IMPACT OF TRANSIT STATION ON DENSITY & LAND USE WITHIN ITS INFLUENCE ZONE - A REVIEW OF THE LITERATURE

D. Karthigeyan
Research Scholar and Associate Professor, School of Architecture, Hindustan Institute of Technology and Science, Chennai, India

Sheeba Chander
Professor, School of Architecture, Hindustan Institute of Technology and Science, Chennai, India

ABSTRACT

Transit stations around the world have contributed to the development of the space surrounding it. The extent of influence of transit station itself is a much debated topic all over the world. Since, the distance of influence zone varies from one place to another, and even on the stations within the same network. The kind and intensity of developments happening around the station not only depends on the quality of service offered by the transit station, but on lot of other factors in the influence zone like the availability of vacant developable land, positive economic conditions of the space, intermodal connectivity that station offers, population density and land use mix of the locality, etc. Even though transit station impact studies have been undertaken all over the world, this literature review is an attempt to analyze the impact of the transit station on land use and density in comparison with Developed countries in Europe and America with the Developing Countries in Asia which have not been comprehensively studied earlier.

Keywords: Transit station, Impact Study, literature review, developmental impact


1. INTRODUCTION

The impact of a transit station in its influence zone have been studied all over the world especially by the developed countries in Europe and America for over a century with respect to land use, land value, population density, etc. The extent to which the influence zone of the transit station exists itself is a voluminous literature which varies between one region and the
other based on various other supporting factors. Transit station alone is not the only reason which is influencing the developments surrounding it, but definitely an important and primary factor when accompanied by a series of other secondary factors results in the rapid development of that space. The impact of transit station in developed countries will be different from developing countries in Asia, since, western countries also spends huge money on development of infrastructure facilities which encourages the usage of personal modes of transportation, which literally limits the patronage of public transport system to live up to its fullest potential.

Government of India is emphasizing on the need to enhance the quality and image of public transport system to boost its patronage thereby leading the country towards sustainable development. Based on its directives many states have already started to implement sustainable mode of public transport systems like BRTS in Ahmedabad, Metro Rail in Delhi, Chennai, Bangalore & Kochi, Mono rail in Mumbai, etc. In this context, there is a need to understand the manner in which a socio-culturally unique and economically developing country like India reacts to the impact of these transit stations where public transport system still plays a prominent role in the transportation needs of its citizen.

2. INFLUENCE ZONE OF TRANSIT STATION

Influence zone of a transit station is defined as the area within which the passengers will walk to the station and utilize the facility. Calvo, Ona, Aran & Nash (2013), emphasis that greater the quality of transport service provided, the larger will be catchment area, since, the passenger will be willing to travel for longer distances and reach the station when transport quality is good. Quality of service depends on its capacity, frequency, comfort, other supports like fare integration, ease of transfer from one mode to another, last mile connectivity, and other facilities offered during travel, etc. The walking distance to reach a transit station will be less in an urban area, then the rural areas, and even within urban area, it will be very less in central business district (CBD) then the suburbs. The reason being the surrounding areas in the central business district are already well developed with higher order transport facilities and infrastructure.

As per Transit Capacity and Quality of Service Manual, the real influence zone of the transit station is the population actually affected by the transit station, which means people who actually use the facility and for whom this service is a viable transport option. In general all over the world the influence zone is defined in terms of radius surrounding the station, like an air-circle with transit station at its center.

Table: 1 below is the list of studies and their findings which identifies the distance of the influence zone of transit stations.

National Transit Oriented Development (TOD) Policy (2017) by the Government of India, defines the influence zone of a transit station to be between 500 – 800 meters which is within 10 – 12 minutes walking distance and if the distance between stations are less than 1 kilometer, and if there exist an overlap between influence zone, then the influence zone can be restricted to 500 meters from the station.
Table 1 Distance of Influence zone of the transit station.

<table>
<thead>
<tr>
<th>Sl. No</th>
<th>Author (Year)</th>
<th>Place of Study</th>
<th>Finding</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Kittleson (2003)</td>
<td>USA</td>
<td>800 meter radius is the influence zone of a transit station.</td>
</tr>
<tr>
<td>2</td>
<td>O’Sullivan &amp; Morrall (1995)</td>
<td>Calgary, Canada</td>
<td>The average access distance for LRT stations is between 325 and 650 meters.</td>
</tr>
<tr>
<td>3</td>
<td>The Royal Institution of Chartered Surveyors (RICS) (2002)</td>
<td>London, UK</td>
<td>Influence zone can extend up to 1,000 m depending on the type of public transport and station area characteristics.</td>
</tr>
<tr>
<td>5</td>
<td>Ko &amp; Cao (2010)</td>
<td>Minneapolis, USA</td>
<td>Influence zone could be extended up to 1,400 meters.</td>
</tr>
<tr>
<td>6</td>
<td>García &amp; Gutiérrez (2007)</td>
<td>Madrid, Spain</td>
<td>600 meters, 10 minutes maximum walking time.</td>
</tr>
</tbody>
</table>

