



IMPACT OF 5 D'S OF DEVELOPMENT ON THE PATRONAGE OF A TRANSIT NETWORK – A CASE STUDY OF VADAPALANI METRO RAIL STATION

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ABSTRACT

The patronage of public transport system in Chennai has reached to its lowest level ever since its inception. In this context, planning authorities introduced 1st phase of Chennai metro rail with 32 stations. The household survey conducted before the finalization of alignment of 1st phase projected the patronage of Chennai metro rail on 2016 will be 7.74 lakh trips / day, whereas the current patronage is only 1.21 Lakh trips / day in 2020, even though the Metro rail is in operation for more than four years. The reason for this low patronage is analyzed through the primary survey within the context of 5 D's of development (Density, Diversity, Design, Destination Accessibility & Distance to Transit) for the selected sample station.

Keywords: 5 D's of Development, Impact study, Chennai Metro rail & patronage of a transit corridor

Cite this Article: D. Karthigeyan and Dr. Sheeba Chander, Impact of 5 D's of Development on the Patronage of a Transit Network – A Case Study of Vadapalani Metro Rail Station, *International Journal of Advanced Research in Engineering and Technology (IJARET)*, 11 (3), 2020, pp 108-119.

<http://www.iaeme.com/IJARET/issues.asp?JType=IJARET&VType=11&IType=3>

1. INTRODUCTION

The aim of this research is to identify the reasons for the low patronage of metro rail then the projected figures within the context of 5 D's of Development. The objective is to analyses the reasons for low patronage through a systematic sample survey of a selected station which is in the middle of the network. The findings and suggestions will help the authorities to come out

with better strategies and policies to increase the patronage of public transport and enhance the quality of life of its citizens.

2. PUBLIC TRANSPORT SYSTEM IN CHENNAI

Public transport system in Chennai metropolitan area is served by Metropolitan Transport Corporation (MTC) buses, suburban rail network and Mass Rapid Transit System (MRTS). The share of public transport system in 1970's was around 54 % and it grew to 55 % in 1984, which is the highest percentage of public transport utilization till date. Since then with the rapid urbanization and liberalization of economy, the share of public transport has steadily declined to 42.7 % in 1992-95 and 31 % in 2008. Under this situation, authorities felt the need to revamp the public transport system which resulted in the formation of Chennai Metro Rail Limited (CMRL).

3. CHENNAI METRO RAIL LIMITED (CMRL)

A Metro rail is an electric passenger railway system in an urban area with high capacity and frequency, which is grade separated from other modes of traffic. Cities having a population of more than three million in India are recommended to have a Metro Rail by the DMRC (Delhi Metro Rail Corporation) which is also the consultant for the CMRL (Chennai Metro Rail Limited). In 2007, the alignment for 1st phase was finalized and construction began in 2009.

In 2007, while finalizing the alignment, a detailed household survey was carried out to assess the traffic demand. In that connection a detailed model was also developed, calibrated and traffic demand forecast was done. Summary of transport demand forecast is shown in the Table: 1 below, which includes the extension of 1st phase (8 stations) which is currently under construction.

Table 1 Summary of Transport Demand Forecast of Chennai Metro Rail (Phase 1)

Year	Corridors	No of stations	Daily pass	Length km	Pass-km	Average lead km	Pass km/ km in lakh
2011	Corridor -1 (Airport to Wimco Nagar)	25	318,532	22.5	2,632,748	8.27	1.2
	Corridor -2 (Fort - St. Thomas Mount)	15	254,144	21.3	2,137,984	8.41	1.0
	Total	40	572,676	43.8	4,770,732	8.33	1.1

Source: Detailed Project Report, Chennai Metro Rail

The traffic demand forecast is done by taking 5.2 % growth rate (as indicated by Government of Tamil Nadu) for the metro rail and the details are given in Table: 2

Table 2 Traffic Forecast for Corridor 1 and 2 combined together

Year	2011	2016	2026
Total Trips (in Lakhs)	5.73	7.74	12.85

Source: Detailed Project Report, Chennai Metro Rail.

The projected patronage for 2016 is 7.74 Lakh total trips / day for the entire network, but the current patronage in 2020 is only 1.21 Lakh passengers / day, where more than 80 % of the corridor is under operation (32 stations) for more than four years in a phased manner. In

this situation, the patronage should have reached at least 50 % and above, whereas it is less than 20 %.

