	 43
1	Surface paved in patches and uneven making a very unpleasant ride	
2	Surface has large cracks and significant potholes and making ride bumpy	 44
3	Surface is slightly uneven with few cracks, ruts	 45
4	Surface even and smooth for a comfortable ride	 46

43. http://jamaica-gleaner.com/gleaner/20111105/news/images/PortMorantJ20111104IA.jpg
44. http://www.washingtonbikelaw.com/images/seattle-bicycle-grates-street.jpg
45. http://www.bicyclenetwork.com.au/media/vanilla/image/good%20design%20guide/fed%20trail%20crack.jpg
46. http://www.fthatscool.com/resources/Spain/IMG_9529.JPG

Parameter 6: Crossing points

Description: Crossings for cyclists are as important as exclusive cycle lanes themselves. Crossing points should be wide enough to accommodate many cyclists and keep them safe at the medians. Crossing points should also be available at frequent intervals with sufficient time for crossings.

Rating Guide:

Rating	Description	Example
0	Wide road with no crossing/median	
1	Crossing time is insufficient to cross/median not accessible	 47
2	Crossing point not well defined/Crossing time is just sufficient/median width too small to accommodate many cyclists	 48
3	Designated crossing place with insufficient time	 49
4	Designated crossing with sufficient crossing time/ Sufficient median space to wait with cycle	 50

47. http://static.guim.co.uk/sys-images/Environment/Pix/columnists/2012/5/1/1335877439030/MDG--Road-Safety-in-India-007.jpg
48. https://upload.wikimedia.org/wikipedia/commons/6/66/Portland_Transit_Mall_with_cyclists_crossing.jpg
49. http://velo-city2013.com/wp-content/uploads/VC13_Vienna-Streets_02.jpg
50. http://geonym.files.wordpress.com/2010/12/007.jpg?w=520&h=390

Parameter 7: Availability of cycle parking

Description: Safe and adequate cycle parking is important to encourage both full length as well as last mile connectivity.

Rating Guide:

Rating	Description	Example
0	No secure parking available	 51
1	Parking available but in poor condition	 52
2	Parking available but without security, or racks to lock or with no cover	 53
3	Parking available but can be improved or need better maintenance	 54
4	Secure covered parking facilities with available	 55

51. http://www.fixmytransport.com/files/paperclip/campaign_photos/images/23/max/cyclestreets9351.jpg?1315306819
52. http://cityexile.files.wordpress.com/2011/09/bike_parking_assen.jpg
53. http://www.camcycle.org.uk/newsletters/68/images/normal2-2.jpg
54. http://farm4.static.flickr.com/3589/3591249053_628502bcec.jpg
55. http://www.cycling-embassy.dk/wp-content/uploads/2010/11/Cykelparkering-Bruuns-Bro1.jpg

Parameter 8: Shaded lanes

Description: Tree shade from the heat makes cycling more comfortable and less tiring

Rating Guide:

Rating	Description	Example
0	No shade and cyclists are exposed to sun	 56
1	Few trees present and far from each other	 57
2	Few trees present giving some shade	 58
3	Shade giving trees present, but not continuous	 59
4	Many large trees present giving continuous shade	 60

56. http://gulfnews.com/polopoly_fs/1.1175971!/image/3032559781.jpg_gen/derivatives/box_475/3032559781.jpg
57. https://encrypted-tbn3.gstatic.com/images?q=tbn:ANd9GcTR4IY6CUd4GWI1cXy5tAlSe-sBq8Ffanqb1Qsu7bXxWD3pj-aC
58. http://extras.mnginteractive.com/live/media/site21/2009/0918/20090918_042809_TREES_500.jpg
59. http://wwbpa.org/wp-content/uploads/2011/01/Brooklyn-Buffered-Bike-Lanes-w-Kids-300x201.png
60. http://c0476951.cdn.cloudfiles.rackspacecloud.com/fairmount-park-600.jpg

Parameter 9: Exposure to air pollution

Description: High levels of pollution can be a deterrent to cycle, exposing cyclists to the pollutant. Cyclists tend to inhale at a higher rate than motorists or pedestrians.

Rating Guide:

Rating	Description	Example
0	Very high levels of exposure to pollution making cycling risky	 61
1	Significant levels of pollution exposure	 62
2	Not significant but still high exposure to pollution	 63
3	Low levels of pollution only at certain times	 64
4	No pollution and air is clean making cycling a pleasure	 65

61. http://i.i.cbsi.com/cnwk.1d/i/tim/2013/01/14/China_pollution_AP971430398958_620x350.jpg
62. http://www.greenpeace.org/eastasia/Global/eastasia/photos/climate-energy/air-pollution-linfen-bicycle.jpg
63. http://www.standard.co.uk/news/article6486715.ece/ALTERNATES/w460/Cyclist+pollution+mask
64. https://c479107.ssl.cf2.rackcdn.com/files/179/width668/Copenhagen_cyclists.jpg
65. images?q=tbn:ANd9GcQXDQ0KuMkkU74xh7udJgtRkdDK3laRyu6m2sqaykFk9e0AX6Z2

Parameter 10: Traffic calming measures

Description: To reduce the speed of motorized modes, traffic calming measures should be in place, in the form of design or other external apparatus.