Eric Jaffe (2015) has identified the influence zone via rental characters, which is a market force. In his study on Dallas, Texas, he finds that the rent decreases as the distance increases from the DART Station. 25 % of the rent premium decreases at about 400 meters from the station. The decreasing trend increased to 50 % at 900 meters and 75 % at 1500 meters. 25 % of the rent premium exists till 1600 meters. In some cases the influence is seen up to 3 Kilo meters. Coleman, P. J (1993), studied the same DART stations two decades before, and identified that the developments of a transit station is backed by the Market forces within the influence zone of a rail transit station.

The other market force is the land value, and Dudani (2008), finds that properties within 500 meters distance from the Delhi metro rail station have experienced higher increase in land value when compared to other places in the same locality, and between 500 to 1000 meters commercial properties alone have seen a rise in land value then the residential. This establishes the fact that the influence zone of the transit station depends on other factors which are specific to the locality.

Figure 1 Walking Distance to transit station

In the above Figure: 1, red dot is the transit station, and two scenarios are presented. In the figure on the left, a random organic city is shown, which was developed based on its topography and other local factors over a period of time. The red circle is the 400 meter air distance radius. The actual space covered via this circle, were a passengers walks for 400 meter from the transit station, is almost less than 30 % of the total area. In the figure on the right, which is a perfectly planned grid iron pattern city, percentage of space covered by...
walking 400 meters is around 64%. Even in the second scenario, the full area of 400 meters is not covered and the maximum radius of its influence zone by walking 400 meters is only 319 meters. Many cities in India are organically developed cities without any master plan for a long time and very few are planned cities with a perfect grid iron or a designated pattern. So in India, the shape and size of the influence zone will be different for different cities.

3. IMPACT OF TRANSIT STATION ON DENSITY

Density in spatial sense is defined as the number of people living in a given area. Transit station influences density in various manners like increase or decrease in population density, dwelling density, employment density, etc.

Coleman, Euritt & Walton (1993), in their study in Dallas, U.S. finds that Rail transit system encourages high density developments near the station areas i.e., the influence zone. Qingyun (2013) also finds that transit system encourages densification and heavy rail systems stations results in more densification than light rail system stations and its quantity depends on number of years of operation of the transit network. The more the year it is in operation, the more the densification effect.

Kolko (2011), in his study in California, finds that opening of new transit stations in urban areas which has less residential and employment density will not result in increase in employment densities, whereas transit stations in localities which already has higher residential and employment densities results in increase in employment densities. So, the existing character of the influence zone decides the outcome of densification effect. Jun (2011) in his study in Seoul also expresses that transit station has an effect in increasing the employment density of the influence zone higher than the residential density. He also finds that transit station related service accessibility benefits have resulted in increase in employment density in urban centers by attracting firms from the suburb regions.

Cervero & Murakami (2008) finds that the population in the whole of Hong Kong region grew by less than 1% between 2001 to 2006, whereas the areas served by New TKO Line grew by 22.7% and already developed Tung Chung Line grew by 6.7% and outlying Lantau island line grew by 53%. This densification effect is only due to the influence of transit station.

Cervero & Kang (2011), in their study in Seoul, was able to identify three types of conversions of built spaces due to the influence of transit station, (i.e.) from single-family residences to multi-family residential rental units or to condominium owner-occupied units, or to mixed-parcels, a combination of commercial and residential uses. All these changes results in densification of the space and addition of Floor space to the existing sites. Mees (2010) in his Comparative study on Los Angeles, New York, Las Vegas & Vancouver, finds that the Transit station reacts mainly with the density right around its stations within the influence zone and not the aggregate density of the whole urban area.

Cities like New York, London, and Paris are a product of Transit stations. All these cities were developed during 1900s, when there was no much development on personal vehicles, and at that time all these cities had extensive rail based public transport systems. These transport systems resulted in the growth of their Central Business Districts (CBD), and during that time all employment opportunities were also concentrated only on these regions due to the availability of transit networks. So, these CBDs are a product of transit stations and still remain the same, due to the unavailability of road network and parking spaces in the CBDs for personal mode of transportation.

According to National Transit Oriented Development (TOD) Policy of Government of India, densification of the influence zone of transit stations should be promoted by allowing
higher Floor Area Ratio / Floor Space Index thereby increasing the population and employment density. Minimum FSI should be 300 to 500% or even more depending on the city and its local characteristics. In Government of India’s Smart City mission, the TOD zone was identified as 500 meters, and higher Floor Space Index (FSI) is proposed in Naya Raipur along Transit Corridors, in Delhi along Delhi Metro, in Navi Mumbai along transit corridors and in Kochi along Kochi Metro to tap the developmental impact of the transit stations.

