Urban sprawl to Compact city: Role of Nagpur metro corridor and feeder transport system

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Abstract

Urbanization and the paradigm shift have been expeditious over the last decade. The rapid expansion of geographic extent of peri-urban and rurban areas have far outreached the carrying capacity and physical infrastructure. India being a densely populated country presents itself with multivariate and complex problems leaving behind a huge gap between people and place. There is no synergy in planning between the city core and the periphery. Introduction of smart infrastructure and mobility under the Smart Cities Mission has certainly boosted development aimed at sustainability but the argument of holistic development still remains.

Smart mobility is advantageous in several aspects ranging from environmental to economic viewpoints. Sustainable development under SDGs 2030 also emphasizes on the use of sustainable transit system. The Mass Rapid Transit System (MRTS) has received a boost in several cities across India. The city of Nagpur in Maharashtra was also identified as one of the beneficiaries of this system. It is the first metro to be implementing the "one project one platform" principle of 5D BIM with ERP. The main intent was to connect the urban fabric and provide last mile connectivity for commuters.

This research focuses on analyzing the role of Nagpur metro corridor and supporting feeder system in the city core. The analysis shall take into consideration a number of parameters including a pilot survey to understand the impact of this MRTS corridor in order to provide suggestive measures based on the research existing research gaps for future improvement.

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Introduction

Urban sprawl refers to the unprecedented growth of city fringes with little attention to planning policies. There are various implications of urban sprawl within the fabric of the city like changing patterns of building typology, density and spatial transformation of spaces. The shift from the urban periphery to the city core and central business district is characterized with a sharp increase in the urban economics of the area. With increased influx of fleeting population, it is imperative to build a robust transit network for increased user benefits.

MRTS is defined as a form of rapid transit system that can transport large number of passengers from two points at quick intervals. MRTS has few subdivisions like underground (metro), on the surface (sub-urban rail) and at an elevated surface (monorail). MRTS minimizes travel time, reduces Greenhouse Gas (GHG) emissions, lessens road accidents and fuel consumption. The MRTS corridor in Nagpur was envisioned to cater to the daily commuters who come from various parts of the city to work within the city core. The estimated core was INR 7327 crores to be completed in phases. Delhi Metro Rail Corporation (DMRC) was entrusted with the Detailed Project Report (DPR) and construction was awarded to L&T – Ramboll Consulting

Engineers Limited. Introduction of such infrastructure also affects the macro-economics of the area with a thrust on feeder transport and urban amenities.

Aim

Analyzing the impact of Nagpur metro corridor and feeder transit system of the urban city core.Objective

The key objectives of this study include:

- To understand the impact of the metro corridor on the surrounding context
- To perform a small pilot survey to analyze the feasibility
- To look for existing gaps
- To provide suggestive measures on how to improve the system

Methodology

The research methodology forms the backbone of any research activity. A well-defined research methodology clearly outlines the structure of the research giving direction to obtain results.

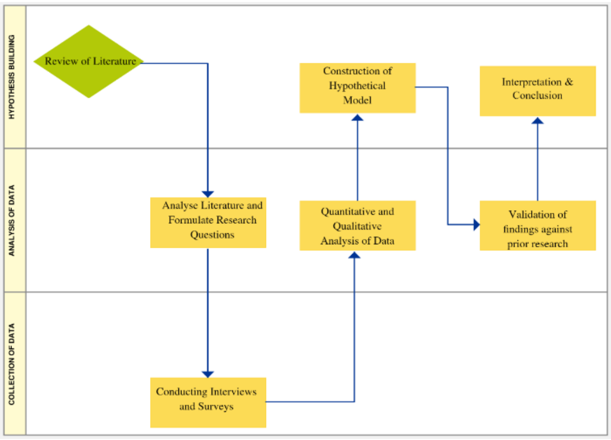

Figure 1: Flowchart showing the methodology of research design (Source: Author)

Literature study

Multi-modal International Cargo Hub and Airport at Nagpur is the biggest economic development project in an Indian context in terms of investment. The MIHAN project is spread over an area of 4354 Hectares. The L&T – Ramboll study report gives direction towards two key parameters of population and employment which are driving factors for infrastructural developments. The population density and employment density has been assumed to be 150/Ha and 40/Ha respectively in the year 2016 with an annual growth rate of 5%.

