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Role of the First and the Last Mile Connectivity in Ease of Urban Commutation and its contribution to the Quality of Everyday Urban Life

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Abstract - Urban mobility is the lifeline for functioning of a city that provides connectivity between home, workplace, educational institutes and all other places of day-to-day needs. While commutability plays a pivotal role in overall transportation planning of a city, increased affordability has seen a corresponding shift to private mode of transportation in most of the cities, specifically developing countries. Due to this there has been an increase in volume of private vehicles which resulted in overwhelming of existing transport network capacities. Capacity of existing infrastructure is not able to sustain increased usage of private transport causing congestion and chaos undermining the very functioning of the city and as well affecting not only human health but overall environmental quality. This has led to the need to identify and explore more efficient and sustainable modes of public transport options such as multimode transport system like metro rail, bus rapid transport etc. However, to enhance overall commuting experience of metro rail, we need to enhance the options of first and last mile connectivity. Metro greatly enhances urban livability with unhindered commutes and also has benefits of environment friendly mode of transportation. First and last mile connectivity (FLMC) at the origin and destination of the metro completes the commute comprehensively and contributes to users' quality of life in general. Options of ropeway and tramway seems to be viable options to address the complexities of First and last mile connectivity (FLMC),land-use, street network, topography, interactions of physical infrastructure at the metro stations and its surroundings.

Keywords - First and Last Mile Connectivity, Wellbeing and Quality of Life, Urban Livability, Metro transportation.

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INTRODUCTION

Accessibility is a crucial aspect examined through educational, cultural and economic disparities in order to evaluate quality of life along with other issues concerning urban mobility. This is a model developed on Amartya Sen's theoretical framework based on categories of functioning and capabilities to test similarities and disparities among cities of different size (Nuvolati 2009). With increasing time spent on urban commutes, the management of a well-organized transport system has become crucial in improving urban safety, health, people's daily mobility, and exploitation of all the available services.

Commuting is one of the least enjoyed activities (Kahneman 2004) and has negative consequences on individuals' life satisfaction (Stutzer 2008). Studies show that commuting, especially with individuals' perception levels of uncertainty in control and predictability of their commute is detrimental to psychological and physical health aspects, such as stress, sleep quality, anxiety, and exhaustion. Further, it is found that life satisfaction was affected

beyond certain threshold of time and distance taken for a commute (Julia Ingenfeld 2019). Contradictorily, a survey of work commuters in three largest urban areas of Sweden show that satisfaction with the work commute contributes to overall happiness and that the possible explanatory factors include desirable physical exercise like walking and biking, short commutes that provide buffer between the work and private spheres. For longer work commutes, social and entertainment activities either increase positive effects or counteract stress and boredom(Lars E. Olsson 2013). In general, car and public transport commutes exceeding 30 minutes is associated with increased everyday stress, lower vitality and perceived poor sleep quality (Hansson 2011) while studies show that public transport users and active commuters report lower Body Mass Index (BMI) and/or body fat (indicators of overweight and obesity) than car commuters (Flint 2016) and satisfaction in commute positively associated with affect balance (experiential wellbeing with walking or cycling to work) and life satisfaction (evaluative wellbeing of active and shorter duration commutes) for Swedish commuters (Olsson 2013).

Commute, an unavoidable activity absorbing substantial personal time and resources and a dominant feature in people's lives for many years, affect the Subjective Well-Being (SWB) during three episodes of commute, i.e. during the journey, immediately after the journey and prolonged term (Kiron Chatterjee 2019). It is found that mood is lower 'during the commute' than other daily activities and stress can be induced by congestion, crowding and unpredictability. Satisfaction decreases with duration of commute, regardless of mode used. 'After the journey', evidence shows that the commute experience spills over into how people feel and perform at work and home. However, it is found that people who walk or cycle to work are generally more satisfied with their commute especially those who use public transportation than those who travel by car. The evidence points at enhancing the commute experience "by recognizing the flexibility and constraints in commuting routines" and thereby accounting for SWB impacts of commuting in policy making and appraisal.

The objectives of the current study are to understand what strategies can improve commuting experience whileensuring user-friendly first and last mile connectivity that contributes to overall quality of everyday urban life. Efficient public transportation, specifically metro travel helps reaching destination in time due to unhindered and faster travel and also has benefits of environment friendly mode of transportation that not only reduces use of private transportation butimprovesenvironmental quality. Mass transit system is seen as a reliable option cities have today to address the problem ofgrowing number of automobile use and corollary effects. FLMC should also become an essential integral component for overallsuccess of mass transit system that connects the origin or destination to and from a transit hub respectively through easy availability of efficient modesand options for transition to intermediary and individual access modes. Here, we look at the factors that aid improved FLMC experience in aspects of affordability, time efficiency, safety, physical and mental wellbeing.