Rating Guide:

Rating	Description	Example
0	No traffic calming to slow down (fast moving) vehicles	 66
1	Calming measures present, but ineffective	 67
2	Calming measures present but not in sufficient number and not very effective	 68
3	Calming measures present and partially effective, but can be better placed	 69
4	Traffic calming measures present and effective	 70

66. https://encrypted-tbn0.gstatic.com/images?q=tbn:ANd9GcSSvfvTkF05RRQDhdrbssZjtIjBl34GlMw2C20BFdYecoM0N0z9jw
67. http://www.fhwa.dot.gov/environment/traffic_calming/image004.jpg
68. http://www.thehindu.com/multimedia/dynamic/00116/18THSPEED_116981f.jpg
69. http://www.istp.murdoch.edu.au/ISTP/casestudies/Case_Studies_Asia/tcalming/photo06.jpg
70. http://www.worldchanging.com/postimages/article/7750_largearticlephoto.jpg

Parameter 11: Connectivity of street network

Description: Presence of well-connected street network make cycling easier by reducing travel distance and time.

Rating Guide:

Rating	Description	Example
0	No connectivity of streets	 71
1	Very poor connectivity or unusable connection	 72
2	Poor connectivity	 73
3	Connectivity present but can be better	 74
4	Good connectivity between neighborhoods	 75

71. https://upload.wikimedia.org/wikipedia/commons/2/2b/Lower_Manhattan_from_Helicopter.jpg
72. http://images.nationalgeographic.com/wpf/media-live/photos/000/001/cache/house-development_194_600x450.jpg
73. http://th00.deviantart.net/fs71/PRE/f/2010/202/f/e/Las_Vegas_Suburban_Sprawl_III_by_guidoanselmi.jpg
74. http://cdn.theatlanticcities.com/img/upload/2011/10/27/AerialTassafaronga_thumb.jpg
75. http://www.helipics.net/hp/images/cortez.jpg

Parameter 12: Signs, markings

Description: Road sign boards and pavement marking help road users to clearly delineate the cycling paths or tracks and provide information to all.

Rating Guide:

Rating	Description	Example
0	No signs and markings at all	 [76]
1	Signs and marking in poor condition	 [77]
2	Very few signs and markings present	 [78]
3	Signs and markings are present, but not sufficient	 [79]
4	Clear signs and markings at the right locations	 [80]

76. https://encrypted-tbn3.gstatic.com/images?q=tbn:ANd9GcT4WrCUz1xsL1x_EToF7BrusVXaVjGgEcZiru3THL9xWpOEvXNQmg
77. https://encrypted-tbn1.gstatic.com/images?q=tbn:ANd9GcQCrazflOM3-jFhqwOVVsPPdARDMTbzAVqmCAqDQ5LL8PS-LC_c
78. https://encrypted-tbn0.gstatic.com/images?q=tbn:ANd9GcTrFXX2-_NjVtnsATDxtj5qNlmtADtxjO82msw9BrWe-JhpevCa4w
79. https://encrypted-tbn2.gstatic.com/images?q=tbn:ANd9GcRxEpNBSgLdZNYjyOUwp_elLkwSBY1EXK4ZJyqn9-gNRdgeLDTF7w
80. http://i.dailymail.co.uk/i/pix/2009/12/08/article-0-0784CA76000005DC-177_634x519.jpg

Parameter 13: Connection with other modes especially public transport

Description: Cycling is a very crucial last mile connector, (apart from being a main mode for some). Therefore integrating cycling with other modes is essential for seamless travel.

Rating Guide:

Rating	Description	Example
0	No connectivity with other modes	 81
1	Connectivity and access to other modes remains difficult	 82
2	Connectivity and access manageable but difficult	 83
3	Connectivity and access with some modes and needs minor improvements	 84
4	Good connectivity and good access with other modes	 85

81. https://encrypted-tbn1.gstatic.com/images?q=tbn:ANd9GcTy2Hp5Z8GY5G_X_eKf-sLuDfGZ-OcS1ahbFElHiiarSvbvxbjC
82. http://idonotdespair.files.wordpress.com/2013/07/cycle-parking-ghent-station-3.jpg?w=584&h=438
83. http://dtfjihky7xwic.cloudfront.net/sites/default/files/styles/article_section/public/How%20to%20Explore/Willow-Station-Bike-Racks-Lockers.jpg
84. http://www.camcycle.org.uk/newsletters/38/images/Bus1.JPG
85. http://railzone.nl/wordpress/wp-content/uploads/2011/01/IMG_6780.jpg

