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Multi Modal Transit Hub as a Solution for Growing Urban Traffic Congestion in Mega Cities

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Abstract: ***Transport has significant role to play in accelerating urban mobility. Urban mobility has different dimensions i.e. mobility for work, education, recreation and other needs; mobility by public, private and personalized modes; and mobility through facilitation of various transport infrastructure and services provided by the authorities concerned. In this context, the role of various modes of public transport in a city is of paramount importance for achieving efficient movement pattern but the same cannot be achieved without modal integration of public transport in conjunction with non-motorized modes such as pedestrians, bicycles and cycle rickshaws. Hence, there is a felt need to evolve multi modal transport system particularly for metropolitan cities through proper integration of existing modes and design of physical infrastructures. Multi Modal Transit Hub is an integrated approach to incorporate all components of urban transport into a single coordinated, planned and operational system for efficient use of available transport resources and infrastructure to ensure better mobility within a wide range of mode choices. It relates to a single trip consisting of a combination of modes i.e. Vehicular (bus, metro, car, BRTS, etc.)or service modes private/public/personalized) between which commuter has to make a transfer (i.e. Change of mode) at transfer points. In other words, a multi modal transport system may be defined as one which enables performing a complete trip from origin to destination by a variety of modes depending on time, cost, weather conditions and the level of comfort desired. Further, seamless travel is a pre-requisite of the system. Integration of non-motorized transport (NMT i.e. pedestrians, bicycles and cycle rickshaws) has been suggested in both design measures and policy options. The study suggests various measures to reduce vulnerability of non-motorized users. Due to implementation of metro, commuters shifted from road-based modes to metro due to less congestion, accident free scenario, less pollution, as well as savings in travel time and cost. In this research work, investigation has been done to assess the time saved and cost saved due to modal shift. Transport is a State Government subject and hence promotion of public transport and enhancement of its modal share depends on policy decisions taken by local authorities and concerned transport department. Hence, formulation of multi modal transport is an important step to promote such a concept in medium sized cities also. The multi modal transport policy integration with other sectors such as education, health, real estate, etc. can help to achieve a more inclusive society. The study also deals with policy matters related to pedestrians, bicycles, cycle rickshaws, personalized modes, local environment, setting up of dedicated urban transport fund at city level and state level, institutional framework, national level data bank: national urban transport information system, planning norms, strategies for improvement of sustainable transport, art and aesthetics in transit, control of car traffic, transport as a multi-sectoral policy, etc. The applications of this research works are many. The results may be used to enhance the reputation and image of public transport as well as planning and design of such multi modal transport system in medium sized cities***

1. Introduction

1.1. General

In recent decades, 'Urban India' has grown manifold both in spatial and Demographic terms. Globalization, liberalization, privatization, inflow of foreign capital etc. have provided impetus for urbanization which not only leads to growth of towns and cities but increase the number of urban centres and urban agglomerations. As per2011 Census, the urban population of the country was 377 million, which constitute31.16% of the total population concentrated in 7935 towns and cities.

The 53 metropolitan cities (2011) accounted for more than a third of the total urban population (42.6%).Among the metropolitan cities there are three very large cities with more than 10 million persons in the country, known as Mega Cities. These are Greater Mumbai (18.4 million), Delhi (16.3 million) and Kolkata (14.1 million). The largest city in the country is Greater Mumbai followed by Delhi. Kolkata which held the second rank in Census 2001 has been replaced by Delhi. The growth in population in the Mega Cities has slowed down considerably during the last decade. Greater Mumbai, which had witnessed 30.47% growth in population during 1991-2001 has recorded 12.05% during 2001-2011. Similarly, Delhi (from 52.24% to 26.69% in 2001-2011) and Kolkata (from 19.60% to 6.87% in 2001-2011) have also slowed down considerably.

