

ANALYZING EFFECTIVENESS OF NON-MOTORIZED TRANSPORT AS A TOOL FOR LAST MILE CONNECTIVITY

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ABSTRACT

The objective of this paper is to examine the role of non-motorized transport (NMT) as a solution in improving the last mile connectivity (LMC) to mass transit systems in Shivajinagar Pune Maharashtra. The paper discusses the transport policies for Indian cities with respect to LMC, NMT and transit systems and their interface. The paper also presents the empirical study findings on NMT as a tool for LMC in Shivajinagar Pune for Public transport system in the area relating the first and last mile connectivity. Pune is a good example of a city that has, capitalized on the central governments funding schemes to deliver quality streetscapes for its citizens in a collaborative manner with civil society and very systematic in delivering NMT infrastructure considering the aspects of Non-Motorized Transport. It is observed that NMT comes out as the most preferred option for covering the first/last mile to transit systems, despite the challenging situations under which NMTs operate. Further the study elaborates that the mode and choice of NMT for LMC for the commuters depends on the real time circumstances as their mode of choice varies periodically. "Bicycle share system" was considered to be the best option for LMC with NMT and walking as a secondary option for FMC/LMC to Public transport. For the betterment of LMC enhanced policy manifestation with better infrastructure for walking and cycling shall be provided ensuring the safety comfort and economy of the commuters. Modes of NMT are Walking/Pedestrians Cyclists Non-Motorized Vehicles (NMVs) for persons with special needs Cycle-rickshaws, NMT for LMC has various advantages and benefits as it improves the social and economic conditions improving road safety and endurance for place making, reducing dependency on fuel and increasing the tourism by providing accessibility to walk or cycle as the study area comprises many historical monuments.

KEY WORDS: Last mile connectivity, non-motorized transport, sustainable mobility, safety and economy.

1.INTRODUCTION

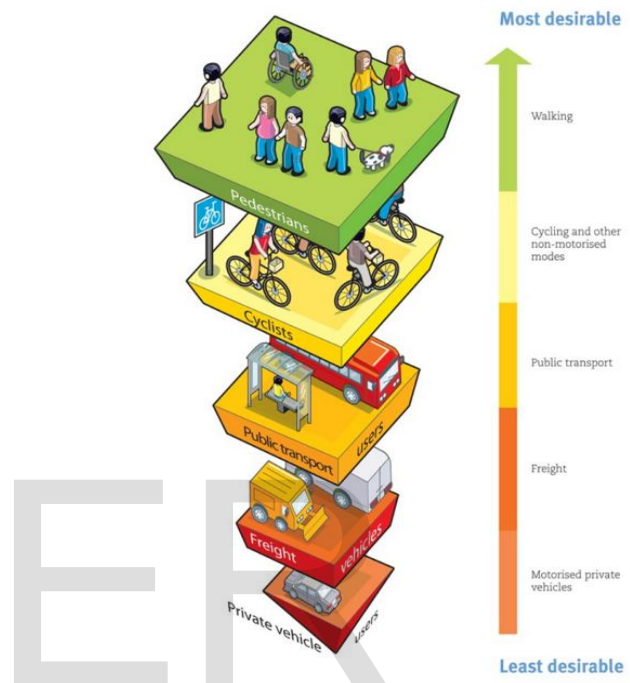
Conventional development paradigm considers cities as vital machines of growth, urban development as supporting tool and transport system providing support as level of economic activities. The Jawaharlal Nehru National Urban Renewal Mission (JNNURM) is the first major urban development initiative in India also has the same paradigm arbitrarily supports the urban development focusing on the efficient transport system considering infrastructure requirements social and economic aspects of transportation. The National urban transport policy which emphasizes on safe, affordable, quick, comfortable, reliable and sustainable transport accessibility. The urban sprawl and increasing transport facilities and various transport modes have created haphazard to the sustainable transport evidently reporting more complications congestions and inadequacy in the metro cities. These all aspects have an impact on the efficiency of transport system and due to these constraints, the use of public transport has reduced, leveraging the increment in personal vehicle ownership. Hence, creating conflict for the first and last mile connectivity for commuters. The inadequate conditions lack of implementation socio economic based perception of not using the public transport distorted the concept of first and last mile connectivity mainly in metropolitans. Concerns for sustainability and equity have seen transport policies, especially in the developing world evolve from being traffic-centric to people-centric. The paradigm shift in policy has been accompanied by metropolitan cities opting