Parameter 14: Presence of service shops

Description: Service shops are essential to fix problems in a cycle, from punctures to other repairs and their presence makes gives a hassle free trip

Rating Guide:

Rating	Description	Example
0	No service shops available	 86
1	Very few available and not open at all times	 87
2	Service shops few and far apart	 88
3	Few service shops available	 89
4	Service shops available at frequent intervals	 90

86. https://encrypted-tbn3.gstatic.com/images?q=tbn:ANd9GcTStkohNypxc-RzvXBWZ8HgAKgxnwCbWrhhsTfUJ1BmjsEOhnpr0w
87. http://www.wrwc.org/images/redShedBikeShop.jpg
88. http://www.thehindu.com/multimedia/dynamic/01577/09TVKZBICYCLE_REPA_1577869f.jpg
89. http://www.indybikehiker.com/2009/08/street-side-bike-repairindia-style.html
90. http://www.bicycleemporium.com/uploads/images/Bicycle-Emporium-Service-Center.jpg

Parameter 15: Priority at junctions

Description: Prioritizing cyclists over motorists at signals, junctions

Rating Guide:

Rating	Description	Example
0	No signals for cyclists	 91
1	Signal available but not enforced	 92
2	Signal available but for short time	
3	Priority signal with other NMT modes	 93
4	Priority signal with sufficient time for cyclists	 94

91. by Clean Air Asia
92. http://t1.gstatic.com/images?q=tbn:ANd9GcR6KgkQ9AelogShLagKnsRwGoBziBj38_8HpTytOqrniERYoRi9
93. http://www.andrewboraine.com/wp-content/uploads/2011/02/IMG_3351.jpg
94. https://encrypted-tbn1.gstatic.com/images?q=tbn:ANd9GcSUcbRSvQiT7Gw7gCy2-xgky2P3ISatc5NaeQLz2SXtNhLM-TZC

Parameter 16: Perception of security

Description: This parameter assesses the feeling of security from crime as slow modes like walking and cycling are more prone to crime such as mugging.

Rating Guide:

Rating	Description	Example
0	Very risky and low feeling of security	 95
1	Risky and the environment feels unsafe	 96
2	Few unsafe sections	 97
3	Significant eyes on street and better feeling of security	 98
4	High sense of security	 99

95. http://cyclingsavvy.org/wp-content/uploads/2011/09/DSC09593-300x300.jpg
96. https://encrypted-tbn2.gstatic.com/images?q=tbn:ANd9GcQaviiSxinSG8e1GG8Tr4MavThJeS55QaMh_xicXSwBoVDQfpPgxg
97. http://www.smartgrowthamerica.org/wp/wp-content/uploads/2009/11/unsafe-283x300.jpg
98. https://encrypted-tbn3.gstatic.com/images?q=tbn:ANd9GcRxoQGHO_jeA7ZJUEHG7CSfoZ0k-NM3KwAbQ_Tn3H9HUXw3I5Fd
99. https://encrypted-tbn3.gstatic.com/images?q=tbn:ANd9GcQMwNhKg_cZhmgiCV1WXbxbaDWXqPx8J-Au3J_i9YExm-sPnehVNA

Annex D: Cyclists Preference Survey

Socio Economic Profile

1. Gender (M/F/O):

2. Origin of Trip: Destination:

3. Age:

4. Monthly Household Income:

Travel Pattern

1. **How many minutes (and distance) to you travel daily in each of the travel modes to reach your main destination?**

Mode/Time	<=15 min	15-30 min	30-60 min	60-90 Min	>90	Distance Covered
Walk						
Cycle						
Bus						
Cycle Rickshaw						
Metro						
Auto Rickshaw, Share rickshaw						
Car/Taxi						
2 Wheeler						

2. **What is the trip purpose?**

Work	Shopping	Recreation	Education	Others

3. **If facilities for cycling are not improved, will you shift to other modes? If yes, to which mode will you shift to?**

Walking	Cycle rickshaw	2 W	Car/Taxi	Bus	Metro	Auto Rickshaw	Continue Cycling

4. When do you think you are most exposed to air pollution? (select one)

Walking	Cycling	2 W	Car	Bus	Metro	Auto /Cycle rickshaw	Waiting for bus	Inside plaza area

5. Rate the following parameters and its dependence on cycling

	Most important	Important	Not Important	Not required
Separate Cycle Tracks				
Public Bicycle Share Systems				
Safe cycle parking				
Better lighting				
Reduced and slow traffic on road				
Cycle hire/rental				
Presence of Service Shops				
Connectivity of street network				
Trip Length				
Land Use				
Integration of cycling with public transport				

