MICROMOBILITY AS A SUSTAINABLE MODE OF TRANSPORTATION – A CASE STUDY

A REPORT

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INTRODUCTION

1.1. GENERAL

The demand for housing, transportation, utility services increases with increase in population, when the cities grow. A well-planned urban transportation system is based on the urban form and has impact on preferences for commuting mode, but an unplanned or unregulated public transportation services with inadequate first and last mile connectivity have been compromising the urban dweller's preferences for private motorised transportation over public mode. Original forms of micromobility, like bicycles and scooters, have both been around since 1817, and it was not until 1908 that cars came to dominate in modal share in cities. Since then, use of bicycles as a utilitarian urban transport mode has been relatively low in comparison to trips made by private vehicles outside of a handful of cities in China, Netherlands and Denmark.

In recent years, micro-mobility is emerging as a potential solution to the growing demands on the existing transportation network. Several micro-mobility options such as safe pedestrian infrastructure, bicycles, e-scooters (docked and dock less), shared e-bikes, can help leverage the benefits of mass transportation system by providing first and last mile connectivity with reduced usage of personal motorized vehicles and lower levels of GHG emissions. With the help of GPS tracking, mobile payments, battery cost and longevity, and the growing trend of smartphones, micro-mobility modes are emerging as a true potential solution for urban mobility. Micro-mobility options can substantially serve the various locations dominated by short trips. It can improve accessibility to employment, education and health care when they are targeted for the areas more than 500 meters from public transport.

1.2. NEED FOR THE STUDY

Indian cities are facing a multitude of issues such as severe congestion; deteriorating air quality; increasing greenhouse gas (GHG) emissions from the transport sector; increasing road accidents; and an exploding growth in the number of private vehicles (largely motorcycles). With the rapid increase in population, the situation could easily get out of control and affect India’s economic development efforts unless remedial measures are soon taken. As per Comprehensive mobility plan for Chennai Metropolitan Area 2019, it is found that the modal shares of non-motorised transport, public transport and personalised vehicles including IPT are 28.2 %, 43.8 % and 28 %, respectively for the year 2018. The data indicates that there is lack of public transportation facilities and citizens are largely dependent on private modes of transport.

While mass transit is the most efficient means of moving large number of people over long distances, the first and last mile connectivity to get people to and from transit remains a major difficulty. If people lack a convenient, affordable way to get on a mass transit, they are most likely to opt for personal transportation, which leads to congestion, poor level of service on roads and other environmental impacts. The first and last mile problem that can be defined as the challenges caused by the built and social environment includes land use mix, neighbourhood design, distance from and to public transportation, employment opportunities, and other related factors.

The benefits of micromobility are obvious, both in terms of the positive impact on congestion levels and air pollution, challenges with which many cities worldwide have been struggling. Even with a modal share of between 10% and 20%, electric micromobility removes or replaces enough four-wheel vehicles on the road to materially impact traffic flow and air quality. The resulting combination of high speed and spatial reach of public transport with the door-to-door accessibility provided by micromobility creates a degree of access, speed and comfort that can compete with that of private motorised vehicles. Micromobility potentially promotes significant modal shifts away from private motorised vehicles.

1.3. OBJECTIVE

- To determine the feasibility of micromobility as sustainable mode for first and last mile connectivity.
- To identify and overcome the barriers for the usage of micromobility.
- To provide an extensive knowledge on integration of micormobility with public transit.
- To identify the strategic locations of micromobility stops or stations for efficient micromobility – transit integration.

CHAPTER 2

LITERATURE REVIEW

2.1. GENERAL

This section deals about the various literatures collected for understanding how the micromobility can be used as sustainable mode of transportation and also integration of micromobility and public transport for better first and last mile connectivity.

2.2. LITERATURE REVIEW

Miriam Ricci (2015) identifies and interprets the available evidence in bike sharing systems (BSS) to date, both impacts and process of implementation. This review of evidence for paper draws on literature search in two requirements, first to provide some form of evaluation, assessment on existing BSS and second to be supported by well explained and robust conceptual and methodological approach. The evidence presented in the study concerns with users and usage of bike sharing like user's socio-economic profile and equity of access, determinants of and barriers to bike sharing use, bike sharing rates, patterns and purpose of use; impacts of bike sharing like transport mode substitution, changes in user's travel behaviour, effects on and synergies with public transport, impacts on cyclist's attitudes, environmental impacts, health impacts, economic impacts on users and local business, financial viability and wider economic benefits; and the process of bike sharing implementation and operation like political, policy and public support to sustainable travel and cycling in particular. However, there is no evidence that bike sharing significantly reduces traffic congestion, carbon emissions and pollution. The study suggests that Positive cycling culture, growing cycling levels and pro-cycling policy measures, such as the provision of quality cycle infrastructure, have all been identified as important complementary factors that can sustain bike sharing during and after implementation.