	2016	2021	2026	2031	2036	2041
POP	60600	77343	98711	125983	160790	205213
EMP	83440	106493	135915	173466	221391	282557

Figure 2: Chart showing the population and employment density with year (Source: DPR, DMRCL)

The Nagpur metro was a landmark project and one of its kind in terms of technology and application of state-of-the-art concepts like 5D BIM ecosystem. This enabled the project to get completed at a much faster rate when compared to other metro projects in India. The system of overhead connection was done using precast members assembled on site. It is operated by the Maharashtra Metro Rail Corporation Limited and caters to a daily ridership of 50000. It is touted as the greenest metro rail currently operating in India. It is a joint venture of the Government of India and the Government of Maharashtra, with 50:50 equity.

Figure 3: A picturesque view of the Nagpur metro (Source: The Times of India)

The peak hour peak direction traffic (PHPDT) volumes for Nagpur metro exceed 7000 for certain corridors where BRT cannot suffice. One of the proposals was the construction of MRTS in phases 2012-16 and 2017-21 to cater to the demand. There were four possible alignment options out of which two were chosen to represent the North-South and East-West corridor. The Orange line indicates the North-South corridor while the Aqua line indicates the East-West corridor.

Alignment	Detail Route
Alignment-1 North-South Corridor (19.658 km, 17 Stations)	Automotive Square, along Kamptee Road, Wardha Road, Variety Square to Abhyankar Road, along Nag River alignment will fall on Humpyard Road, Rahate Colony Road, Wardha Road, Parallel to Railway Line, Khapri Station and finally in MIHAN Area near concor depot
Alignment-2 East – West Corridor (18.557 km, 19 Stations)	From Prajapati Nagar, along Central Avenue Road, Railway Feeder Road, Munje Chowk, Jhansi Ranee Chowk, North Ambajhari Road, Hingna Road, Lokmanya Nagar

Figure 4: Final alignment selected for MRTS corridor (Source: DPR, MAHA METRO)

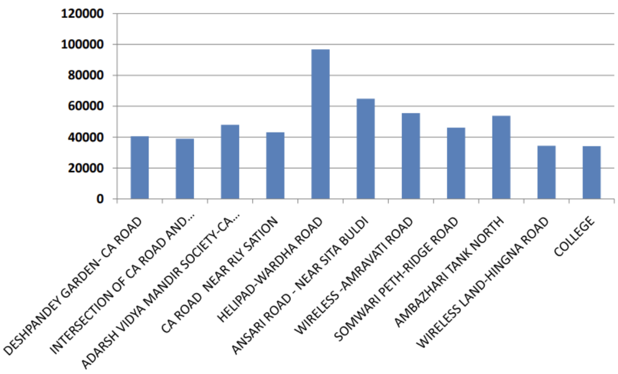

Figure 5: Daily passenger traffic variation on East-West corridor based on traffic count (Source: DPR, NMRC)

The passenger share and traffic volume are important factors to be studied in order to identify key routes. Important surveys like passenger count, traffic volume, visual survey is indispensable towards garnering key data related to the project. The figures **Figure 5** *and*

Figure *6* below shows the tabulation of these data sets. It is observed that along the North-South corridor

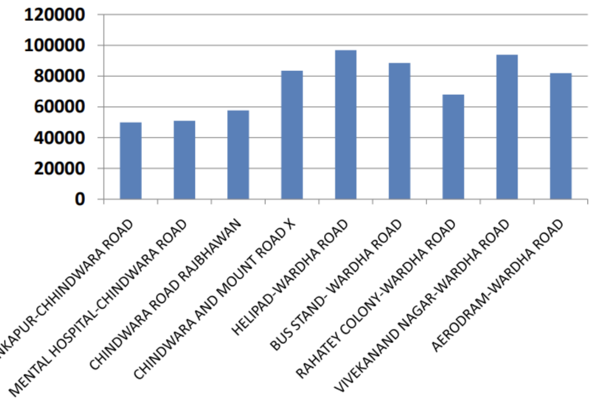

Figure 6: Daily passenger traffic variation on North-South corridor based on traffic count (Source: DPR, NMRC)

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Based on a series of carefully organized surveys the index plan for the Nagpur metro corridor was prepared which consists of 2 lines, 24 operational stations covering a length of 26.6km.