Annex E: Pedestrian Preference Survey

Socio Economic Profile

1. Gender (M/F):

2. Age:

3. Monthly Household Income:

Travel Pattern

1. Time spent on each mode of travel

Mode/Time	<=15 min	15-30 min	30-60 min	60-90 Min	>90	Distance Covered
Walk						
Cycle						
Bus						
Cycle Rickshaw						
Metro						
Auto Rickshaw, Share rickshaw						
Car/Taxi						
2 Wheeler						

2. What is the trip purpose?

Work	Shopping	Recreation	Education	Others

Pedestrian Preferences

3. What kind of crossings would you prefer? And why?

Subway	Foot over bridge	Over bridge with lift and ramp facility	At grade (same level)

4. How far will you walk to access a crossing?

<50m	50-100m	100-200m	200-300m	+300m

5. How would you rate pedestrian facilities at Nehru Place and its surroundings?

0 = Worst	1 = Very bad	2 = bad	3 = Ok	4 = good	5 = Best

6. If facilities are not improved, which mode will you shift to?

Cycle	Cycle rickshaw	2 W	Car/Taxi	Bus	Metro	Auto Rickshaw	Continue Walking

7. Would you consider cycling if which of the following are available, choose the most required

Separate cycle tracks	Public cycle share system	Safe Cycle parking	Better lighting

8. When do you think you are most exposed to air pollution?

Walking & crossing	Cycling	2 W	Car	Bus	Metro	Auto /Cycle rickshaw	Waiting for bus	Inside plaza area

9. What are the factors that can increase safety for vulnerable class or women? (Tick as many as possible)

Good illumination	Better planned bus shelters	Continuity of footpaths	Hawker spaces	Others (specify)

10. If given an opportunity what improvement you would like to have in pedestrian facilities in Nehru Place and its surroundings

	Most important	Important	Not Important	Not required
Easy access for people with disabilities such as ramps, handrails				
Wider, Level and clean sidewalks/ footpaths				
Improved street lighting				
Reduced and slow traffic on road				
Remove obstacles/parking from footpath				
More crossing points				
Reduced parking space				

11. Please rank the following in order of requirement (1 is most required; options can be modified based on the neighborhood being surveyed)

- **Clean Toilets**
- **Seating benches/ resting areas**
- **Covered walking place (protection from rain/sun)**
- **Others (please specify)**

Surveyor details

Date & Time:

Name:

Location:

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About Clean Air Asia

www.cleanairasia.org

Clean Air Initiative for Asian Cities (Clean Air Asia) promotes better air quality and livable cities by translating knowledge to policies and actions that reduce air pollution and greenhouse emissions from transport, energy, and other sectors.

Clean Air Asia was established as the leading air quality management network for Asia by the Asian Development Bank, World Bank and USAID in 2001, and operates since 2007 as an independent non-profit organization. Clean Air Asia has offices in Manila, Beijing and Delhi, networks in eight Asian countries (China, India, Indonesia, Nepal, Pakistan, Philippines, Sri Lanka, and Vietnam) and is a UN recognized partnership of almost 250 organizations in Asia and worldwide.

Clean Air Asia uses knowledge and partnerships to enable Asia's 1,000+ cities and national governments understand the problems and identify effective policies and measures. Our four programs are: Air Quality and Climate Change, Low Emissions Urban Development, Clean Fuels and Vehicles, and Green Freight and Logistics.

The biennial Better Air Quality (BAQ) conference is the flagship event of Clean Air Asia bringing experts, policy and decision makers together to network, learn and share experiences on air quality management. Past BAQs have proven to influence policies, initiate new projects and establish partnerships.

About UN-Habitat

http://www.unhabitat.org

UN-Habitat is the United Nations agency for Human Settlements. It is mandated to promote socially and environmentally sustainable towns and cities with the goal of providing adequate shelter for all. UN-Habitat's Urban Transport Section promotes policies and models to achieve sustainable urban transport systems across the globe. Set against the overall mission of the organization to promote socially, environmentally and economically sustainable human settlements development, the practical work places particular emphasis on promoting effective answers to the challenges of the rapid urbanization process in developing countries and the needs of the urban poor. At the same time, urban transport policy all over the world has to substantially contribute to solutions addressing global warming.

About Shakti Sustainable Energy Foundation

http://www.shaktifoundation.in/

Shakti Sustainable Energy Foundation (SSEF) works to strengthen the energy security of the country by aiding the design and implementation of policies that encourage energy efficiency as well as renewable energy. Shakti belongs to an association of technical and policy experts called the ClimateWorks Network

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