John Pucher et al. (2017) in their study gives an overview on cycling trends in European and American cities, improvements in cycling safety and policies to promote safer cycling. The fig.1 shows increasing bike mode shares in large cities of Europe and America, 1990–2015, based on travel surveys conducted for each city. The study highlights the bike shares of trips in 19 major cities of Western Europe, North America and South America have risen sharply in recent decades. One of the most important approaches to increasing cycling is to provide off-road bikeways and mixed-use paths and protected on road cycling facilities, separated from motor vehicles by physical barriers or buffer zones. The study suggests that such efforts have succeeded in improving overall cycling safety. The study has found that protected facilities are especially important for women, children and seniors, but also for anyone who is risk-averse or feels vulnerable cycling on roads with motor vehicles and also comprehensive traffic calming of residential streets, has speed limits of less than 30 km/hr, has great potential to increase cycling, as well as walking, in local neighbourhoods.

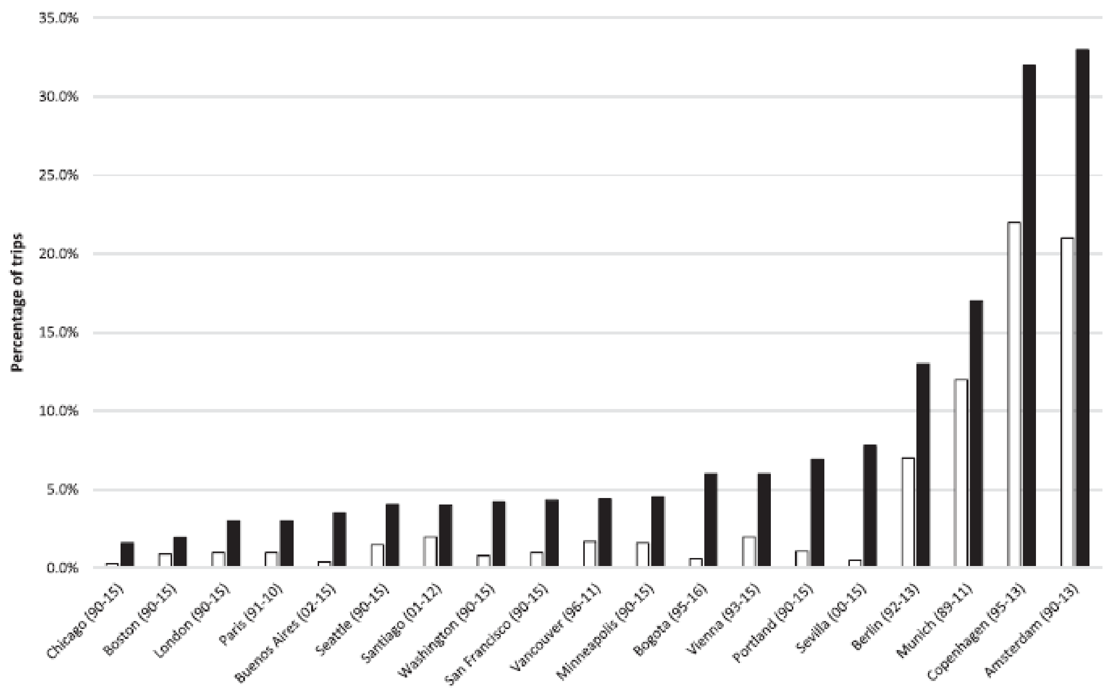

Fig.2.1 Cycling mode shares in large cities of Europe and America, 1990-2015

Yung-Hsiang Cheng et al. (2017) examines how metro stations can expand their service coverage for passengers by implementing public bicycle sharing system (PBSS) in the vicinity. The study was conducted for Kaohsiung metro network, Taiwan, used stated preference survey to investigate passenger characteristics. Mixed logit (ML) model is used to calibrate the survey data and also used geographic information system to display this expansion in metro station service coverage following the incorporation of PBSS. After increasing the service coverage, cost-benefit analysis is done to evaluate appropriate strategy for future PBSS station allocation. The fig.2.2 shows the result of cost-benefit analysis.