for mass rapid transit systems. Yet, the larger context of the entire journey experience that begins at the point when one steps out of a place of residence to the final destination remains an area of negligence in most transit planning exercises. In Indian cities, policies till now have remained silent on last mile connectivity (LMC) but talk of low-carbon transport and non-motorized transport (NMT). Most cities take up transit system and NMT planning in isolation to each other. It is also true that while cities have been enthusiastic in introducing transit systems, there has been rather lackadaisical approach towards NMT planning and its integration with transit systems. The new National Urban Transport Policy (NUTP) for the first time talks explicitly on "last mile connectivity". It broadens the scope of multi-modal integration to include "private modes of transport i.e., walk, cycle, cars and 2-wheelers and para transit modes i.e., tempos, autos, mini bus and cycle rickshaw to the mass rapid transit network" which was previously "limited to integration of buses with Metro rail". The policy also recognizes the significance of improving last mile connectivity to public transport through provision of footpaths and cycle lanes, provision of feeder services, and incorporating design principle to promote safety, accessibility, reliability and affordability, amongst other measures. The objective of this study was to prepare strategical policy that can be implemented confirming the aspects of importance for LMC (safety, comfort, economy, feasibility) to adopt. It is also observed that the choice of

commuter for modal shift or adopting the NMT has an impact of socio-economic inclusion and land use pattern. The prospect of providing LMC is way far different in Indian context where the climatic conditions Physical infrastructure and rapid growing areas have brought a serious constrain to the condition.

NMT in India means far more than simply walking and cycling. Instead, it encompasses a wide array of people on streets riding in cycle rickshaws, pulling handcarts, selling wares on vending carts, riding handicap tricycles and bullock carts as well as children being pushed in prams. All of these modes conflict with a number of motorized modes on city roads, which lead to unsafe and congested environments. The concept of sustainable transportation promotes the balance between transportations economy social benefits and need to protect the environment. "It's about choosing aright mix for a better transport system". A sustainable transport system provides an individual or societies to meet their needs safely. The concept of non-motorized transport system NMT is vital for sustainable transport system to ensure clean healthy and high-quality environment. In general terms, NMT users can be classified into two categories: those who walk or cycle out of choice and those who are "captive users" and have no other choice. Indian cities are dominated by the latter, though choice users are substantial in number. NMT use by choice remains a latent demand primarily due to the absence of dedicated infrastructure. NMT is mostly used for short-distance trips, with cycling particularly relevant up to 6.5 kms, and walking up to 2.5 kms. As up to 70% of cars trips cover less than 5 kms, NMT has a large potential to replace car travel in the study area. India, the second most populated country in the world faces huge growth in private vehicles which leads to increased greenhouse gas emissions, air pollution and congestion. Sustainable mobility concerns have seen cities introducing mass transit systems, but travel choice factors such as accessibility, convenience, comfort, and safety cannot be addressed through a transit system alone. The lack of suitable last mile options discourages private mode users to shift to public transport. For a larger mass, cycling and walking are the only solutions for negotiating the last mile. Non-motorized transport (NMT), which mainly includes walk and bicycle, has got a number of advantages as less congestion; less health hazards, accident and social cost; and reduced infrastructure costs. creating apposite spaces and environment for pedestrians and other non-motorized transport as 'green mobility' solutions for covering the last mile to transit systems. Metropolitan areas are increasing and so is the need for sustainable transport system. In Indian context it is very much important to think about the Indian scenario for last mile connectivity using NMT.

MoHUD (Ministry of Housing and Urban Development), **JNNURM** (Jawaharlal Nehru National Urban Renewal Mission) with the **NTP** (National Transport Policy) are manifesting the policies regarding last mile connectivity and use of NMT by means of walk or cycle to the last leg of commuters' journey. Delhi, Mumbai, Ahmedabad Gurgaon, Chennai and **Pune** mainly have focused on NMT integrated