The development of new urban transport infrastructure to meet trip demand needs a coordinated and integrated approach amongst several agencies involved with urban services and development at the city level. The urbanization and migration pattern have direct impact on intra-urban, sub-urban and inter-urban modes of transport and vice versa. In this context, better urban transport infrastructure and services leads to city efficiency in which people and goods are transported at minimal investment and operating cost. And all of the above mention cities are facing heavy traffic congestion problems.There are the number of modes of transport available in these cities which are creating heavy traffic

problem.In Mega cities Mumbai and Delhi are ranked 1st and 4th amongst the cities with the worst traffic congestion.

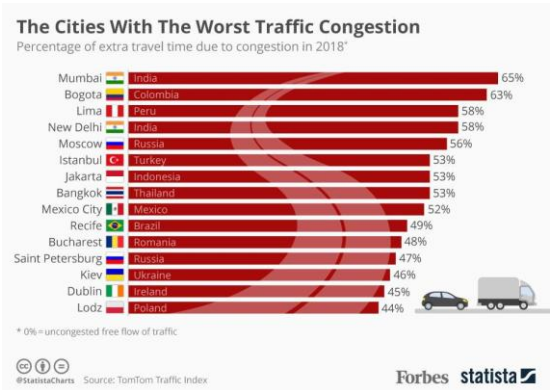

Figure 1: Cities With The Worst Traffic Congestion (Source: Forbes, TomTom Traffic Index (2018))

Figure 2: Most traffic congested cities of India

1.2. Transport Profile

1.2.1. Transport System in Selected Metropolitan Cities

Roads and railways are two dominant modes of transport in India. Water transport i.e. navigable rivers, sea, etc. provide alternative means. In India, only limited navigational river services are available in Kolkata (The Hoogly River), Bombay (sea), Goa(sea) and Andaman &Nicobar Islands. This system may not be attractive for urban public transport but in Venice (Italy), Gothenburg (Sweden) and Hamburg (Germany),inland navigation is an essential part of the public transport system. In Paris, London, Cologne (Germany), navigable rivers exist but is more popular for pleasure trips. Other transit systems such as Light Rail Transit (LRT), Sky Bus, Advanced Light Rail Transit System (ALRTS), etc also have potential to be used particularly in urban areas. However, integration of all these modes is required to provide efficient transport system. In Kolkata, a combination of bus services, tramways, suburban rail and metro services are used for mobility but still there is lack of planned integration of metro with other modes. Mumbai has a combination of bus services, ferry services and suburban rail network though railway stations are not integrated with other modes, but the use of suburban railway is extensive due to the linear structure of the city. In Chennai, bus services and suburban railway are used as major modes of public transport are common facilities are available to integrate different modes. In Delhi, operation of metro has given a new and strong image to public transport. Metro fails to have its full efficiency in the absence of synergy with other modes. Delhi ring rail (35 km. length having 23 stations) is still under-utilized (less than 25% of its designed capacity) due to most of the stations having low travel demand. Therefore, there is a need for integrated development of road and rail-based transport systems to meet the requirement of demand.

2. Institutional Framework

A unified transport authority is required for well-designed and coordinated multi modal transport system with the following advantages:

- Better distribution of area wide transit system,
- Eliminate wasteful duplication in the same areas and corridors,
- Extend the availability of services,
- Combined planning, design and operations,
- Better utilization of resources,
- Single fare and single pass, Efficient and better interchange nodes,
- Smooth and comfortable transfer, etc.

Recently, the Ministry of Urban Development, Government of India has asked all states having cities with million plus population to speed up the process of setting up a Unified Metropolitan Transport Authority (UMTA). The Ministry has also advised to the State Government seeking funds under the Jawaharlal Nehru National Urban Renewal Mission (JNNURM) to set up a dedicated urban transport fund to integrate land use and transport planning. To streamline public transport, the Ministry has directed the States to nominate a single department to deal with all urban transport issues. The States have also been asked to set up a traffic information management control centres and to frame parking policies. The Ministry has suggested the setting up of a regulatory and institutional mechanism to periodically revise fares for all public and intermediate public transport

2.1 Multi Modal Transport Scenarios

2.1.1 Background

In the present scenario, the corresponding road capacity has been saturated and is not able to cope with the increasing transportation demand. Apart from the problems and requirements of transportation at the macro level, there are special problems in specific areas particularly the old part of the cities, which need special attention. There has been a rise in the number of middle-class populations having desire to own personalized mode.