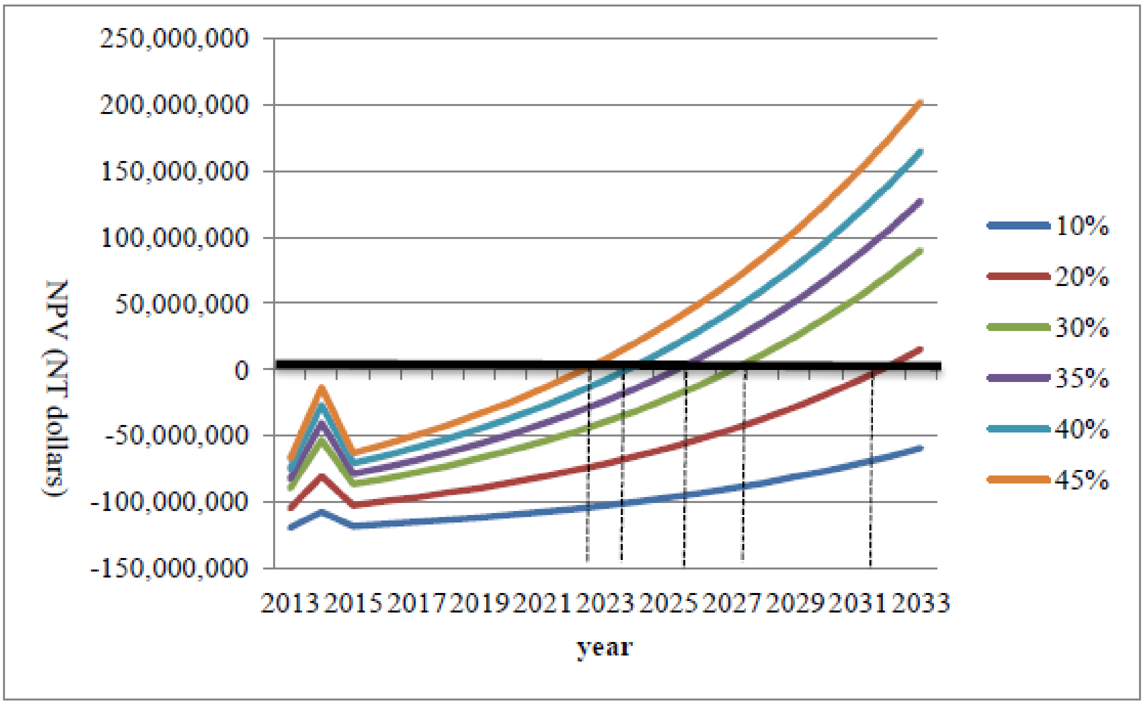

Fig.2.2 Cost-benefit analysis of PBSS associated with different passenger transfer percentages

The questionnaires were distributed at Kaohsiung metro station and 309 valid questionnaires were considered for descriptive analysis. The study found that metro mode preference is governed by gender, age, vehicle ownership and income.

The study established the ML model with in-vehicle time of using metro, PBSS station configuration, and egress distance as the generic variables. It is found that egress distance and number of PBSS station has positive correlation with mode choice preferences. The result also found that the variables of metro station characteristics, which cover population density and the availability of motorcycle parking spaces, considerably influence passenger intention to use PBSS after exiting a metro station. However, it is seen that metro stations with the highest ridership have failed to expand their service coverage. This is due to these stations are often located in areas near business centres, shopping malls, and restaurants within accessible walking distance. Thus, passengers are less willing to use PBSS when they exit the metro stations located in areas with high population density. The study used net present value method for Cost-benefit analysis of PBSS associated with different passenger transfer percentages.

Aihua Fan et al. (2019) in their study investigates the mode choice behaviours of travellers for first and last mile trips before and after the introduction of bicycle sharing systems in Beijing, China. Travel choice models for first and last mile trips are determined using a multinomial logit (MNL) model. Before the introduction of bicycle-sharing systems, travellers had three travel options for first/last mile trips: walking, private bicycles, and automobiles. After the implementation of bicycle-sharing systems, they have four choices: shared bicycles and the three mentioned choices. It is seen that the gender, bicycle availability and travel frequency were the most significant factors before the implementation of bicycle-sharing systems. However, after implementation, access distance dramatically affects mode choices for first and last mile trips. The questionnaire used for modelling has individual and sociodemographic attributes, travel characteristics, distances related to the built environment, and mode choices for first and last mile trips. 512 valid questionnaires were considered for the analysis. The study divides the entire trip into first mile trip, public transport trip (main trip), and last mile trip. Policy implications, environmental factors, road congestion were not considered, is the major limitation of this study.