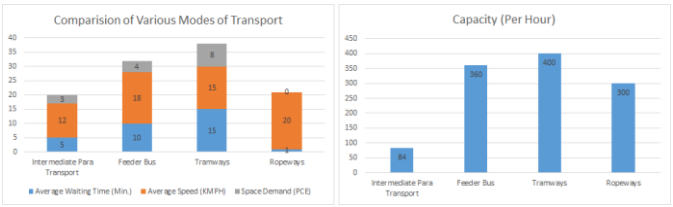
MATERIALS AND METHODS

Literature study is conducted to explore the best practices of FLMC across the globe and evaluate methods adopted to assess their efficiency and contribution to overall quality of commuting experience. It is apparent that the Importance of FLMC in public transport and the quality of service that the passenger experiences during the trip from origin to destination as a whole may determine the overall satisfaction of the trip.Transit Capacity and Quality of Service Manual considers proximity of stations, stops to origins and destinations along with safety, security, door-to-door travel time and passenger amenities as crucial to ensure overall commuting experience(Kittleson & Associates Inc. 2013). Further,(Frank 2010) considers aspects of sidewalk availability, ease of street crossing, terrain and connectivity that contributes to walkability index. However, in India the conditions are appalling and challenging with most of them facing the problem of uncomfortable environment, long waiting hours, long walking distance, overcrowding, traffic congestions etc. Alsothe complexities include landuse and urban form, street network, pedestrian facilities etc. along with integrationof physical infrastructure of transit hub with the surrounding urban fabric.

A study assesses the quality of FLMC with measures of user perceptions which can be applied at a route or stationusing Environmental audit methodology thatevaluatesefficiency of walkability, pedestrian level of service, and feeder bus metrics.The study identifies attributes of FLMC elements by categorizing them such as,Personal security from crime while waiting for and walking to public transport, Comfort of waiting areas, Ease of finding information, Safety from traffic accidents while waiting and walking, Sidewalk comfort and quality, Time and distance of access trip and Cost of access trip(Venter Christoffel 2020). As per the results of the visual assessments, Security and crime is considered the most important followed by Cost of access trip, Comfort and convenience waiting for bus and Traffic safety.FLMC shouldaddress these factors to improve quality of commuting experience andthereby the overall quality of urban life.

There are several technological options of FLMC under varied conditions that are used in cities across the world from economically developed nations. Tramway not only serves as a mode of transport but also provides a positive impact on urban space and peopleto enhance quality of life(Ivan Savchuk 2020). In recent years' ropeway transport systems have also been increasingly used in urban areas as transportation solutions. The function and mode of operation eases the urban traffic flow that are presently under construction or already in operation (Liehl 2005).These are characterized and evaluated

by varying properties in terms of usability, infrastructural requirements and environmental impacts(Helmut Brunner 2018), (Sergej Težak 2016). Parameters include the Traffic space demand in Passenger Car Equivalent (PCE), Average speed in Kilometers per Hour (KMPH), Average waiting time in Minutes (Min.) as a reference for the user-related criterion (Figure 1). Data from various sources are taken for different modes of transport to understand and show various potentials of criteria that could be used as a decision-making tool to recommend for location specific requirements. Thus the study aims to look at alternative modes to analyze suitability as an effective mode of intermediary FLMC.While the conventional modes of intermediary FLMC like Feeder bus, Intermediate Para Transport (Auto-rickshaw, Taxi, Ola, Share auto etc.)are facilitating the users, alternate modes have advantages in terms of waiting time andthe capacity of commuters.With maximum capacity of commuters that could travel in Intermediate Para Transport, Feeder Bus, Tram (Tramway) and Cable Car (Ropeway) are 7, 60, 100 and 5 respectively, considering the waiting time and the number of trips each could make, ropeways and tramways have advantages in hourly capacity of commuter. Further, with the average speeds of 16.25 KMPH with 3.5 standard deviation, a trade-off with location specific commuter flow will be useful for optimal choice of the mode of transport. Nevertheless, tramways and ropeways have advantages in terms of capacity, average speed and waiting time. In addition, ropeways have far greater advantage with no requirement of space demand on roads.With respect to tramway, due to its dedicated lane it has lesser interference with the traffic flow though it has higherPCE and has an advantage of increased capacity.



RESULTS AND DISCUSSION

There are several existing modes of FLMC like Feeder service, Auto rickshaw and Walking or Bicycling. Infrastructure and regulatory mechanism required to operate these existing modes seems to be inadequate and needs improvement. Also, alternative technologies of FLMC that are used in cities across the world which includetramway and ropeways could be a viable option considering the benefits of urban livability.