4. LITERATURE STUDY

Density, Diversity, Destination accessibility, Distance to Transit and Design of the station including its immediate surroundings are regarded as the 5 D's of Development. The impact of 5 D's of development on the travel pattern is highly established through various literatures in the European and American context.

According to Global report on Human Settlements, 2013, on "Planning and Design for Sustainable urban mobility" published by United Nations Human Settlement Programme, the average influence of 5 D's of development on VKT (Vehicles – Kilometers Travelled) is identified through a meta-analysis of more than 100 studies in North America expressed as elasticities (denoting the percent change in VKT for a 1 percent change in each D factor). In that study among the 5 D's, 'Destination accessibility' is found to be the most important D which strongly influences travel behavior of the passengers. The result says that on an average, doubling of access to destinations is associated with 20 percent decline in VKT. So, any development in the central and accessible location will generate less motorized travel than the best-designed, compact, mixed-use development in a remote location of the city.

5. METHODOLOGY

Vadapalani metro station is taken up as the sample station and analyzed w.r.t., 5 D's of development which includes pedestrian facilities in and around the station, existing land use and population density of the influence zone, demographic profile of the passengers, multi modal connectivity which includes ease of integration of various modes & last mile connectivity the station offers.

Primary Survey was conducted with the passengers, who are using Chennai metro rail via Vadapalani metro station. A sample size (100 Nos) was chosen through stratified random sampling technique. The days and time of the survey were carefully chosen to have both weekdays and weekends including peak hours. The survey was carried on three different days with four different timings (25 Nos each). The timing of the survey are morning peak hour (9.00 AM to 10.00 AM), evening peak hour (5.00 PM to 6.00 PM), afternoons (2.00 PM to 3.00 PM) and an evening week end (4.00 PM to 5.00 PM).

6. STUDY AREA – VADAPALANI METRO STATION

Vadapalani metro station is located on the western part of the city, a residential neighborhood which also includes Software Industries, shopping malls, Theatres, University, Schools, Hospitals, etc. This is a typical neighborhood scenario for any neighborhood in the Chennai city.

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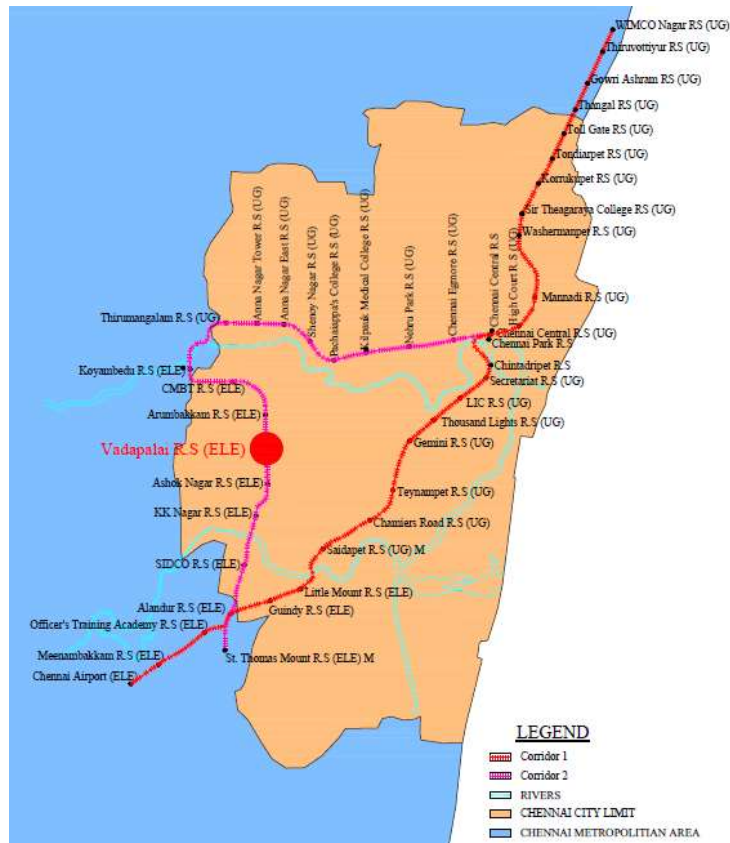


Figure 1 Location of Vadapalani station in CMRL Alignment – Phase 1

7. ANALYSIS

7.1. Distance to Transit

Conventionally 800 meters distance is considered as the ideal walking distance to reach a transit stations by the planning authorities. Some guidelines call it as 500 meters, while others say that for bus stops (400 meters) and train stations (800 meters). But none of guidelines makes it more than 800 meters by foot.