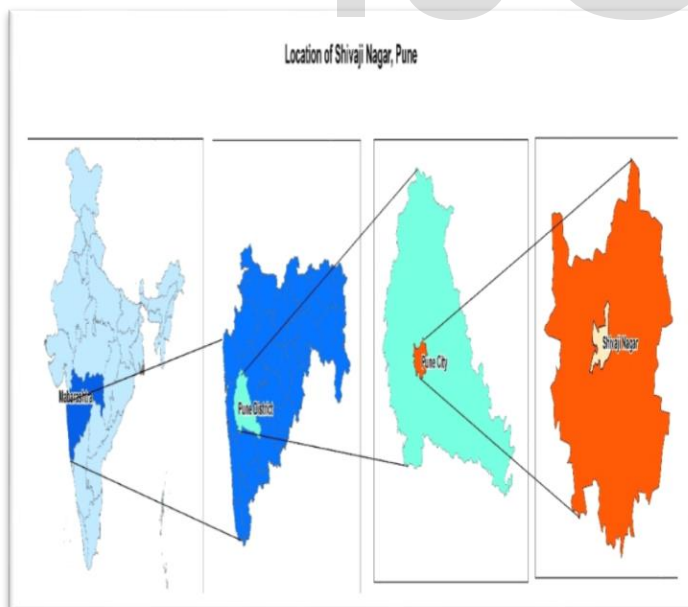


with public transport to

achieve LMC. Users defer by the social, economic class where use of private vehicle increment has put a major impact on transport system. NMT can be an effective measure where for longer trips, NMT provides access last-mile to public transport. High quality fast, comfortable and reliable public transport, both rail and road-based In India even low-income residents are forced to depend on motorized vehicle because of accessibility issue reducing the social equity. Current study is an attempt to understand the extent of impact of characteristics, socio-economic, transportation network, and environmental (NMT) walk and cycle mode choice, when they are used. Indian conditions area predominantly better for implementing bicycle plans as a mode for NMT.

A change is required in policies, plan implementations and fund allocations, in order to, Retain the existing modal share of NMT, and address the needs of captive users and encourage potential commuters to use the non-Motorized transport.

- **Study Area details:** The study area selected is, **Shivajinagar Pune** having MSRTC bus stand, PMPML buses suburban rails and IPT as the modes of public transport available significantly the study is carried out to understand the present practices of Last-Mile Connectivity as perceived in existing public transport systems.
- Pune city is the second largest city of Maharashtra after Mumbai and the ninth most populated city in the country (Census 2011).The Pune city has various modes of transport including sub-urban railway, MSRTC, PMPML, BRTS, IPT, etc. The sub-urban railway network with Dehu road, Akurdi, Chinchwad, Pimpri, Kasarwadi, Dapodi, Khadki, Shivajinagar, Pune station, Hadapsar, Ghorpadi, Manjri as stations in Pune city limits.
- Pune is situated near the western margin of the Deccan Plateau on the leeward side of the Sahyadri ranges and Western Ghats, 560m above sea level, on the banks of the rivers Mula and Mutha.Pune has always been known as the bicycle city of Maharashtra and has a history of high bicycling modal share. A report published in 2003 shows a modal share of 13 per cent cyclists in Pune there is a declining trend in bicycle mode share from 35 per cent in the 1980s to 30 per cent in the 1990s and 17 per cent in the 2000s.



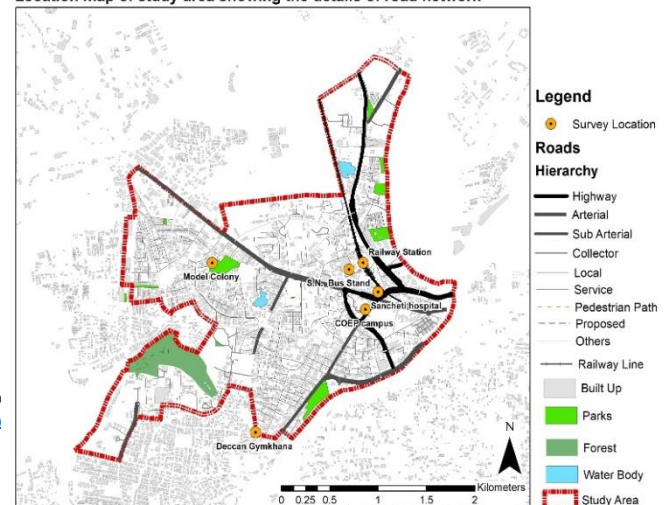
The locality **Shivaji Nagar** falls in **Pune** district situated in Maharashtra state, with a population of 1,41,086. The male and female populations are 72,610 and 68,476 respectively. The size of the area is about 7.36 square kilometer. An area around 3 km radius is found to be influenced by the use of

NMT for last mile connectivity for the commuters of public transport. This is an area approximately around 5km of radius considering the various point of the surveys done by using NMT as a tool for LMC. It is observed that NMT comes out as the most preferred option for covering the first/last mile to transit systems, despite the challenging situations under which NMTs operate. Further the study elaborates that the mode and choice of NMT for LMC for the commuters depends on the real time circumstances as their mode of choice varies periodically. "Bicycle share system" was considered to be the best option for LMC with NMT with walking as a secondary option for FMC/LMC to Public transport. For the betterment of LMC enhanced policy manifestation with better infrastructure for walking and cycling shall be provided ensuring the safety comfort and economy of the commuters.