Further, automobile companies are also coming up with mini cars at reasonable cost. Thus, personalized vehicles are increasing in number which further causes deterioration in traffic and environmental conditions. Hence it is necessary to shift mode of travel from car to walk/cycle for short journeys and to public transport for long journeys. A single mode of transport is neither viable nor economical and efficient. It is necessary to integrate various modes of mass transport and evolve a Multi Modal Transport System (MMTS) for both harmonious growth of the cities and efficient mobility. The main aim of multi modal transport system is to reduce personalized modes promote public transport and reduce traffic congestions.

2.1.2 Definition of Multi Modal Transport System

A multi modal transport system may be defined as one which enables performing a complete trip from origin to destination by a variety of choice modes depending on time, cost, weather conditions and the level of comfort desired. The basic requirements of multi modal transport system.

2.1.3 Concept of Integration

The concept of integration in transport is defined as measures for improving the overall quality of services to the commuters and attracting more people to use public transport. Integration means that whatever modes or types of transport (rail, road, water, air) are involved, they all operate as one 'seamless' entity for the benefit of the commuter and the system as a whole. It can be achieved by proper planning and design of the services so that where a change of mode is required; passengers can enjoy easy to use, pleasant and sheltered interchange facilities along with shorter waiting time for the next service. Hence various aspects of transport in terms of Interface between two or more modes of mass transport,

- Extend to all mass transit and intermediate para transit,
- Synergy among all modes (public and private),
- Land use and transport,
- Land use along transit corridor,
- Land use around transit point,
- Surrounding environment,
- Travel behaviour of commuters,
- Travel information &guidance,
- Inter-organization and co-ordination, etc. are required to be integrated.

2.1.4 Integration of Mass Transit, Intermediate Para Transit (IPT) and Personalized Modes

Multi Modal Transport System (MMTS) is an integrated system of Mass Rapid Transit System (MRTS), Bus Rapid Transit System (BRTS), suburban rail, etc. with Intermediate Para Transit (IPT) such as auto, rickshaw, tempo, etc. and personalized modes. IPT plays an important role as access and egress mode for connecting to rapid transit system. Similarly, park and ride, kiss and ride, etc. provide good facilities for personalized vehicles to access MRT/BRT.

Integration of Demand and Supply

Multi Modal Transport System is an integrated system to address demand andsupply side management measures. A commuter while choosing a bus route/metrocorridor prefers minimum travel time, maximum comfort and proper connections to reach the desired destination. The options may be either a direct bus route from originto destination or integrated route of both metro and bus. The commuter has to make a choice of mode. The commuters always prefer the route and mode which connects the destination directly and completely. As such, a multi modal transport system is a step forward to integrate and meet such demand and supply.

2.1.5 Integration of Mechanized and Non-mechanized modes

Multi Modal Transport System is an integrated system which involves the coordinated use of two or more modes of transport i.e. rapid, mechanized, non-mechanized and pedestrian including walking for efficient movement of passengers in urban areas. A proper planned and integrated system provide seamless journey to commuters.

2.1.6 Integration with other Sectors

Multi Modal Transport System is an integrated approach which connects education, health, housing sector, etc to make a fairer, more inclusive society. MMTS not only provide accessibility to school going children, patients and disabled persons but also promote development along the transit corridor. In fact, it enhances the socioeconomic characteristics of the areas and residents. Public transport requires reliability and attractiveness so that the commuter willingly abandons the use of personalized vehicle and takes to public transport. It should also meet the needs of the weaker sections of the society. Further, public transport should be available from origin to destination with minimum interchanges involving least time loss and stations which easily and safely accessible. Hence public transport network must be integrated and multimodal. It is equally important to integrate various modes of mass transport with IPT. Integration of walk and bicycle may also be taken with public transport to enhance share of non-motorized modes. Improved integration among various modes of mass transport helps people to move around easily and reduces the cost and inconvenience of travel. Thus, it brings reduced congestion on the road, convenience to commuters, efficiency and cost effectiveness. The information regarding parking facilities near interchange station, unified ticket coordinated timetables and public awareness play an important role.

