The Energy and Resources Institute

TERI-NFA Working Paper No. (11)



Defining Sustainable Urban Mobility

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March 2014

Acknowledgements

This paper was written as part of a project **Analyzing Sustainable Urban Transport: A City Level Modelling Approach** under the Program of Activities, Framework Agreement between the Norwegian Ministry of Foreign Affairs (MFA) and The Energy and Resources Institute (TERI), briefly referred to as the Norwegian Framework Agreement (NFA). We are grateful to the **Dr. Ritu Mathur** and **Dr. Atul Kumar** for insightful comments.

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Abstract

Indian cities are experiencing rapid urbanization as an effect of economic growth and industrialization. The urbanization process impacts the spatial distribution of land uses and travel demand created by the distribution of activities. Therefore it becomes imperative that the mobility of people and goods should be planned appropriately to minimize congestion and other environmental impacts on the cities.

This paper focuses on the understanding of urban mobility, and its issues related to economy, society and environment. The paper proposes a definition of sustainable urban transport by incorporating the mobility and accessibility needs of the people and goods (termed as mobility+), by emphasizing the relation and interdependence of land use and transportation system.

Defining Sustainable Urban Mobility

People's travel decisions are based on residential, job, and activity location. It is also a physical outcome of interactions between cultural backgrounds and physical needs of a particular society and the potential of land availability (Chawla, 2012). The land use system consists of spatial distribution of opportunities supplied at each destination in terms of jobs, shops, healthcare, residence, and social and recreational facilities. Transport infrastructure is a means to overcome the space between two destinations, so as to meet the demand generated by displacement of people and goods. The transport system typically consists of multi-modal public transport connecting spatially-distributed activity location which is planned by the Government on a decadal basis.

Mobility and Accessibility

Mobility and accessibility are two main components of transportation system. Ilan Salomon and Patricia L. Mokhtarian (1998) have defined mobility as a demand for activities or travel, where the costs are an integral part of the demand. Travel can be an activity when a person travels for enjoyment and satisfaction whereas travel is a derived demand when a purpose is attached to travel i.e. reaching a destination. Beimborn et al., (1999) has defined mobility as the ease of movement from one destination to another with the help of transport network and services available within the two destinations. The location of origin and destination largely governs the travel pattern and depends on the placement of activities (Cervero R., 2009). Mobility between origin and destination is measured as the distance travelled by people in person miles travelled, goods in ton-miles travelled and vehicle trips for both people and freight, and is enhanced by increasing the speed and mileage of the vehicle (Litman, 2003). In other words the demand for travel is the distance travelled by an individual between the origin and the destination using a specific transport mode, which includes a time dimension (as travel time, waiting time and parking time) opportunities (in terms of income, travel budget, education level etc.) and an assurance dimension (in terms of reliability, level of comfort, accidents, risks, and others). Any confrontation of supply and demand for opportunities due to restricted capacities at any one destination results in greater mobility need and disutility.

On the other hand, accessibility is a measure of supply, namely, potential mobility, and is not a descriptor of user behaviour (Jones, 1989). Access is the ultimate goal of most of the transportation, except a small portion of travel in which movement is an end in itself with no destination (Litman, 2003), it means that travelling becomes an activity in itself (as mentioned above) and is not a means to access destination. Accessibility is also the management of travel demand across different income groups and gender (Cervero R., 2009), which is achieved by providing transport infrastructural and logistic facilities to meet the mobility demand. The supply of infrastructure includes location of activities and various transport infrastructure and service characteristics such as maximum travel speed, number of lanes, public transport schedules, and travel costs. Traditionally, improvements in accessibility were obtained by improvements in transport supply, particularly through the expansion of infrastructure (roads and rail) and associated services. In recent years, such accessibility gains attained by means of increasing inefficient (automobile-based) mobility are deemed undesirable and unsustainable. Instead accessibility improvements accomplished through better land use planning policies such as mixed-use developments and job-housing balance, as well as by temporal policies such as alternate work schedules, are considered socially more efficient. In addition, non-motorized transport system is consider sustainable along with compact and mixed

land use that helps to increase walkable communities in order to reduce the amount of travel required to reach respective destinations.

The above definition frames accessibility as a more sustainable approach of travelling when compared to mobility, but in recent times the definition of mobility has been modified as a combination of the above mentioned components of transport system. This paper looks into redefining the mobility so that it over arcs the concerns that is the repercussions of the current travel pattern.