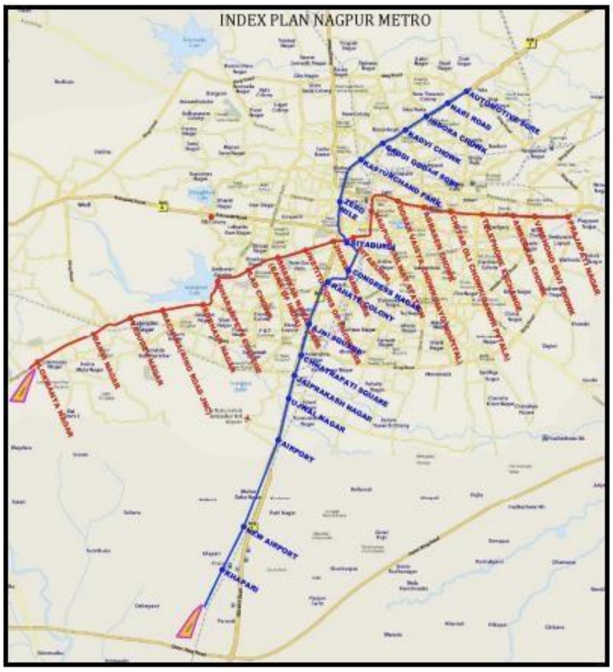

Figure 7: Route map of proposed Nagpur metro (Source: DPR, NMRC)

Analysis and Discussion

Nagpur is economically more viable than smaller towns. There is a vast majority of the population which travel on a daily basis. There are various types of transit modes which is availed by the commuters. These range from private vehicles to non-motorized transport. It is important to understand that in order to use the metro services, a well-knit network of feeder transport system needs to be established. Families living within the radius of 8-10 km will be eager to use the metro while people residing at a distance of more than 10 km will feel reluctant owing to the cost incurred by the inter-modality.

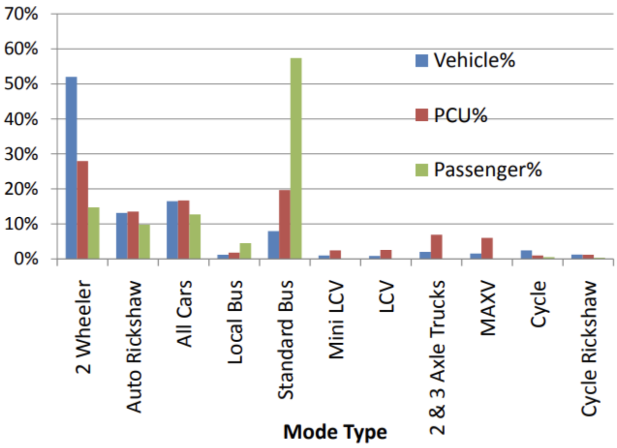

Figure 8: Modal share of vehicles on roads (Source: DPR, NMRC)

The average passenger trip distribution between various modes can be seen below in **Figure 9**. Travelling by two-wheeler and by taxi, auto is mostly opted by people comprising of nearly 33%

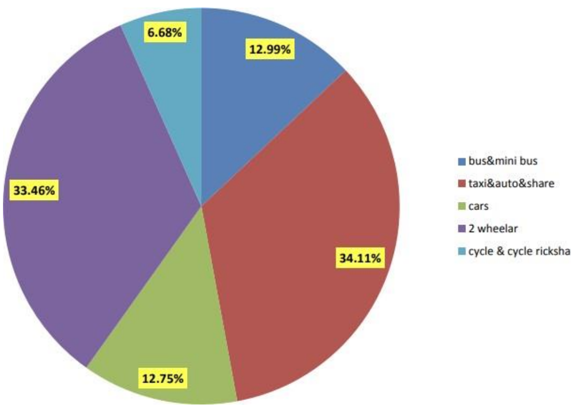

Figure 9: Modal split within Nagpur city (Source: Detailed Project Report, DMRC)

A survey was conducted among 70 users in order to gain valuable insights about the use of this metro corridor. Out of 70 users, the responses of 65 was identified legible and the rest 5 was discarded due to error in response. The primary aim was to inquire about their usage, issues faced and modality used to commute on a daily basis. The responses were analyzed and converted into graphical charts for ease of readability.