2.2 Need of Study

The mega cities of India are facing heavy traffic congestion problems and having one third population as migrant, creates the heavy traffic at ISBT and Railway Station, and the modes which carry them to these destination like BRTS, LRTS, MRTS, Bus, Auto, Taxi etc. So, it become important to study and analyse the functioning of MMTH and recommend that how it can be more helpful in reducing traffic congestion by integrating

different modes at a single place, so that if a person get a exit from the MMTH then he directly go to his destination, and not create the haphazard movement around the terminal and in the city.

2.3 Aim

To analyse impact of MMTH in reducing traffic congestion in mega cities.

2.4 Objectives

1) To study the principles of MMTH.
2) To study the impact of MMTHonmega cities like Delhi as case studies.
3) To analyse the impact of MMTH on Urban areas for land-use, land-value, density &Connectivity.
4) To suggest recommendations for the development of similar future transit projects.

2.5 Research Question

1) How can we reduce traffic congestion by MMTH?
2) What are the best possible ways to integrate most no. of transportation modes?
3) Is connecting different mode will be helpful or create more traffic congestion problems?
4) How MMTH is the need of the future?

2.6 Hypothesis

Operating maximum no. of modes from a terminal will reduce traffic congestion in the city.

2.7 Broad Methodology

In order to achieve the objectives stated the study will include the following sequential stages,

- Understand issues and potentials of transportation systems in India and globally through literature studies.
- Understand the characteristics of MMTH and its impact on various aspects like land-use, land-value, density & Accessibility.
- Case studies of various MMTH projects.
- Analysing the impacts of the MMTH project on the study area using study parameters.
- Finding inferences and giving recommendations for future proposals.

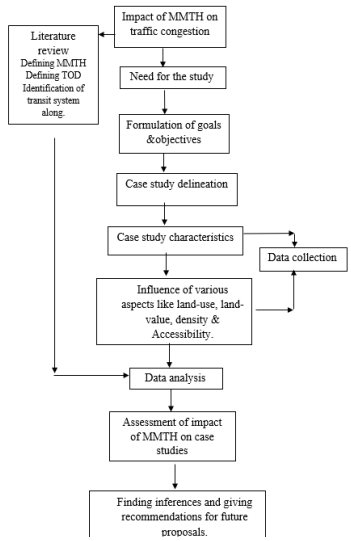

Figure 3: Research Methodology
(Source: Author)

2.8 Scope and Limitations

- It will provide us the impact of a Transit Project on land component of the area as land is the most important component of any development.
- It will provide the development strategies involved after implementation of Transit Project.
- Study will be based on Primary surveys like personal interviews, observation/reconnaissance survey, walk along the site & Secondary sources of information like master plans, zonal development plans, literature studies and case studies which may have limitations regarding to accuracy.

3. Literature Review

3.1 General

Transport is the lifeline of physical and socioeconomic growth of any town, city, state and nation. In urban areas, efficient modes of transport, better facilities and passenger friendly services lead to city efficiency. Multi Modal Transport System (MMTS) is an integrated approach to incorporate all components of urban transport into a single coordinated planning and operation system for efficient use of available transport resources and infrastructure to ensure better mobility within a wide range of mode choices for commuters. Multi Modal Transport System (MMTS) relates to a single trip consisting of a combination of modes La. vehicular modes (bus, metro, car, tram, etc) or service modes (private/public) between which the traveller has to make a transfer. Transfer is an essential part of multimodal trip and the traveller has to change modes at transfer points. Hence seamless travel is an important characteristic of the system. In fact, MMTS provides multiple choices to enable a trip to be performed in the most convenient manner but the critical requirement of the whole system is integration.Better planning, designing, operation and management of facilities combine two or more modes to provide utility and service

for safe, rapid, convenient and environmentally compatible movement of people. This combination is known as Multi Modal Transport System.