Figure 1 Walking Distance to transit station

In Figure: 1, the red dot is a transit stop and the red circle is the air-distance radius (400 meters). If we analyze the circle with a near perfect pedestrian grid iron settlement pattern, then only 64 % of the area will be covered by walking 400 Meters and its actual radius will be only 319 meters. If the settlement is organically development with obstructed pedestrian pathways, the area covered by walking will be much lesser. In Delhi Metro Rail project, 500

meters surrounding the station was identified as the transit influence zone, and authorities came up with a policy to increase the FSI to tap the potential of the metro station.

7.2. Diversity

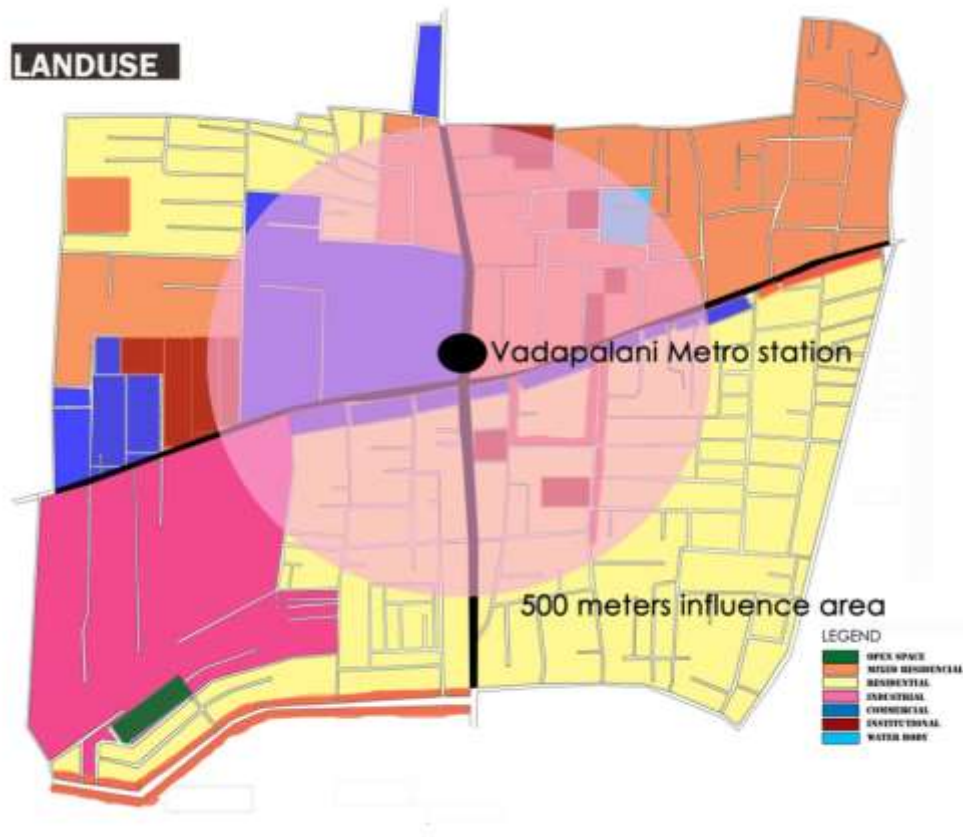


Figure 2 Land use Plan - Vadapalani Metro Station

A Primary land use survey was done keeping the station at its center to an extent of 500 meters to 1 km with major roads forming the boundary, since in Indian conditions from the people's perspective major roads forms the physical boundary of the space. It's found that the residential land use (households) form the maximum (38%) followed by mixed residential land use (28.6 %) which also includes dwellings. The other land uses includes Industrial, commercial and institutional. The Land use details of the influence zone are given in the table below.