The ongoing metro connecting three corridors and intersecting **Shivaji Nagar** the existing bus station railway station are needed to be redeveloped accordingly that NMT can be opted in priority for last mile connectivity.Pune Metro work has been initiated in 2017, and as per the Metro Rail Policy 2017, metro projects are required to develop the last mile connectivity in a 5 km catchment on both sides of metro stations, including non-motorized and para transit transport facilities.

Road network inventory Laxmi Road, Tulsi Road, Tilak Road, Shivaji Road, Thorle Bajirao Road and Jangali Maharaj Road in core city and Ambedkar Road and Karve Road on fringe area are the most congested roads due to highly specialized commercial and other administrative activities. The intensive developments on both sides of the roads consent no possibility of widening the roads.The radial roads in the Pune city include the University Road, Mumbai –Pune NH-4, Alandi Road, Pune Nagar Road, Sholapur Road, Singhad Road and MundwaRoad.The circumferential/ rectilinear arterial roads are Jangli Maharaj road, Maharshi Karve road, Kothrudroad, Chiplunkar road, Senapati Bapat road, Ghokale road, Fergusson Road, Jawaharlal Nehru Road, Laxmi Road, Bajirao road, Tilak road, Lal Bahadur Shastri road and Sankar Seth road. As

Location map of study area showing the details of road network



per Comprehensive Mobility Plan for Pune city, 42% of the roads in Pune city are four lanes divided and 35% roads constituted with two lanes. In addition to four lanes and two lanes 10% roads are six lanes, 1% road intermediate lane and 12% roads are four lanes undivided.

2. METHODOLOGY AND FRAMEWORK

- The primary survey data collection basically emphasizing on Existing NMT condition survey, covering presence of footpath and quality along with cycle facilities provided. Pedestrian count survey for active users of non-motorized transport system.
- Gathering inputs on commuters' perceptions about, walking and cycling environment and views on NMT improvements.
- Infrastructure survey and secondary data collection such as Route maps Metro station area maps Last mile travel time and cost connectivity, Random sampling method for survey with analytical approach done by correlation method adopting a random sampling. The results of correlation analysis suggest the strong relation between the variables concerned to last mile connectivity. commuters try to balance the cost and time by keeping it low for one leg of the journey when the other leg gets considerably high, as it is very clear in the case of Shivajinagar. Evaluating the public transport system in order to identify the missing links for integrated transportation and assessing the role of Last-Mile Connectivity in efficient delivery of a Public Transportation System.
- The NMT has some limitations when it comes to the last mile connectivity where Geographical features of the terrain uneven slopes undulations and no frequent flat terrains have made the situation more complicated.
- The major issues related to the NMT for LMC were making streets vibrant, reorganization of the right of way and designating spaces for NMT usage for last mile connectivity as lack of infrastructure, encroachment on the sidewalks, high density traffic not safe for walking or cycling such measures have ill impact on the policy design and implementation has a greater impact in the area.
- Public perception on walking, cycling (and public transport) is perceived as the transportation mode for the poor. The richer part of the population often has a disproportionate decision power, which makes NMT-focused policy risky.

- Average Trip length, trip time, quality of trip and fare for commute are considerable factors. For a larger mass, cycling and walking are the only solutions for negotiating the last mile in the study area. Unsafe, uncomfortable last mile conditions compel transit commuters to use private modes for last mile connectivity, thereby generating massive parking demand at metro stations.
- Land use planning and management for effective and seamless functioning of non-motorized transport. Linking the transport policy norms with better integration of NMT with public transport thus creating cognizance for safety reliability and comfort related to use of non-motorized transport system in the study area. Encouraging the use of various modes of non-motorized transport viz walking cycling E rickshaws. The ongoing metro rail project connecting three corridors and intersecting **Shivaji Nagar** the existing bus station railway station are needed to be redeveloped accordingly that NMT can be opted in priority for last mile connectivity. The concept of sustainable transportation promotes the balance between transportations economy social benefits and need to protect the environment.