Sustainability and Mobility

The travel demand of a settlement is governed by various factors like demographics, economic activity, vehicle ownership and maintenance cost, public transit availability and cost, level of congestion, non-motorized transport use conditions, vehicle sharing options, land use development patterns, and health and environmental concerns (Litman, 2013). Furthermore, urbanization, a by-product of increased economic activity has consequences on the rate of motorization, thus increasing the travel demand and need for transport infrastructure and services (Ghate & Sundar, 2013). The increased travel demand of India can be seen through rise in the number of registered vehicles from 55 million in 2001 to 142 million in 2011, and with this the share of transport sector on GDP has also increased from 3.9% in 2001 to 4.7% in 2011. Whereas, during the same period the growth rate of roads was 3.4% as compared to 9.9% of vehicular growth rate, thus, creating a gap between the need for transport infrastructure and supply of the same (MoRTH, 2012). Aforementioned rate of motorization poses several mobility challenges like insufficient road capacity, low levels of clean air, high fatality rates and lower access conditions (Tiwari, 2011).

Table 1: Compound Annual Growth Rate (in %) of Vehicles and Road Length

Period	Vehicles	Roads
1951-1961	8.1	2.7
1961-1971	10.9	5.7
1971-1981	11.2	5.0
1981-1991	14.8	3.0
1991-2001	9.9	2.1
2001-2011	9.9	3.4

Note: Roads include - National Highways, State Highways; Other Public Works Department roads, Rural and Urban roads and various projects. Vehicles include – Two-wheelers, Cars, Jeeps, Taxis, Buses, Goods vehicles, Tractors, Trailers, Three-wheelers (passenger vehicles/LMVs) and other miscellaneous vehicles which are not classified separately. **Source:** MoRTH, 2012

Therefore, sustainable urban mobility provides an alternate concept to understand the complex movement needs of people and goods in a city and amend the links between transport and land use. For this alternative approach, emphasis is given to the future of cities with respect to existing infrastructure (i.e. reality), desirability (what is the need and expectation of the community) and role of transport in order to meet the above expectations of the city (Banister, 2008). Based on empirical research, Banister (2008) quantifies sustainable city parameters with a population of 50,000 and more, with medium density of 40 persons per hectare, and mixed land use developments representing public transport accessibility or public transport mode used significantly. Several settlements of the above mentioned size and transport characteristics helps in creating an urban

agglomeration with amenities in close proximity and of a scale which requires least use of personalized vehicles. He further states essential steps required to achieve sustainable mobility, which includes reduction in the amount of travel, number of trips per person, and travel distances; increase in modal split travel and finally the use of efficient transport system.

Further Banister has compiled Marshall's (2001) measures for sustainable mobility – an alternative approach which includes the social dimension, accessibility, focus on people (either walking or in vehicle), local in scale, street as a space and not just a means to travel, change in transport hierarchy with a bottom up approach for modes of transport i.e. preference to cyclist and pedestrians, integrating people and traffic, travel management, and reduced travel times. Further adding to the list is a holistic approach for the city rather than just traffic, scenario development & modelling, integration of social and environmental concerns, type of travel (i.e. derived demand and valued activity), management of mobility, reducing and slowing the movement, travel time reliability, reasonable travel times and integration of people and traffic.

Redefining Sustainable Urban Mobility

Existing Definitions

In addition to the above mentioned broader sustainable concept, below mentioned are specific definitions of sustainable transport given by various agencies.

The first definition of sustainable development by Brundtland Commission (1987) explains it as 'Development that meets the needs of the present without compromising the ability of future generations to meet their own need'.

The Transport Research Board (TRB, 1997) a US National Advisory Board on transportation has defined sustainability w.r.t. transportation as 'Sustainability is not about threat analysis; sustainability is about systems analysis. Specifically, it is about how environmental, economic, and social systems interact to their mutual advantage or disadvantage at various space-based scales of operation'.

According to Moving on Sustainable Transport (MOST, 1999) program launched by Canada Transport defines sustainable transport as 'The goal of sustainable transportation is to ensure that environment; social and economic considerations are factored into decisions affecting transportation activity'.

World Bank Council for Sustainable Development (WBCSD, 2001) explains sustainable mobility as 'The ability to meet the needs of society to move freely, gain access, communicate, trade, and establish relationships without sacrificing other essential human or ecological values today or in the future'.

Center of Sustainability (2004) elucidates sustainability as 'the capacity of continuance into the long term future' which means the ability to continue anything for indefinite period is sustainable otherwise it is unsustainable.

In 2006, after the approval of Union Cabinet, a National Urban Transport Policy (NUTP) was formulated. The objective of the policy is to 'ensure safe, affordable, quick, comfortable, reliable and sustainable access to all residents'.