Table 3 Land use of Vadapalani Neighbourhood

Sl. No	Land use	Percentage
1	Residential	38 %
2	Mixed residential	28.6 %
3	Commercial	8.1 %
4	Industrial	16.75 %
5	Institutional	6.25 %
6	Open space & water body	2.3 %
Total		100

7.3. Density

Population density is expressed as the total number of people residing in a given area. Population density of the influence zone is normalized and calculated from Census of India 2011. The details are given in the Table: 4.

Table 4 Density of the municipal wards in Vadapalani Station Influence area

Chennai Municipal Corporation	Total population	Total Area of ward (in hectares)	People / hectare	Area (500 m from station) (in hectares)	People living within 500 Meters
Ward No.117	36,192	75.13	482	38.06	18334
Ward No.121	25,912	67.37	385	29.09	11189
Ward No.129	59,322	236.26	251	9.94	2496
Total				77.09	32019

Source: Census of India, 2011.

Population density is found to be 41534 persons per square kilo meter, which is about four times higher than the overall density of the Chennai city (10988 persons per square kilometer). This establishes the fact that the influence zone has more number of people residing to utilize the metro facility.

7.4. Design of the Influence Zone



Figure 3 Vehicles parked close to station entrance and disable friendly design features adopted in the station

Private vehicles are parked close to the station entrances and on the edges of the road, occupying the carriage way width of the road, which affects the flow of traffic and the entry of passengers to the metro station. The metro station has incorporated disabled friendly design features to attract the passengers.



Figure 4 No designated drop off zones for Intermediate Public transport near the station

There is no proper designated drop off zones for the intermediate public transport vehicles (Share Auto's and Auto's) to drop or pick up passengers from the metro station.



Figure 5 Pedestrian pathways near the station – not able to use

Available Pedestrian pathways have too many undulations and occupied by sign boards forcing the pedestrians to walk on the road, occupy the vehicular carriage way width, which is a safety issue.



Figure 6 Pedestrian pathway leads to nowhere and presence of hawkers

The pedestrian pathway is too high when compared with the road level, leading to nowhere and presence of hawkers near the edges of the pedestrian pathway forces the pedestrians to walk on the road.



Figure 7 Uncontrolled movement of vehicles in all directions and absence of zebra crossing and signaling

There is no control on the movement of vehicles on the road, which makes the junctions more vulnerable to accidents, especially to pedestrians and cyclist and absence of zebra crossing escalates the issue of safety.

7.5. Analysis of the Survey Collected

Analysis and inferences of the data collected through the primary survey and its observations are,

Maximum number of trips is found to be work related trips (42 %) followed by Education, Shopping and Health care (Figure: 8). The reason being Destination accessibility like major Offices, Hospital cum Medical College and shopping Malls are located very close to the station.