Figure 4: Multi Modal Transport Trip (T =Transfer/ Interchange Point)

A well-developed multimodal transportation system has many dimensions such As-

- Physical infrastructure for mass rapid transit, non-motorized modes, intermediate para-transit and feeder services;
- Interchange facilities (provision of transfer facilities such as skywalks, overhead bridges, under passes, bus shelters, taxi stands, good signage, public convenience, etc for minimum transfer time, walking time and waiting time;
- Customer care information and Traveller Information Services (TIS) to provide complete real time information of public transport system at metro stations, major bus stops, interchange points, off-site and on-site information.
- Route maps withtimetable, real time information for multi modal journey plan, real time bus passenger information system and touch screen kiosk; (v built environment (architectural design of terminal building, high order of facilities and services, cleanness, hygiene, high level of maintenance, aesthetic and pleasant interiors and exteriors, sufficient natural and day light in tunnels and route ways, indoor and outdoor street furniture, signage, better movement pattern and waiting space.
- Provision for lift/escalator/ concourse/passage, surveillance cameras, emergency entry and exit, fire-fighting and seismic design.
- Human aspects (live human voice rather than pre-recorded messages, both manual and mechanized ticket machines/booth, co-operation to provide information for other facilitators/operators on mutual basis, presence of staff which increases passenger sense of personal security, deployment of security personnel.
- Special provision for disabled, children and women (provision for mobility of disabled persons, provision for children, women and people carrying luggage, women feel insecure in passageways and hence proper light and presence of security personnel, control of crime and monitoring of overcrowded busy interchanges are important).
- Intelligent transport system (ITS) such as smart card tickets in Delhi metro, radio taxi using wireless system in Delhi and Chennai, automatic vehicle tracking system using Global Positioning System technology by Delhi Transport Corporation in Delhi and Bangalore Metropolitan Transport Corporation in Bengaluru.

3.2 Transportation and Urban Structure

Transportation is of prime importance in the urban areas because of the complexities that are involved such as the modes, the multitude of origins and destinations and the amount and variety of traffic. The traditional focus of transportation has been on passengers, but cities are also placesof production, consumption and distribution. Transport in India is important as it provides the basic framework of our economy. Since the economic liberalization of the 1990s, development of infrastructure within the country has progressed at a rapid pace, and today there is a wide variety of modes of transport by land, water and air. However, India's relatively low GNP per capita has meant that access to these modes of transport has not been uniform. “Transport (British English) or transportation (American English) is the movement of people and goods from one place to another. The term is derived from the Latin trans ("across") and portare ("to carry").”

Figure 5: Various Transport Systems in India (www.enjoytrip.com)

Figure 6: Various transport systems in India (www.livemint.com)

Structural Elements of Transportation

- **Node**

A Node is a place of accumulation of various economic activities and which also serves as links to the transport system. Terminal, such as ports, airports, rail yards and stations are important nodes around which activities concur at a local and regional level. It is a NODE i.e. a point of access trains and increasingly, to other transportation networks. At the same time, it is a PLACE i.e. a specific section of the city with a concentration of infrastructure but also with diversified collection of buildings and open spaces.

- **Linkages**

They are the supporting infrastructure required to carry the flows between the nodes. The linkages follow a hierarchy beginning from the lowest level of streets to regional roads, railways and international connections by

air and maritime transport systems. In an urban scenario, trips form he basis in determining the type of mass transit system that would be feasible for a given corridor.

The various components of a trip are-

- Origin
- Destination
- Purpose
- Mode
- Route
- Time of Day
- Travel Time/Distance/Cost

Each type of urban activity has its own mobility requirements that are serviced by the urban transport system. The diagram shows the location preferences according to urban transport infrastructures. Population based activities (e.g. residential) are dominant where rail (metro and passenger) and bus infrastructures are converging, while freight-based activities (e.g. manufacturing and warehousing) agglomerate nearby high capacity road infrastructure.