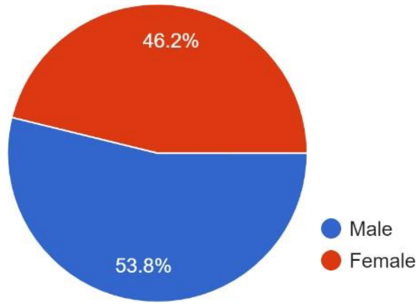

Figure 10: Gender ratio of respondents (Source: Survey)

Of the 65 respondents, 53.8% are male while the rest 46.2% are female. This indicates users are equally split between male and female. Occupation of respondents signify the kind of users availing the metro. Most of users have been found to be students and people doing business. The peak hour is also decided based on the number and type of users. The peak hour was from 9am-11am in the morning and 5pm-7pm in the evening.

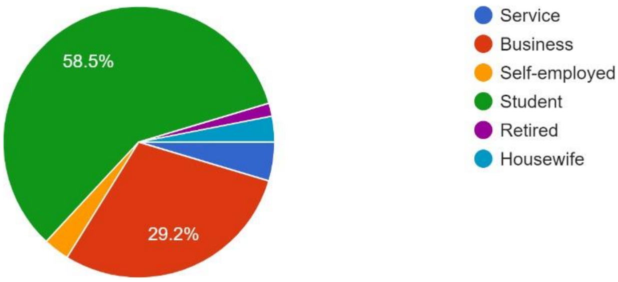

Figure 11: Occupation of respondents (Source: Survey)

The distance from the metro station also influences the user behaviour and usage pattern. The pie- chart below indicates that a majority of the population resides within 5km radius from the metro station.

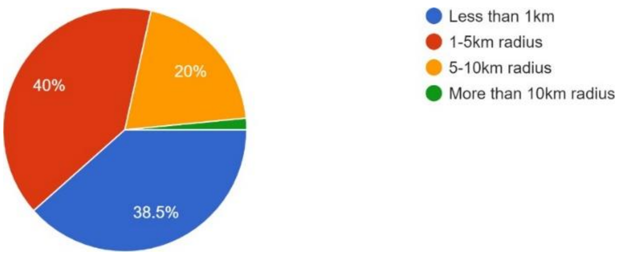

Figure 12: Distance of metro station from users' residence (Source: Survey)

On asked the question of "Do you avail the metro?", a resounding 87.7% of the respondents answered yes. This clearly indicates that people are availing the metro in high numbers on a daily basis. This is a positive sign as it encourages a shift from personalized vehicles to smart mobility which is clean and green.

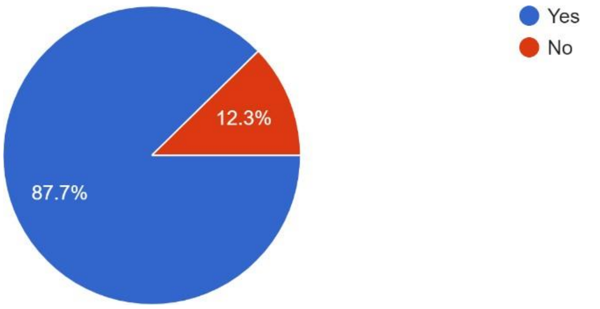

Figure 13: Users availing the metro services (Source: Survey)

Users who live within the 5km mostly avails the metro, which indicates a clear lack of connection of feeder transport with the metro stations for people living in the interior part of the city. The dense urban fabric also adds to the chaos taking too much time for passengers to reach the metro. A very percentage (40%) users avail private vehicle to avail the metro which is a major deterrent if we are aiming towards sustainable mobility. The thrust must be on encouraging majority of the users to use public vehicles as feeder transport which do not pollute the environment. This would not only reduce the emission levels but also help in maintaining the air quality in the locality.

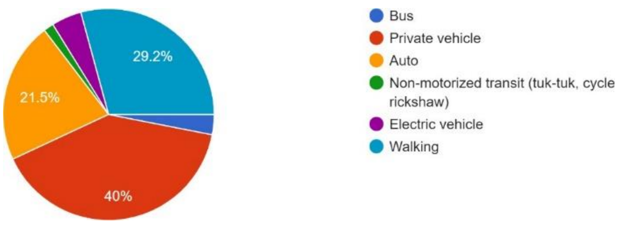

Figure 14: Mode of transport opted by commuters availing the metro (Source: Survey)

Based on all the above studies and pie-charts, it is evident that people want to use the metro as it saves time and cost. It is an efficient means of transport involving simplified usage with no gimmicks. The design of the stations is also universal, which implies even differently-abled users can use these services without facing any difficulty. They have all the required amenities like elevator, escalator, toilets, water fountain, proper signage, medical facilities and even food kiosks. The responses of the survey undertaken signify a positive approach towards the Nagpur metro services. Both male and female uses the metro equally. Students and business professionals are the highest users on a daily basis.