3. ANALYSIS AND RESULTS

The independent variable to be considered as the modes opted according to the feasibility and choice of the commuters in the study area which keeps on changing periodically and the dependent variable is travel time, travel cost, safety and economy.

Design and implementation of local area transport policy emphasizing the benefits of NMT viz health economy and safety of commuters. Providing better infrastructure for walking cycling as these modes are more preferred by the commuters in study area to reach the public transport and for daily trips related to work and other activities. Pune was known as the "cycle city of India"; however, cycling has lost its popularity as the ownership and use of motorized two-wheelers has increased. Due to the substantial slum population and student population, there is a significant continued usage of bicycles in Pune. About 11% of the total trips in the city are made by cycles in the form of Non-Motorized Transport. However, on most of the roads there is no segregation for the cycle traffic from the motorized traffic causing potential unsafe conditions. Footpaths of major roads as well as narrow streets of the dense urban core are encroached by hawkers and vendors. In many cases these activities have spread on the carriage way reducing its effective width. Pedestrians and senior

citizens are forced to walk on the carriage way which is not safe.

Correlation analysis was used to calculate the variables as below and the following results were obtained random sampling of 200 samples was done.

- 1) (Vehicle ownership): About more than 80% of the population surveyed own a vehicle two wheelers about 63% people and 15 % own a car, while 15% use IPT/other modes.
- 2) (Trip purpose) 44% of total trips are done for education purpose and 22% for work purpose 15% for business.
- 3) Expenditure on various modes of transport 43% of the population spends more than 28,000 INR on travel per month.

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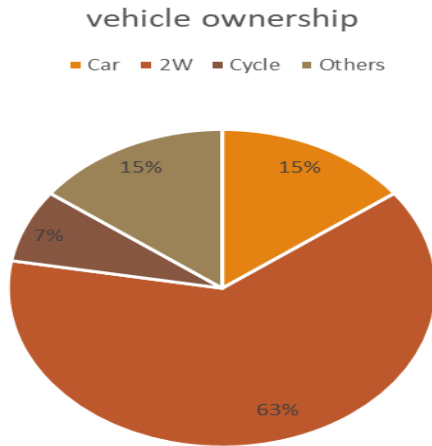


Figure 1.

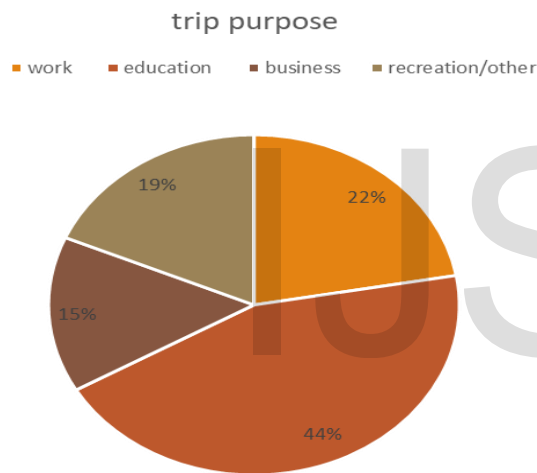


Figure 2.