Forms of Transportation There are basically two major forms of urban transportation

- Collective Transportation/ Public Transit including bus, tramways, transit rail, metro rail and ferryboats. The efficiency of the system is measured by the number of people using the system and its benefits from economies of scale.
- Individual transportation including car, walking, cycle or motorcycle.
- Relationship Between Land Use And Transportation

Land use impacts are the changes in land use that are caused directly or indirectly by improvement in accessibility. The connection between transportation and land use is a fundamental concept in transportation.

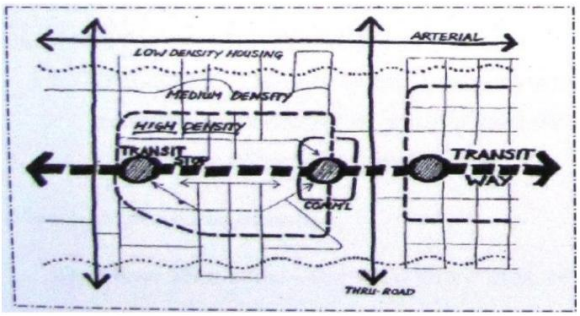

Figure 7: Land use density along Metro corridor

Though, TOD remains primarily a transport problem involving transit network design, effective transfer between nodes and scheduling, it is related directly to compact development principles as TOD efficiencies are achieved through densification of urban nodes resulting in modal shift from automobile to transit, and mixed-use development. The increased access to land provided by new or upgraded transportation facilities can either induce new development or change existing development patterns. In case of existing underutilized transit infrastructure, construction of new transit infrastructure is not an option and redevelopment of the existing transit nodes at higher density using mixed use development principles should be the priority.

Coordinated transit services both between and within activity centres and between primary residential areas and activity centres are required to improve transit system performance. To achieve spatial balance, development should take place according to new Mass Transit corridors. This has implications in terms of land use planning along major corridors.

3.3 Transit Oriented Development

Transit oriented development (TOD)* has become the dominant urban growth planning paradigm, which is also termed as transit focused development. ―TOD, it is suggested, will increase pedestrian and transit trips taking while reducing the number and length of auto trips and it will contribute to the liveability that some feel is lacking in modern suburban development‖ (Calthorpe,1993).

As Bernick and Cervero (1993) discussed, ―TOD are built both to support rail transit and to leverage the development opportunities that a rail station may provide‖. TOD is defined as a centre with a mix of high density residential, retail, office public and open space uses. Retail shops and services are in a commercial core within an easy walk of homes (within a distance of 600 meters or 10 minutes).

A transit station is at the centre of the core. Uses in the core are vertically integrated apartments and offices rise above ground floor stores (Calthorpe, 1993). Secondary areas for lower intensity used surround the core to a distance of 1600 meters. These areas might be locations for single family housing in a range of sizes, small parks, schools and light industries. The number and mix of commercial establishments in each TOD would varydepending upon the size, location and overall function of each centre. (―A New Template for Transit Oriented Development‖, Nelson Niles, July 2000).

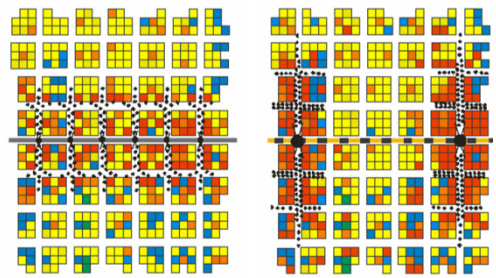

Figure 8: Development patterns according to BRT & MRTS (source: transportation department report.

Above Figure compares the type of development Bus Transit System and that of MRTS. In case of the bus transit system, the number of stops or access stations required is more. In such a case, there appears a mix of land uses all around and not of any specific type.

However, a concentration of public and semi-public uses appears along the corridor.

There is no clear road hierarchy and feeder services are required to access the stations. On the other hand, the development pattern around an MRTS corridor is more compact. Fewer access stations are required along the same length of service as compared to BTS. The public amenities are concentrated near the nodes and as one move away from the stations, the land use changes more towards residential.

