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Traffic and Transportation Plan for Bengaluru

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ABSTRACT
Bengaluru as a metropolis has witnessed explosive growth – both in terms of population, which has doubled since 2001, and growth in vehicles, which have more than quadrupled in the same period (RTO 2016). This has significantly stressed the city's road infrastructure, leading to congestion and increases in pollution. Economic losses due to congestion for two of the city's Information Technology corridors alone are estimated at INR227.7 billion annually (Bharadwaj 2015), without taking into account the health costs of increased emissions due to a surge in the number of vehicles plying in the city.This paper investigates the spatial job accessibility in the Bangalore Metropolitan Area through an accessibility measurement technique. Methods of measuring accessibility have been studied from available literature and a location-based cumulative accessibility measure has been chosen to interpret job accessibility at aggregate level. The method is found most suitable for the purpose of ascertaining accessibility in the catchment area of transit stations. The statutory master plan of Bangalore, the public transport network – namely, the bus network, metro network and suburban railway are the prime data sources. Spatial data in vector form has been analysed on an integrated GIS platform. The preliminary result of the study shows the accessibility pattern of the jobs in the city through public transport. Consequently, a secondary study has been done to assess the potential high accessibility locations of jobs in the city using data of population density, land use and transit stations. The results have been presented in the form of choropleth map outputs showing the high and low potential areas. Keywords: jobs, employment, accessibility, Bangalore, spatial planning, master plan, transit, station.

I. INTRODUCTION

Bengaluru is the fifth largest metropolis (6.5 m in 2004) in India and is one of the fastest growing cities in Asia. It is also the capital of Karnataka. The name Bangalore, which was earlier used, was an anglicised version of the city's name and as of now, the city is called Bengaluru. It is globally recognized as IT capital of India and also as a well developed industrial cityBengaluru city was built in 1537 by Kempegowda. During the British Raj, Bengaluru developed as a centre for colonial rule in South India. The establishment of the Bengaluru Cantonment brought in large numbers of migrant workers from Tamil Nadu, Andhra Pradesh and North Indian states for developing and maintaining the infrastructure of the cantonment. The cantonment area covers nearly dozen revenue villages, which included Binnamangala, Domlur, Neelasandra and Ulsoor to name a few. The defence establishments and residential complexes are part of the core area. Bengaluru is a radial pattern city growing in all directions. The city which was 28.85 Sq. Km in 1901 increased to 174.7 Sq. Km in 1971 to 272 Sq. Km in 1986 and 437 Sq. Km upto 2007. However, subsequently the existing TMCs & CMCs along with the surrounding villages was amalgamated and brought under the overall jurisdiction of City Corporation which was renamed from BMP to Bruhat Bengaluru Mahanagara Palike (BBMP). Accordingly, the total area under BBMP increased from 437 Sq.Km to nearly 800 Sq.Km.

Public Transportation System:

Buses are the predominant public transport system in all Indian cities. While four other metropolises Mumbai, Kolkata, Chennai, Delhi andeven Hyderabad have one or more forms of rail transport systems to cater to varying extents for commuters, Bengaluru has only bus as its public transport system. The city has one of the better run city bus transport systems in the country. It is operated in the Public Sector by Bengaluru Metropolitan Transport Corporation (BMTC), a wholly owned company of the State Government. As per the statistics of 2009, BMTC operates services on 5370 routes with fleet strength of 5593. BMTC has 24 depots in and around Bengaluru city. The corporation has about 28000 employees to man its operation. The daily ridership is approximately 40 Lakhs. BMTC operates 578 City and 1756 Sub-Urban routes per day. It has established state of the art commuter friendly modernized bus stations at Shivaji Nagar, Shanti Nagar and MCTC. The Kempegowda Bus Station at Subhash Nagar is also modernized with improved commuter amenities. The other major terminal of BMTC operating in the city is located at K R Market. In addition to this, sub nodal stations at different parts of the city have been constructed for the benefits of commuters. Its patronage has started having significant growth since

2002-03. In order to increase the frequency of services and to provide direction oriented services in place of destination oriented services, about 27 high density trunk corridors (Grid Routes) were started in 2007.

Public transport network:

The public transportation system in BMA consists of bus transport run by the Bangalore Metropolitan Transport Corporation (BMTC), the metro rail run by the Bangalore Metro Rail Corporation Ltd (BMRCL) and the sub urban railway operated by the Indian Railways. The coverage of the bus transport system is extensive, and buses are operated on both arterial and sub arterial roads. The metro rail operates only on the key traffic corridors and is elevated and underground in parts. It provides high speed connectivity between different zones of the city.

Development of a Structured Road Network: The emphasis being on:

• Core Ring Road
• Supplementing Outer Ring Road
• Organising transportation/Logistic facilities: Specific Areas strategically located to provide for storages facilities, garages, and heavy vehicles supported by personnel, technicians and offices as well as integrating various transport modes like road, railway and air.
• Developing Multimodal Public Transport System: consisting of rail & road based systems i.e. Metro-Rail, Mono-Rail, Circular Rail and other proven MRT systems.

TRANSPORTATION FUTURES

To meet expected travel needs of commuters a multi modal public transportation network is necessary along with the evolution of economic, transportation planning with a low cost transportation system operating under certain policies providing commuters acilities. Direct origin and destination service for commuters providing is not possible. There is a need of providing seamless connectivity for the passengers to cross various modes of transportation at low cost. A circular grid corridor on radial networks provided such that the commuters does not needed one or two interchanges.