Result 1: Literature studies clearly elucidate that urban commutes have bearing on Quality of Life and Urban Livability.

Result 2: Mass transit system is seen as reliable option cities have today compared to use of private transportation and corollary effects. However, alternate FLMC options to the existing ones are to be considered for the success of mass transit system that connects the origin or destination to and from a transit hub respectively that aid improved experience in aspects of affordability, time efficiency, safety and SWB.

Result 3: Factors that contribute to improved quality of commuting experience are as follows,

1. Personal security from crime while waiting for and walking to public transport:
    - **Tramway:** It is safer for tramway due to their capacity and presence of fellow passengers. They have a dedicated space on road and could be anticipated. Hence it is appropriate for seamless traffic flow and safe for pedestrians. The frequency of trams can also address the waiting time of the passengers.
    - **Ropeway:** With capacities of 10-15 persons a cable car can accommodate, it is relatively safe with fellow passengers. As they operate as aerial system disconnected and insulates from the original factors of traffic related issues on the ground such as, congestion, slow moving, pollution etc. with regular on-road traffic, all the concerns relating to them are reduced to great extent.

      Studies show that transit environment with features of flow, crowdedness, visibility, lighting, CCTV contribute to perceived safety(Vania Ceccato 2022).

2. Comfort of waiting areas:
    - **Tramway:** With increased frequency of the services, the waiting time of the passengers is greatly reduced and also the need of waiting areas. Amenities can be accommodated for passenger comfort for a relatively shorter duration.
    - **Ropeway:** Because of the nature of ropeway travel having small capacity cable-car and very high frequency, the need for an elaborate waiting facility is greatly reduced.
3. Ease of finding information:
    - **Tramway:** They are on grade to road level and can be accessed at par with any other mode of transport. The Route and time schedule information to the passengers at stations and on-board the tram can be provided. Weather resistant and day-light readable displays can be used.
    - **Ropeway**: These provide point-to-point trip and can be accessed from or to the metro stations at the same level.
4. Safety from traffic accidents while waiting and walking:

- **Tramway:** Relatively less prone to accidents because of the nature of confining to the edge of the traffic corridor.
- **Ropeway:** Because of elevated nature of mobility, ropeways are safely insulated from traffic accidents than that of other surface based FLMC options such as autorickshaw and bus are vulnerable to.

5. Sidewalk comfort and quality:
    - **Tramway:** These aspects are relatively high in case of trams, because of the alignment of tramway is along the side of walkways and pavement on the edge of the roads.
    - **Ropeway:** Being at an elevated level of mobility, it is insulated from the issues concerning the sidewalk comfort and quality.
6. Time and distance of access trip:
    - **Tramway:** Even though the tram bound commute scores positively in the aspect of safety, convenience and comfort, in terms of time and distance it doesn't have perceptible benefits.
    - **Ropeway:** This has point-to-point elevated traveland is not effected by the road length, traffic volumes, traffic signals etc. It is a very highly efficient option in terms of time and distance access trips. Access and egress distances and condition of the street to multiple feeding modes are crucial for better accessibility in a metro-based trip(Xia Li 2022).
7. Cost of access trip:
    - **Tramway:** Because of low level of infrastructure in the form of tracks merging with the existing road surface, it is the most cost-effective option of FLMC in trms of cost of access trip.
    - **Ropeway:** These are less dependent on conventional fuel and do not require elaborate infrastructure except in the form of supporting structures with longer spans. Its built and operational cost is greatly reduced and also because of large volumes of commuters with a very high frequency, the possibility of overall cost of access trip is very less and affordable.

Hence Ropeway and Tramway has advantages as they do not interfere with existing traffic. The capacity of these modescan be increased with frequency that can save travel time and is secure as well. Based on the above results and discussions the study proposes that these two can be considered as alternative modes of transport for an effective FLMC along with measures to improve walkability.

CONCLUSION

Improving public transportation could be plausible with efficient FLMC specifically in terms of time and route flexibility. In fact, the fixed travel time and route of public transportation guarantee reaching a place in time. However, the duo should also address the travel requirements of the commuters who have intermediary activities along with main motive of commuting in a day, such as shopping, recreation, home or work related needs etc. to enhance flexibility component. Technological options of tramway and ropeway provides point-to-point access to their neighborhoods which actually provides safe and secure walkable environs enhance the urban livability. Further, FLMC should address universal accessibility, specifically with the varying complexities at respective locations of metro stations in cities. Further survey based analysis can be done to understand the viability of these new options of FLMC for metro station in Indian cities.

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