The concept of focusing compact, mixed-use development around transit nodes has emerged as a key strategy to manage the effects of growth, create more liveable communities and reduce automobile use, thus reducing greenhouse gas emissions, congestion and costly road expansion. These places, characterized by pedestrian-oriented routes, a range of land uses and parcel sizes, a mix of residential densities and, well-established transit nodes, support a range of efficient and reliable transportation options. This form of development, often referred to as Transit-Oriented Development (TOD), is now experiencing resurgence in cities across Canada, the U.S. and elsewhere. TODs are showing promise as one method to boost transit use and contain urban sprawl while contributing to healthy, walk-able neighbourhoods.

3.4 Classification of Impact of a Transit System

A large-scale transportation infrastructure will have a hierarchy of impacts that can be classified as follows:

1) Primary: Changes in people's travel pattern or modal shift.
2) Secondary: Effects on activity centres or accessibility.
3) Tertiary: Impact like land use and land value changes

The primary impact of a transit system is the purpose or basic intent of introducing the new system. Once this modal shift is achieved it will trigger the other changes the land system surrounding it. This work will involves in taking a closer look at the tertiary impacts of a transport system, which can be further classified as Direct and Indirect land use impacts:

3.4.1 Impact of Transit System

At a superficial level, the definition seems self-evident: Land use impacts are changes in how land is used, that are caused directly or indirectly by an improvement in accessibility. But land use impacts can blend with environment and economic impacts. Consider changes in population and employment growth. Though not land use character per se, they are clearly drivers of land use change and development. Population and employment growth may demand new or rehabilitated space, leading to land development or redevelopment, which is a land use pact.‖.

A transit project has an impact on a business by changing the performance affects business profitability, and that change in profitability gets capitalized into property value, which then stimulates changes in land use.

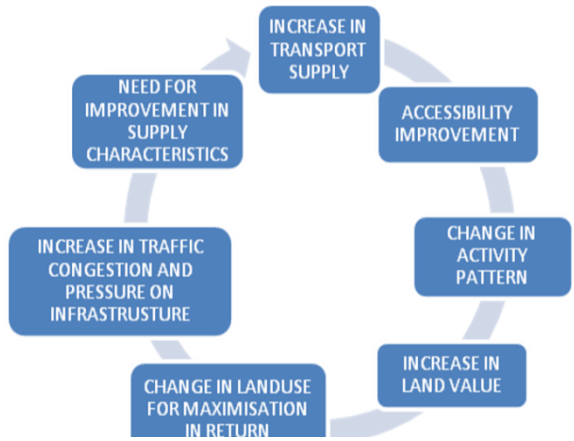

Figure 9: Impact of Transit system (www.impactnews.com)

4. Data Analysis

The proposal of RRTS for Delhi Meerut corridor and Delhi Alwarcorridor, the footfall on major transit hub like Sarai Kale Khan and AnandVihar will increase rapidly and because of that a major transformation required at these two hubs, already they are catering to more than 8 mode of transport which have a footfall of 1.5lakhs per day creating them a major interstate junction. Because of the metro phase 3 and RRTS along with the current railway station and ISBT the projected footfall in 2041 will be around 4.5 lakhs per day. The statistics leads to the major research points for the multi modal transit hub.

4.1 Case Study Area Characteristics

The population of Delhi is estimated to grow from 16.8 million (2011) to 23 million (2021). In the same period, intra city vehicular trips per day are estimated to grow from 14.7 million to 24.7 million. If about 15% intercity trips are added, the total trips to becatered by 2021 will be about 28.7 million per day. Thus 80% of these trips i.e. 24 million are required to be carried by the public transport by 2021. The present bus services, metro rail and integrated rail and bus transport (IRBT), if implemented as planned together, are estimated to carry about 15 million trips per day by 2021. Thus 9million trips perday must be additionally catered to by other means of public transport.

Hence it is necessary to take appropriate steps for optimally using the carrying capacity of public transport modes and their proper integration with other modes.Of late, share of public transport in Delhi has declined to 43% as compared to the desirable figure of 70-75%.Now-a-days; there is rise in the number of middle class population desirous of owning personalized modes. Further, automobile companies have also been coming up with new models of mini cars at affordable price. Hence, personalized vehicles have been increasing. It is important

to synchronize metro, bus, personalized modes, etc. to evolve multi modal transport system along with non-motorized transport.