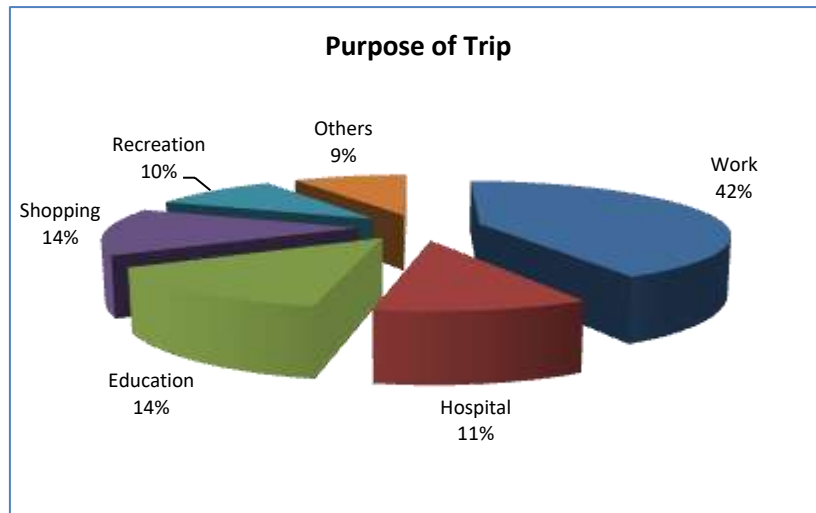


Figure 8 Purpose of Trip

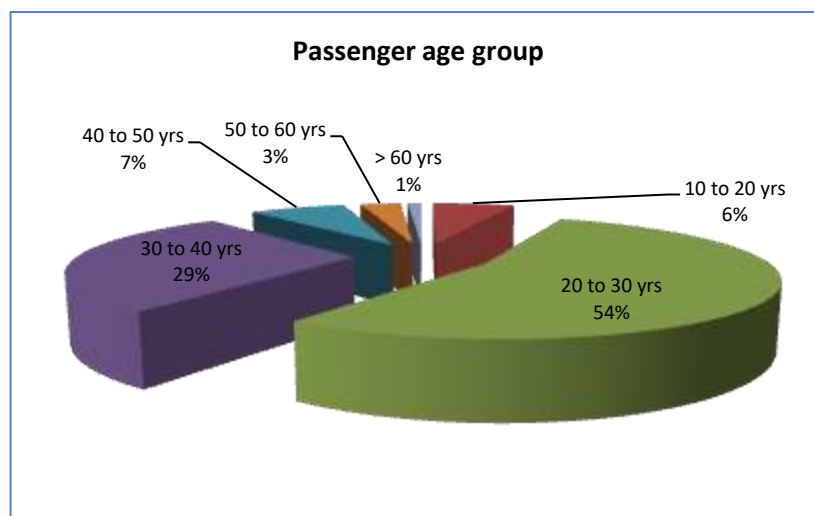


Figure 9 Passengers age group

Around 80 % of the passengers fall between the age group of 20 to 40 (Figure: 9), which is linked with the quality of access roads for the cyclist, elderly and the pedestrians to reach the station. Other age groups especially children's are not using this metro rail due to vulnerability of the access roads to accidents.

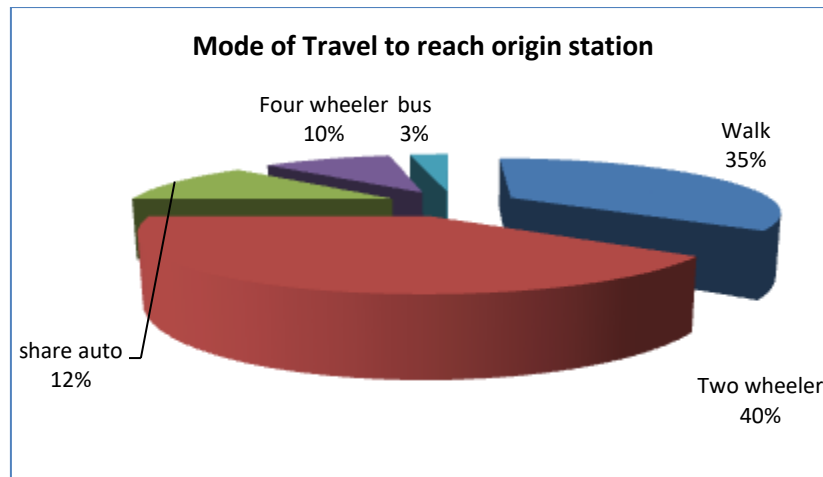


Figure 10 Mode of travel to reach Origin Station

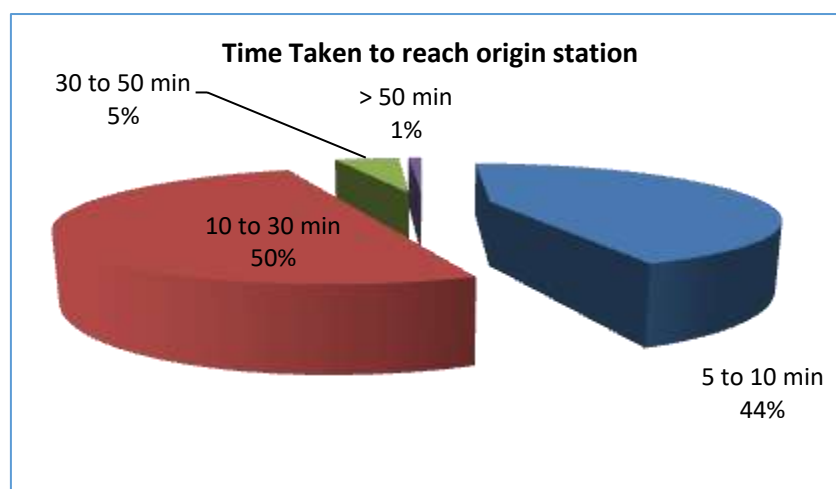


Figure 11 Time taken to reach Origin station

Around 35 % of the passengers reach the station via walk and 40 % uses two-wheelers which is a personal mode of transportation (Figure: 10). Only 3 % of the passengers use buses to reach the station, which shows the poor intermodal connectivity among the various public transport systems. Even the Intermittent public transport (share autos) has much limited role (12 %).