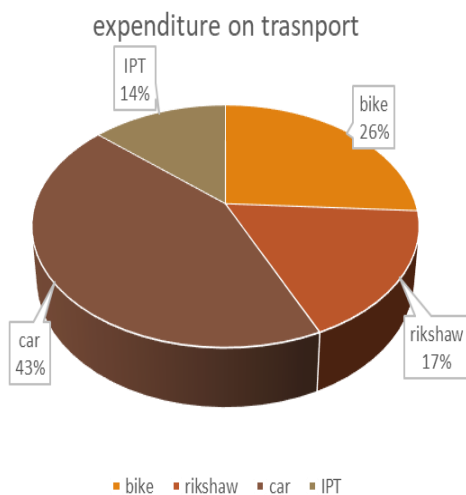
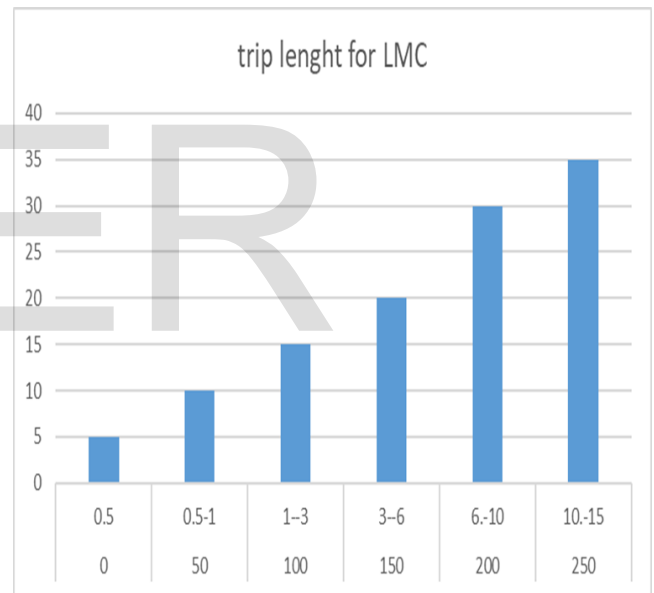
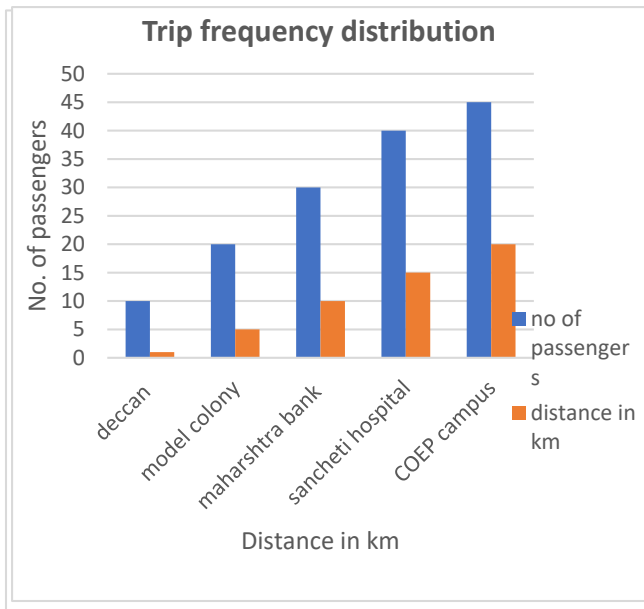


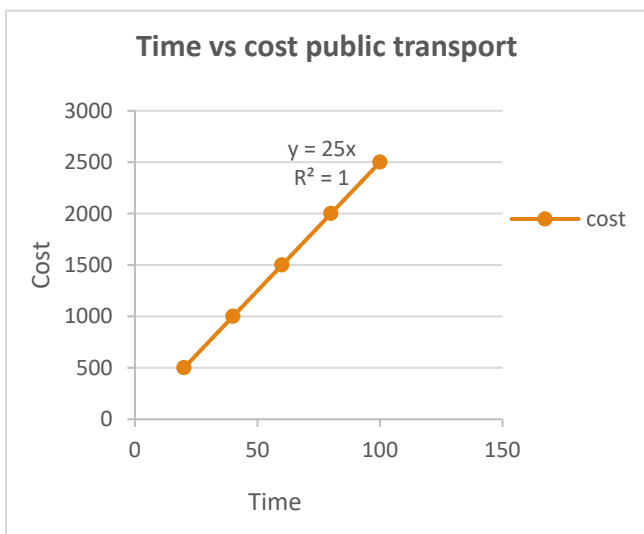
Figure 3.

- 4) Trip frequency distribution graph, the highest number of trips are observed for educational purpose in the study area as majority of the population reside in the area are work professionals and students where the study area consists of India's most reputed institutes and education hubs. The trip frequency distribution graph shows the no of passengers commuting to locations that are Deccan gymkhana Model colony Maharashtra Bank Sancheti Hospital and COEP campus.
- 5) Trip lengths compared to the distance and time taken for trip is a dependent variable relying on the mode choice and the cost these variables keep on changing as they are based on choice of the commuter.