4.2 Justification of the area

The area around these transit hub share border with Uttar Pradesh and Haryana, which create the heavy traffic inflow at these hubs. And with increase in time this area is rapidly and haphazardly growing due to good connectivity with central Delhi. To confirm that all the developments in this zone have happened after connectivity to the RRTS we needed to analyse this area for a better development of these transit hubs.

4.3 Parameters for Impact Assessment

Literature review and various research studies clearly indicate that the impact of a transit hub is manifested in the change in land attributes of adjoining areas. In the case of transit hub, it is the station area where the change is most prominent. The parameters of study and basis for analysing the context in order to assess the impact of transit system that have been selected are:

1) No. of modes of transport
2) Footfall per day
3) Accessibility
4) Major transport mode
5) Pedestrian connectivity
6) Un-utilised space
7) Designated path for different transport mode
8) Key facts
9) Key takeaways

These parameters will be studied in response to the passenger dispersal at stations selected as the intent of the study is to relate passenger attributes with land attributes associated with a transit station and the corridor between stations.

Inferences

After analysing the above case studies and literature studies we conclude that to develop a multi modal transit hub, we need to concentrate on following aspects such as:

- There should be Integration of non-motorized vehicles in infrastructure.
- A facility of proper Auto-court to accommodate large volumes and types of vehicular traffic.
- Designated loop for different modes of transport must be planned.
- Parking space should be enormous.
- Extensive bicycle infrastructure(wide well-marked bike lanesand enormous formalized ‘bikebeds’--parking) is required.
- Ample space for pedestrian movement.
- Designated bus lanes and boulevards.
- Physical barriers erected in street to direct pedestrian flow.
- Extensive space should be provided for pick and drop for the passengers.
- Variety in right-of-way allocation parking/loading types are dispersed rather than concentrated.
- Heavy focus on pedestrians and designated urban park and plaza space.
- Formalized vehicular and pedestrian zones with partitions, and there should be categorized areas for a range of parking options.
- A Comprehensive, iconic way to find the directs multitude of vehicular types.
- Adaptive reuse of ‘leftover’ spaces and under-performing asphalt as signature pedestrian spaces.
- Extensive use of one-way vehicular circulation.
- Maximization of primary vehicular loop around the station.

5. Finding and Recommendation

5.1 General Findings

- Stretch between the Terminal (ISBT) and the railway station is a bottleneck.
- More than half of the carriageway is occupied - Roadways buses.
- Problem is compounded by buses parked randomly to attract passengers and the hawkers dotting the area.
- Little-used, footbridge.
- Three-wheelers are parked on the road to pick up passengers coming from terminal.
- Drivers prefer to park on road and, that too, haphazardly.
- It takes about more than 15 minutes to cross the stretch during the peak hours, for pedestrian movement.

5.2 Design Recommendations

- Easy to Use: The hub should be easily discernible to residents and visitors
- Accessible: Connections within the hub should be designed for people of all abilities
- Connected: The hub should connect as many transit systems and routes as possible within the shortest distance possible
- Imbedded: The hub should offer convenient access to adjacent areas of Centre City
- Iconic: The hub should be iconic and memorable

6. Conclusion

There are no prescribed guidelines for the development of MMTH in India, and because of the heavy traffic and footfall load there is need to redevelop these transit hubs as a component, so that they can serve to maximum no. of people and provide them easy access and better facilities. There is need to see these transit hubs in new form because in present time and in future these are the destinations which provide pace to the people life and developments.

India will become the most populated country by 2030, and Delhi will be the most populous city in the country,

and in recent time Delhi has also created a bad image in the world as most polluted city in the world. So, there is need to reform the transport policy in India and transfer the interest of people from their own vehicle to Public Transport.
In present time 70% of people prefer their own vehicle for travel, so there is need to reduce these stats for that we need to develop the transport hub in a way where people love to go.

By doing this whole research, and learning about the Anand Vihar, I want to take "**MMTH at Anand Vihar**" as my thesis topic.

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Author Profile

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