A. Integrating transportation land use and environmental planning for sustainable urban development
B. Ride sharing technology in transportation.
C. Optimal coordination of connected and autonomous cars in smart cities
D. Feeder services i.e.Para Transit modes within 0.5 – 1Km is provided.
E. Pedestrian facilities like foot over bridges
F. Adequate parking areas.
G. Route guides with time tables along with information boards.
H. Promote balanced spatial growth.

Key planning consideration for 2016 project

The 2016 project consisted of studying a single electric bus in real conditions and studies what steps are necessary to incorporate the solutions in the city. So, they started with the study of technology and followed up similar projects worldwide. Then a validation protocol of technical characteristics indicated by manufacturer took place followed by resource training for staff, and last performance evaluation under real service conditions according to the business model. Along with these, CUTCSA also had to develop their own management tool. Route solution: The 2016 project laid the criteria for service operations, like distance, profile, permissions of government, autonomy profile, obstacles etc. The different stages of the project included the pilot test of an electric bus, then replacement of few auxiliary fleet, adding 20 new electric buses and putting up a charging centre in place. Charging management: Based on data seen from real service conditions, parameters for an optimal charging plan were decided. These parameters included battery consumption, battery status on the road, air conditioning etc. The data was extracted from the operation of 1,37,400 km of operation with approximately 0.5 million passengers transported. The pilot of 2016, included understanding charging management and management system, through 5 electric car usage for real-time practical monitoring. Protocols: Based on the prior experience, several protocols for charging solutions, realtime monitoring, fleet management, and service profitability were defined, to ensure correct usage of vehicles. Real-time monitoring: Having real-time data allowed to make quick decisions in cases of unforeseen events in operations, such as clashes etc. and also allowed to monitor the battery to prevent loss that could damage them in the long run. It is important that all tools for management are based on the city's specific need and management. Fleet management: Proper management of all actors on board is crucial to allow efficient service management. This includes driver, service owners, charging centres operators, maintenance crew etc. It is logical that it is easier than the same company is that manages all the parts. From the experience acquired from projects, it was determined that some factors which are crucial for electric bus operations are data monitoring, training, planning and operations, charging protocols and management tools.

Local Planning Area:
The entire local planning area of Bengaluru has been categorised into three major areas for application of Zonal Regulations and consist of:Main Areas: Comprising
1. Old Urban Areas including the Petta Zone & Traditional Area Zone Urban Redevelopment Areas M.G. Road Area Zone, CBD Zone, CBD Areas, CD Precinct Zone, Transformation / Development Zone and Mutation Corridor Zone
2. Residential Areas including mixed residential area, mainly residential area, and Commercial Axis Zone Industrial / Activities Areas including Industrial, High Tech and Logistics/ Transport Zone
3. Green Areas including Protected Land, Restricted Development, and Agriculture Land Zones.

Key challenges in bus sector in India

The key challenges are increased shift towards private transport leading to negative environmental impact, limited coverage demand-supply gap, lagging service delivery due to ageing fleet, and requiring operational sustainability, customer focus and multi-modal integration. Fragmented institutional roles and responsibilities and limited funding and investments – CAPEX and OPEX also are of concern. To secure development financing for buses, there are some pre-requisites for transit authorities. these include

- Clarity in policy, planning, operations and management of urban bus services, at national, state and city level with policy and strategic framework for operations and management which enable regulatory framework.
- Clear obligation to deliver urban public transport services: Urban public transport to act as a service, with supply and management which is customer oriented, integrated, affordable and inclusive.
- Performance, sustainability and viability of the bus service operations – models of operations. The development must be holistic and comprehensive ecosystem development rather than just purchase and asset creation. There should be performance indicators for coverage, level of service, accessibility, fare, and supporting infrastructure. Additionally, the agency must be a self sufficient agency to manage and scale up the system with skills/trainings.
- Intermodal/multi-modal integration at different levels: Integration of services across modes of transportation in a city are desirable. Physical integration of infrastructure should also be present including bus stops, bicycle docks, metro exits points, pick-up/drop etc There should also be seamless Information integration flow enabling journey planning and management at customer front and also operations end. In addition to it, Fare sensitivity to urban bus services is critical, standalone as well as on an integrated basis to promote bus travel. Lastly, there is a requirement of a champion integrator to ensure coordination and optimisation of agency roles and responsibilities
- Environment and social impact and outreach: the impact in terms of green fuel technology, their management is critical, climate impact and environmental sustainability in terms of reductions of emissions, GHG and other emission, and the source of energy are all critical. Social impact on captive users and induced users, vulnerable groups, low-income groups, extended coverage to smaller towns and cities is to be known.
- Capacity building and training - skill up-gradation: Capacities of the agency for policy, planning, operations and management must be known, and whether they are interested in skill up-gradation, as it could be covered under the grant component along with the loan.

II. Conclusion

Bengaluru, currently the fastest-growing metropolis in India, is at a decisive point in its history. With most road infrastructure heavily overloaded, city planners an opt for conventional solutions in wider roads and

elevated corridors, further incentivising people to use private transport. Alternatively, they can decide to use road capacity more efficiently by encouraging multi-ple forms of mass transit — a critically necessary ap-proach in the case of Bengaluru. In the context of mass transit in India, the current trend in India is to prioritise capital-intensive rail-based system such as metros. Our research, however, indicates that Bengaluru will remain heavily dependent on bus transit even after the introduction of rail-based mass transit, with 80% of public transit trips still by bus

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