Samir J Patel et al. (2019) in their study determined the feasibility of providing PBSS in the CBD area of Surat city. The Household (HH) survey was undertaken for 856 household samples covering a total of 3826 individuals, to understand travel behaviour and demand of Central zone, reveals that about 75% two-wheeler users and 78% car users are willing to use PBSS if implemented. The data of major activity centres, routes of intermediate public transit and public transit stops, land use, road network, population density, traffic generating activity map were collected and analysed in GIS software. Based on the analysis, Spatial Location was set and long term, medium term, short term system design was carried out as three phases. Maximum production and attraction of trips possible, are considered for the first phase, Phase II includes areas with the high potential of growth and phase III includes rest of the central zone to ensure PBS network for the whole area. The results from analysis give an idea about if PBS system is launched, then daily commuters, Pedestrian, etc get benefits and willing to use these types of NMT facility in their daily trips.

Bhagyalaxmi Madapur et al. (2020) in their study analysed the trends on urban mobility with focus on micromobility, addressing first and last mile connectivity for efficient usage of mass transit system in Hebbal area, Bangalore. The study area has been analysed under different parameters such as access-exit points, traffic dominated pedestrian environment, walkability, intrusive driving and parking and weak and less accessible connections, to understand the impact on the mobility choices and quality of commuting. The study also presents the schematic proposals for Hebbal study area for integrated micromobility infrastructure and regulatory framework such as adaptive regulation, outcome-based regulations and regulatory test pits, to improve the urban mobility landscape. This study gives only an overview of micromobility in the context of urban mobility and it fails to give any detailed analysis on trips analysis.

Giulia Oeschger et al. (2020) presents an extensive systematic literature review of 48 articles that focus specifically on the integration of micromobility and public transport systems. This paper also offers an understanding of how micromobility – transit integration has been studied to date, which factors and aspects have been considered and analysed in these articles. This paper provides a comprehensive collection and critical discussion of suggestions and recommendations included in the literature which are analysed in this study, aimed at improving and further promoting the effective integration of micromobility and public transport services. The suggestions and recommendations made in 48 selected articles have been grouped into six different categories, infrastructure like safe, user-friendly and affordable micromobility parking facilities at public transport stations; built-environment like population density, land use types; planning, policies, technology and pricing. It also highlights the gaps that impacts of the integration of micromobility and public transport has on various aspects of society, environment and economy, and also on studies which conduct data analysis on how micromobility is used as an access and egress mode to public transport.

Rahul Goel et al. (2021) in their study presents a descriptive analysis of cycling behaviour including level of cycling, trip purpose and distance, and user demographics, at the city-level for 35 major cities and in urbanised areas nationwide for 11 countries. The study used the combination of city-, region- and country-level travel surveys from 17 different countries across six different continents. The study correlates the cycling levels of different geographies with trip purpose, cycling distance pattern, gender and different age groups. The study also finds the global typologies of cities based on cycling levels and representation of gender and age among cyclists. The result indicates that equal work and non-work trips for high cycling levels, whereas at low cycling levels, cycling to work is higher than to other trips; cycling distance pattern is similar, irrespective of the cycling levels; women contributes equal or more cycle trips than men if cycling mode share is greater than 7% and for less than 7% mode share, women cycle trips is much lesser than men; all age groups have better representation in high cycling geographies, whereas for low cycling children are overrepresented and older adults are underrepresented; representation of female increases with increasing level of all age groups. The limitation in the study is that the urban areas definition in various countries differs and the survey used in the analysis excludes the cycling trips that is done for a part of trip, for example, to access public transport.

2.3. INFERENCES FROM LITERATURES

The following inferences were observed from the above literatures,

1. The socio-economic characteristics like gender, age, income, vehicle ownership, highly influence the people's preferences on different micromobility options.
2. Providing infrastructures like exclusive bicycle lanes separated from motorised vehicle lanes by physical barriers or buffer zones, considerably increasing the NMT mode share.
3. Integrating public transport with public bicycle sharing system (PBSS) benefits the people in first and last mile connectivity, ensuring door to door accessibility, shift towards a sustainable mode from motorised two-wheelers and cars.
4. The literatures fail to provide detailed analysis on reduction in congestion, carbon emissions and pollution and other environmental factors like climate were not considered.

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