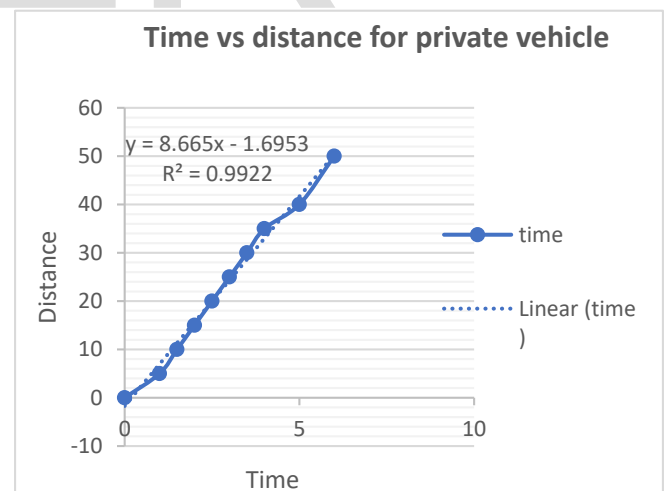
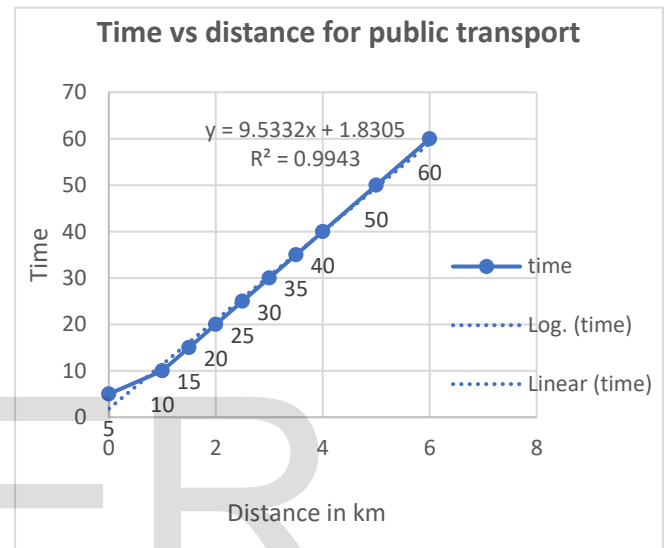




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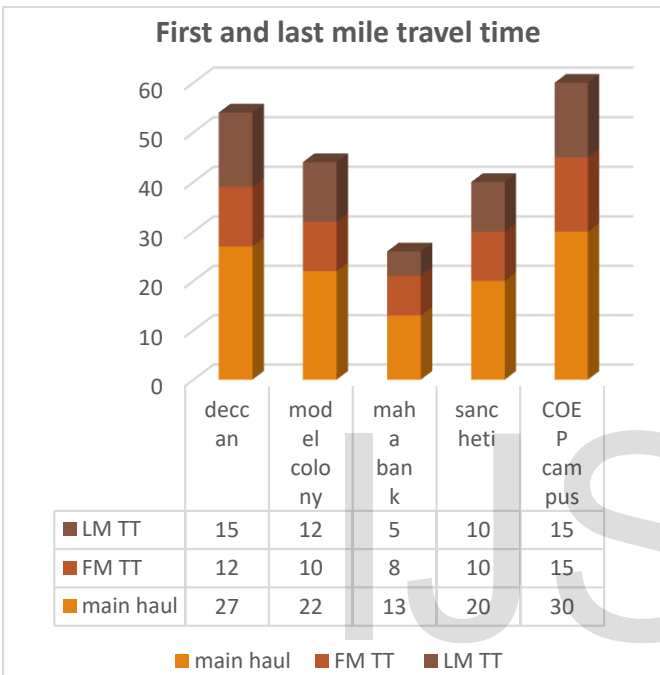
- 8) Correlation analysis for Public Transport (Time vs Cost).
- 9) Correlation analysis for private vehicle time vs cost the value of coefficient of correlation is 0.99 and 1.0 which shows a strong relation between time vs cost.



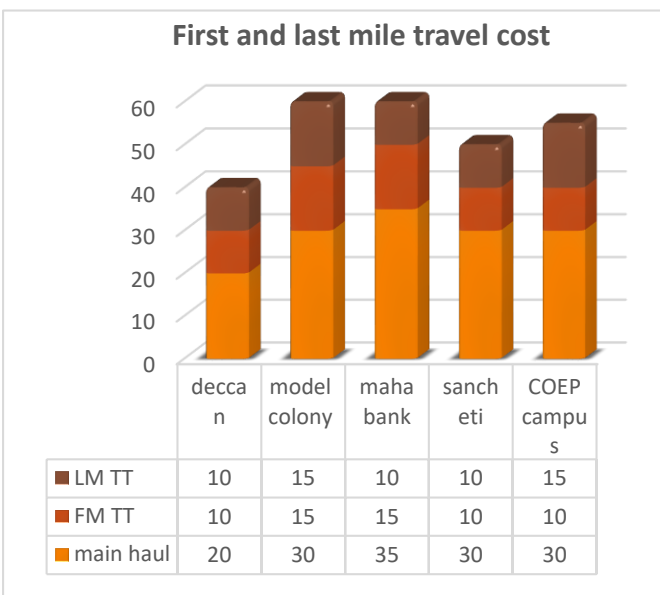
- 10) Correlation analysis Time vs distance for Private and public vehicle both of the variables show positive value hence it shall be considered that the public and private vehicles have strong correlation for time vs distance.