The less percentage of users availing public transport like bus or feeder transport like autos indicate a concern for connectivity and accessibility. This is one area which must be taken into planning and carefully implemented. Increased focus must be given towards creating a well-knit network of feeder transport which is eco-friendly in nature (like short route electric buses, tuk-tuk, e-rickshaws, EV motorcycle and cycle). The shift towards smart mobility is the future ahead but it requires a strong policy level planning with clearly defined criterions to be implemented.

Conclusion

It is clear that urban sprawl has aggravated issues of development beyond the carrying capacity thereby having a negative impact on the socio-economic, environmental and edaphic factors. The phased implementation of the Nagpur metro was a success which was short-lived since there were several deterministic factors. This is often attributed to the poor on-ground implementation without involving the public; who is considered to be the primary stakeholder and beneficiary.

Several places do not have feeder transport while in other locations they are expensive for daily convenience. The feasibility of the project is often hampered owing to these implications. A smart mobility policy framework needs to be drawn up for the urban fabric so that the beneficiaries can have better accessibility and connectivity. These areas often serve as commercial magnets increasing the micro-economy of the area. Establishing small commercial hubs to promote mixed-use development is vital as it gives added incentives to use the metro. One can on the way home buy essential items related to their daily requirements.

Solutions, Suggestions and Recommendations

The Nagpur metro at present does meet its goal of serving the commuters but going forward there are certain areas which need to be incorporated. On analyzing the multitudinous parameters for the successful implementation of MRTS system in Nagpur, here are a few recommendations or suggestive measures aimed at improving the system.

Following a bottom-up approach i.e involving all the concerned stakeholders including public: This is a vital step and involves the basics of participatory planning approach. The problems identified must be addressed from the grass-root level. Before proceeding further, the feedback of the stakeholders must be taken into account form the very beginning to avoid unidentified issues in future.

Community participation and engagement: The community from where the metro lines are crossing must be taken into participation so that they feel involved and an indispensable part of the process. Setting up shops or generation of micro-economy will come from this parameter. The system of

engaging local people for infrastructural activities is a tried and tested process which yields meaningful results.

Capacity building and awareness campaigns: Awareness must be brought among people on the use and effectiveness of using metro as a means of daily transport. Not only this, capacity building programs must be conducted at various levels on the environmental, social and economic significance of metro as a smart mobility system. The more the awareness among people, the better shall be the way forward planning for future phases of the project.

Preparation of a mobility policy framework: This is exclusive to the policy level where various organizations including the Government shall come together to frame a robust mobility policy specifically targeted towards sustainable transport system with a thrust on the metro and allied services. The policy must highlight the need, mode of operation and maintenance of feeder transport to enable easy movement of commuters at affordable rates. The implementation must be well defined encouraging stakeholders and investors for strategic investments aimed at mutual benefits.

Stress on establishing last-mile connectivity: On improving last-mile connectivity, commuters coming from far-reaching areas of the city will find it easier and more accessible to use the metro services. Women will automatically feel safe at night and allow them to work with a fair degree of comfort. This is a key parameter which needs to be implemented if Nagpur metro has to operate at a city-wide scale. For example, if students are availing the metro services during peak hours, then there must be sufficient availibility of feeder services like auto rickshaw, e-rickshaw, public buses at strategic points. These points must be well spread out throughout the city and a resultant of extensive transport surveys (travel demand, travel behaviour and peak time) conducted by local authorities.

The above recommendations are mostly suggestive in nature covering varying areas to assist in boosting the metro services of the city. These points are pivotal in the smooth functioning of the MRTS system and posing a tremendous potential for future growth. The Nagpur metro boasts of a tremendous future potential for integrated development in a phased manner incorporating all the key infrastructural pre-requisites with the added advantage of being safe, sustainable and accessible to all its users. This paper highlights few key areas which if looked into will enable this metro corridor to become a blessing to the people of Nagpur.

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