4. IMPACT OF TRANSIT STATION ON LAND USE

Land use refers to any human developmental activity that takes place on the land and changes the vegetation cover of the land from its natural state. This includes the use of land for agricultural purposes, construction activities, etc.

The impact of transit station on land use is the interaction between space and transport infrastructure. Allocation of certain use to a land will create the demand for travel to that land, as people need to access that space which require transport infrastructure, and in turn transport infrastructure adds to the attractiveness of the space by improving accessibility. With improved accessibility, the locations become attractive for further investments and it results in development of that space and change in land use, which is a cyclic process.

Jun (2011), in his study in Seoul, finds that due to the accessibility improvements provided by the Bus Rapid Transit System (BRTS) service has resulted in the redistribution of commercial activities especially firms from suburbs to the city centers. Coleman, Euritt & Walton (1993), also finds that Rapid transit system is one of the important forces that shaped land use decisions in the bay area of Dallas, US.

Hurst (2011) finds that there was a change in land use in the influence zone of Hiawatha Light Rail Transit system, but the influence zone was only up to 90 feet from the stations. In the influence zone, the first type of property to undergo conversion to denser use was the vacant land and Industrial sites located within 1600 meter distance are 10% more likely to experience land use change. Light rail transit system encourages infill development, and its effect on land use was very less in wealthy and low-density neighborhoods. Influence zones which already have mixed land use, higher population density, lower-income residents and older structures experienced maximum change in land use. Knight & Trygg (1977), in their study in US, Canada & European countries aggress that availability of vacant, developable land and levels of land use mix were important predictors of land-use changes in influence zones.

Higgins, Ferguson and Kanaroglou (2014), in their study in North America, synthesized the literature on Light Rail Transit systems and rapid rail systems and found that transit station alone is not enough to change the land use. It has to be supported by other parameters like the accessibility to the station, positive economic growth and demand, positive social and physical condition of that region, availability of land and complimentary planning regulations to witness a rapid change in land use.

Deng & Nelson (2010), in their study in Beijing, China, finds that Bus Rapid Transit System (BRTS) has an impact on land-use patterns in the city. This was identified by the authors’ surveys on the BRTS corridor residents and business owners, where 75% of the people have responded saying that BRTS was an important factor in their choice of location.

According to Government of India’s, National Transit Oriented Development (TOD) Policy, the influence zone of the transit station should be provided with activity oriented spaces like shopping centers, entertainment facilities like theatres, mails and public amenities including education facilities like schools, health care facilities like hospitals and recreation facilities like parks, playgrounds, etc., within the walking distance of the residents. And land uses like ware houses, petrol pumps / CNG Stations, cremation grounds, Prisons, surface and
multilevel parking should be restricted. It also insists on making these influence zones, more pedestrian friendly to minimize the usage of personal vehicles like two wheelers, cars, etc.

Sekar & Devyani (2016) in their study on impact of suburban train stations on Chennai city finds change in density and land use within the influence zone. Sekar & Sadasivam (2012) project that the Chennai metro rail corridor would alter, at varying levels, the structure of the city by encouraging compact, high-density city centers and by converting residences to commercial and institutional uses.

5. CONCLUSION

There is an impact of transit station on the land use and density within its influence zone. The change in land use and density is a process and its time varies from one region to the other depending on the localities characteristics. The change is positive in nature and brings in economic growth for the region. The volume of impact the transit stations had on land use and density during 1900s cannot happen today, due to the advancement in information technology and usage of personal mode of transportation which limits the impact of these transit stations. The equation between the transit stations and its surrounding areas are changing dynamically over time and will continue to be so.

The impact of transit station is higher in places where it is supported by other factors like available vacant land for development, positive economic and social condition of the region, intermodal connectivity the station offers, already existing developments and land use mix of the influence zone, population density, etc. So, this impact will be different in different regions based on the regions characteristics.

6. SCOPE FOR FURTHER RESEARCH

There is a need to analyze the impact of these transit stations in a broader and comprehensive manner, since, Asian countries like India are presentation a high rate of urbanization, and the numbers of people living in these urban centers are increasing daily. More studies are required to identify the impact of these transit stations on its influence zone, with various socio-cultural and economic characters of the residents, as it’s very much different in countries within Asian Continent. It’s time to understand the impact on transit stations in its influence zone, so that a detailed implementable Transit oriented development policy with development regulations can be formulated to make use of the positive economic change which will happen due to the functioning of these transit stations.

REFERENCES


D. Karthigeyan and Sheeba Chander


Impact of Transit Station on Density & Land Use within its Influence Zone - A Review of the Literature