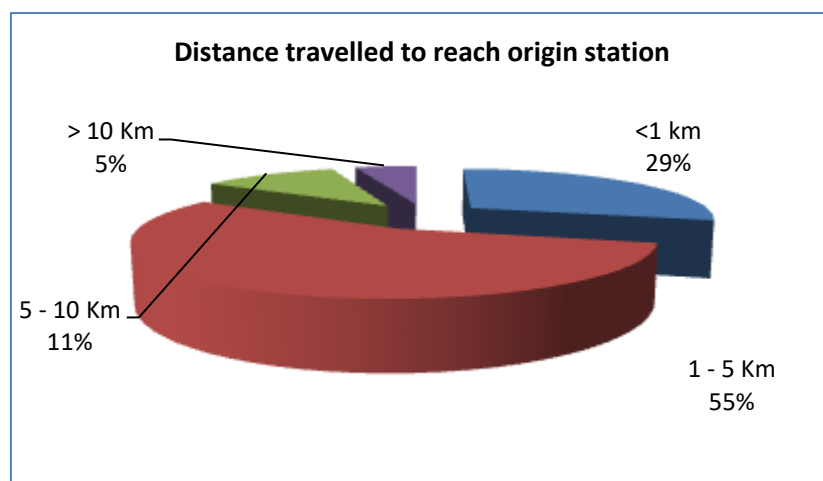


Figure 12 Distance travelled to reach origin station

Around 94 % of the people reach the station within 30 Minutes of travel from their origin which shows that the catchment population lives close to the station (Figure: 11). Influence zone of the Vadapalani metro station has more than 68 % of the land allocated for residential and mixed residential purpose, than the other use and the population density of the region is also four times more than the cities overall density. It is also found that around 84 % of the passengers origin location is within 5 Km from the station (Figure 12).

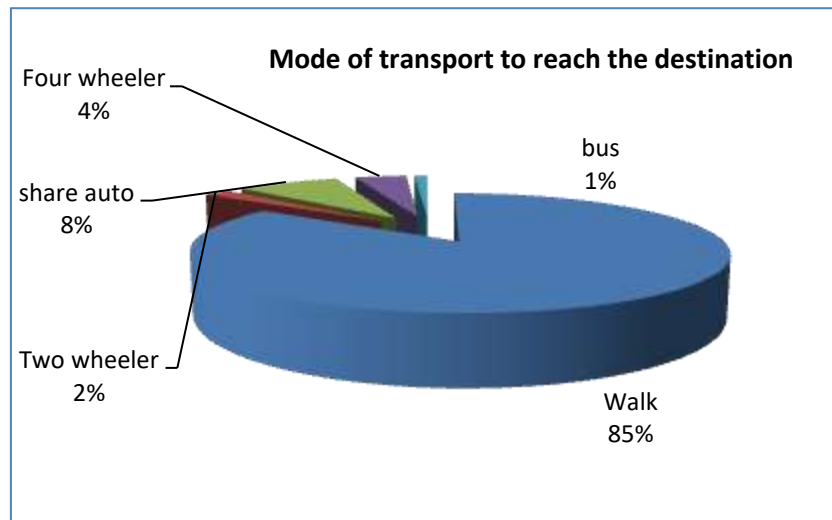


Figure 13 Mode of transport to reach the destination from the alighting station

85 % of the people travel to their destination from the alighting station via walk, and 82 % (Figure: 13) of the passengers reach their destination within 10 Minutes of travel (Figure: 14) and 74 % of passengers destination are within 1 KM distance from the alighting station (Figure: 15). This clearly establishes the fact that the destination accessibility is one of the main reasons to choose this mode of transport. The surrounding land use has major destinations like offices, Hospitals and a mall which is attracting lot passenger trips.