The above graph shows first and last mile travel time at various locations of study area which by means of walk or

cycle or rikshaw are completed while commuting for business, work education or residential trips. It can also be inferred from the figure that commuters try to balance the cost and time by keeping it low for one leg of the journey when the other leg gets considerably high, as is very clear in the case of Shivajinagar. This means that they must walk at least one leg of the journey, which further underpins the importance of providing adequate NMT facility and infrastructure.



4. CONCLUSION AND RECOMMENDATIONS



Integrating various modes of non-motorized transport with public transport. Land use planning and management for effective and seamless functioning of non-motorized transport. Linking the transport policy norms with better integration of NMT with public transport thus creating cognizance for safety reliability and comfort related to use of non-motorized transport system in the study area. Encouraging the use of various modes of non-motorized transport viz walking cycling E rikshaws. NMT in India is going to need much more beyond infrastructural improvements. It will need institutional reform, private sector involvement, interagency collaboration, investment prioritization framework, and most importantly - cultural change.

NMT measures proposed by an Indian city should conform to existing policy at national, state and city level. The National Urban Transport Policy for India (The safety concerns of cyclists and pedestrians must be addressed by encouraging the construction of segregated lanes for bicycles and pedestrians. Segregation of vehicles moving at different speeds would improve traffic flow. Activities on footpaths such as street vendors must be properly controlled to secure pedestrian safety.

Design and implementation of local area transport policy emphasizing the benefits of NMT viz health economy and safety of commuters.

Providing better infrastructure for walking cycling as these modes are more preferred by the commuters in study area to reach the public transport and for daily trips related to work and other activities.

Removal of encroachment on the designated NMT lanes (walking and cycling) which are creating congestion and non-safe environment for the commuters.

Creating a city-wide cycle track network, a public bicycle sharing system, design guidelines for cycle-friendly infrastructure, bicycle parking facilities and strategy for awareness campaigns. Public Bicycle Sharing (PBS) makes bicycles available to the public at a nominal cost for the short-term use. The Public Bicycle Sharing initiative aims to ease the pain of people reliant on public transport and facing last-mile connectivity as a challenge in Pune.

- Provision of bike sharing stations or electric bike stations as the Pune city has around 6.4km of area easily accessible for non-motorized transport from any point.
- The ongoing metro connecting three corridors and intersecting Shivaji Nagar the existing bus station railway station are need to be redeveloped accordingly that NMT can be opted in priority for last mile connectivity.

A multimodal transport network with integration to NMT system having an improved physical infrastructure shall be

provided as interconnecting streets having feasible space for walk and cycling shall be provided.

Clearly designated barrier free walking a cycling hub at minimum distance of 1km to 2km shall be given for first and last mile connectivity for origin to public transport and destination point.

A unique approach towards NMT for LMC as surveyed 70% out of the total population surveyed in the study area are comfortable to adopt a modal shift which mainly focus on centralizing the NMT modes at various stations particularly 500m to 1500m around the public transport for which they are ready to walk or cycle. Affordable rent and easily accessible operating system will promote people to use NMT for first or last mile connectivity with a fully automated locking system.

Collaboration with stakeholders' public agencies local businesses nonprofit groups is essential to implement and create awareness to use and promote NMT for Last mile connectivity.

Insertion of a suitable methodology and plan to alter streets in business with the Pedestrian Design Guide- lines: better

quality street furniture, including tree shading, spaces for hawkers to provide road users with refreshments, spots to congregate, and require a breath away from traffic.

It would be beneficial to provide a bike share system as last mile connectivity to public transport. Cost saving, reducing travel cost, improves health due to cycling to PT. Decrease in traffic congestion due to a greater number of NMT users. Increasing level of service, saving the green space as a very large number of trees are cut for widening of roads or new construction /maintenance.

Decrease in pollution by using NMT properly manageable parking demand as less space occupied.

Under JNNURM mission it began creating a better network of roads with footpaths and cycle tracks. The PMC also came up with a proposal for pilot public bicycle scheme following these steps since 201 Pune was selected under smart city mission and further taken NMT infrastructure projects and identified 100 km. of streets to be redesigned overlaying a budget of 526 crore.

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