A precise adaptation of Brundtland Commission Report's definition of "sustainability" mentioned above with respect to sustainable transportation is 'a set of transport activities together with relevant infrastructure that collectively does not leave problems or costs for future generations to solve or bear', here the cost does not limit to environmental degradation but also the social and economic impacts of transportation (EMBARQ, n.d.).

The abovementioned definitions address a couple of common agendas of sustainable transport system which are mentioned below.

1. Revolve around stabilizing the costs incurred under economic, social and environment aspects, the three pillars of sustainability.
2. To minimizes the burden on future generations.

Whereas the definitions don't take into account factors like

1. Making the transport system accessible to all segments of society at affordable prices.
2. Land use allocation as an integral part of mobility and accessibility.

Thus we need to have a broader concept of mobility that incorporates the role of transportation and land use in meeting the travel demands of people with a sustainable approach.

Sustainable mobility: A broader concept

Sustainable mobility is not only about reducing one's own travel footprint but also to reduce the same of the society, therefore, a sustainable transport system should not only look into individual's mobility need but also the mobility need of the society at large.

Sustainable transport system goes beyond the concept of consuming lesser amounts of fossil fuels to improve energy security and proactively work towards lowering carbon emissions. It is about taking holistic approach by considering economy, society and environment along with the mobility and accessibility requirement of the people. For instance, a narrow approach towards sustainable transport would be implementation of alternative fuel vehicles like biofuel, hydrogen, electricity etc. without addressing the problem of acquisition, maintenance, operation and parking cost of the vehicle. This kind of technological advancement should not be restricted to automobile modifications but should also be involved in traffic management systems and in dissemination of traffic information. Furthermore, this approach does not include the indirect cost like that of accidents, sprawl, poor health and more.

The broader concept of sustainable urban mobility should incorporate the land use planning and sectoral allocation of land for different activities. The proper allocation of land for different activities will help in reducing the travel demand through reduced trip frequency and trip distance. The compactness of the various activities will also promote walk and non-motorized transport.

Achieving the broader approach for sustainable mobility becomes very complex in case of developing countries where the gap between rich and poor is high along with varied requirements of mobility and accessibility depending upon the spending capacity of an individual. In most cases, the poor becomes a captive non-motorized transport user thus being the most vulnerable to safety issues (Tiwari, n.d.). In addition to the above social constrain there is considerable amount of gap

between the need of transport services and infrastructure as compared to the requirement for the same.

Issues of urban transport which should be taken into account

Several authors have mentioned various issues from economic, social and environment perspective that are generated by the movement of goods and people. Most of these issues arise due to excessive use of personalized vehicles. The issues are compiled in the table below.

Table 2: Issues of Urban Transport System

Economics	Social	Environmental
Traffic congestion	Mobility for vulnerable groups	Air pollution
Infrastructure costs	Human health impacts	Habitat loss
Consumer costs (fares, automobiles, etc.)	Community cohesion and street life loss	Hydrologic impacts
Mobility barriers	Community livability	Depletion of non-renewable resources
Accident damages	Aesthetics	Noise
Productive rural land loss	Isolation in suburbs	Urban sprawl
Urban land loss to bitumen surface	Public safety	Storm water run-off problem
Time loss due to sprawl		Photo chemical smog, lead and benzene

Source: (Litman & Burwell, 2006); (Newman & Kenworthy, 1996)

Proposed definition

With reference to the aforementioned definitions, issues and broader concept that are to be considered while working towards achieving sustainable urban mobility the following definition has been derived and proposed with the intention to attain the same.

"*Sustainable Urban Mobility+ is a system that incorporates economic viability, environment stability and social equity by meeting the needs of transport and land use of both current and future generations in an efficient manner*".

The above definition also deliberates both user and service provider's perspective for attaining sustainable mobility. From a user's perspective, the transport system should be quick, affordable, safe, secure, reliable, comfortable, energy efficient and environmentally benign for every category of traveller. It means that the transport system should reduce the distance travelled, time taken and use of personal vehicles along with increasing accessibility though proper land allocation for different activities. From system operator/infrastructure provider perspective, the transport system should be profitable along with meeting out the requirements of travellers across various income group and

gender. So, normative view on sustainable urban mobility+ suggests integrating the transport and land use so that it becomes economically viable for user and profitable for the provider. It requires optimizing the use of existing infrastructure through lowering the cost incurred and investing adequately on sustainable modes of transport and land use.

Conclusion

Definition forms the base of knowledge which helps in designing the future action plan. In the current environment, transport system cannot be looked in isolation where there are significant repercussions of it on society, economy and environment. Integrating land use with transport infrastructure gives a holistic approach towards sustainable mobility. Hence, by redefining mobility as sustainable urban mobility+, the aim is to increase the horizon and make it more comprehensive.

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