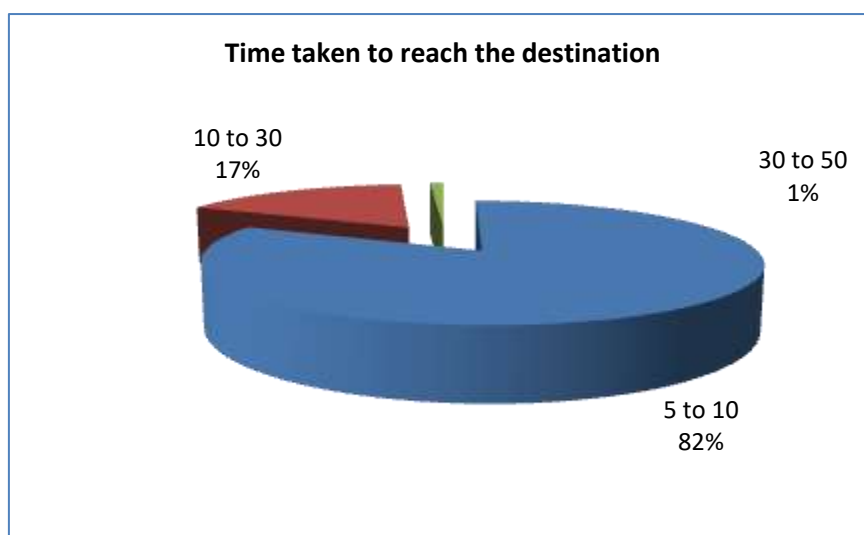


Figure 14 Time taken to reach the destination from alighting station

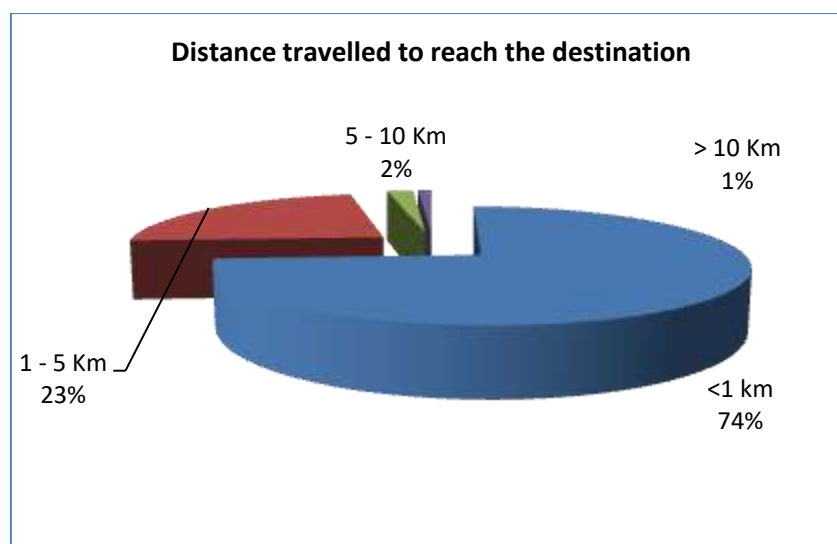


Figure 15 Distance travelled to reach the destination from the alighting station

8. CONCLUSION

In Vadapalani metro station, Destination accessibility is found to be the major positive feature which is currently influencing the travel mode of the passengers. It is evident from the survey that people are willing to travel a considerable distance by walk or by any other mode to reach a station, provided the destination is very close to the alighting station. This clearly establishes the fact that the land use and transportation network should work in tandem to increase its patronage.

In this Vadapalani station, the other factors which are influencing the patronage in negative manner includes lack of intermodal connection between various modes of public transport and the last mile connectivity which is usually offered by the Intermediate Public transport system. Not only the Design of the station, but the accessibility to the station from the neighborhood also needs to be considered while planning the station; only then the elderly and the children can be part of the public transport system.

9. SCOPE FOR FURTHER RESEARCH

The reason for the low patronage then the projected figures is analyzed within the preview of 5 D's of development. There are lot of other factors like the socio-economic profile of the residents, traffic situation of the space, safety and security features of the transit station, etc, which needs to be analyzed in a detailed manner to understand the reason behind low patronage then the projected figures.

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