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Transport Corridor: An approach for Smart urban development

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Abstract: - Most large cities in developed countries began their spread in a 'tentacle' pattern along the main roads leading to the city centre, and then continue to sprawl because of high rate of car ownership. Growth of traffic due to individual mobility results in urban congestion and a decline in the use of public transportation. The 'Transport Corridor' consists of rethinking the composition of a city around main lines of public transportation. Using the same amount of land, it enables the transport of larger numbers of people than is possible with private vehicles, while reducing the social and environmental impact of mobility. The goal is to produce a more sustainable pattern of urbanization so that residents have access to the services and amenities they need without recourse to a private motor vehicle. The quantifiable measure for transport corridor is urban form, traffic and road characteristics which are catered by design element of a corridor. Considering overall findings, analysis and interpretations it is found that the combination of urban form, travel behavior, engineering street design and community preferences creates ideal base for implementing transport corridor approach for smart urban development.

I. INTRODUCTION

For economic and environmental reasons, cities in both developed and developing countries are seeking to organise or reorganise their urban development along major routes of mass transit (with surface, underground and elevated systems), constituting "corridor" for mobility and urban densification. The "corridor design" consists of rethinking the composition of a city around main lines of public transportation. The emergence of explicit transportation problems such as congestion and pollution has caused increasing governmental and public concerns about urban development. These problems are not only caused by transportation system design, but also relate to land use planning (urban sprawl) to some degree. There has been growing recognition that the relationship between land use and transportation needs to be understood in a consistent and systematic way. Land use has been interacting with transportation systems during the course of urban development. For example, a new urban road will encourage the development of adjacent land. As the land is developed, travel demand will increase, leading to the congestion on this new road. As the traffic increases, the road need to be improved or a new road will have to be built. The new highway will then encourage additional land development, and the cycle continues. Considering environmental and financial constraints, it is implausible to "build our way out of congestion" by continuing new highway construction. These include how development along major routes of the city contributed in integrating landuse and transportation planning. In particular, certain transportation planning decisions tend to increase *sprawl* (dispersed, urban-fringe, automobile-dependent development), while others support *smart growth* (more compact, infill, multi-modal development). These development patterns have impacts in various sectors. This report describes quantifiable measures for integrating land use and transportation and supports corridor approach for smart urban development. The ultimate goal is to develop quantifiable performance measures derived from this review of the research.

1.1 TRANSPORT CORRIDOR

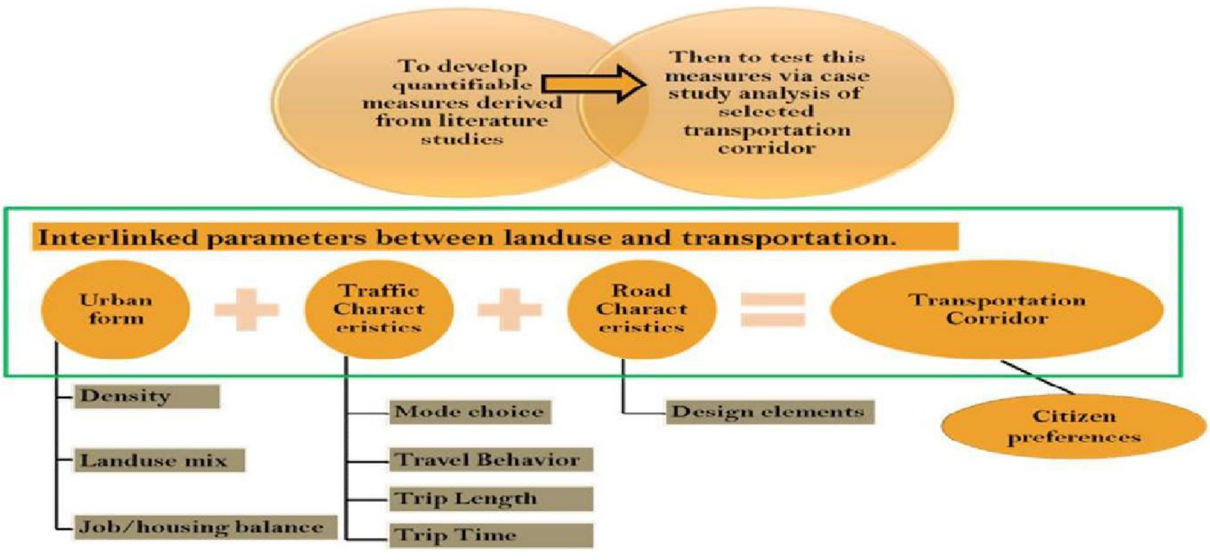
Transportation corridors are big, complex, and frequently problematic public projects. They affect and involve many stakeholders. They require significant financial resources. Yet they are critical to the mobility of a region and often support the economic development of impacted areas. This report summarizes corridor study findings and offers planners and public officials a framework for developing corridor strategies. It explains how the key factors influence corridor success or failure and offers concrete suggestions to help planners and public officials anticipate and respond to potential roadblocks to corridor development. While the case studies and analysis included here examine surface transportation projects, the principles developed should be applicable to any corridor planning process. . Key factors that affect the success of Transportation Corridors are finance, economic impact, governance, design and citizen preferences.

1.2 SMART GROWTH CONCEPT

The smart growth development concept gives principles like mix land uses, take advantage of compact building design, create a range of housing opportunities and choices, create walkable neighbourhoods, foster distinctive, attractive communities with a strong sense of place, preserve open space, farmland, natural beauty, and critical environmental areas, strengthen and direct development towards existing communities, provide a variety of transportation choices, make development decisions predictable, fair and cost effective, encourage community and stakeholder collaboration in development decisions.

II. MODEL

The quantifiable measures derived from literature studies which shows significant impact on landuse transport integration are urban form, traffic, road characteristics and citizen preferences. These four parameters when studied together and interlinked give ideal basis for transportation corridor. The urban form or built form of city talks about density pattern, landuse mix, job housing balance, street design etc. The traffic characteristic shows influence of mode choice, travel behaviour, trip length, trip time etc. The road characteristic gives engineering design elements, pedestrian friendly environment, parking etc. The community preference not only gives success to the development of corridor but also helps in its ideal functioning. These measures are tested for Nagpur city to study the urban planning and mobility planning coordination. The potential area for future growth in Nagpur city is towards south with higher number of passenger per hour per direction on N-S corridor, which is also known as NH7 (Wardha Road).



Model of quantifiable measures to integrate landuse and transportation

III. ORGANIZATION OF THIS PROJECT

This study incorporates use of GIS mapping, statistical tests in Mini Tab, relevant research, structural surveys and corridor oriented surveys. The corridor survey was conducted to collect valuable opinionated information from the people who are using the corridor and who are living adjacent to the corridor. The structural survey physically assessed the corridor to provide relevant insight toward the aesthetics and developmental characteristics of the byway. Overall, the results of these examinations and analyses confirm the need to integrate landuse and transportation planning in Nagpur city along with corridor development The corridor study shows very faint coherence between landuse and travel behavior. The best suitable concept for the study corridor development is “Structural Axes Concept” which basically talks about linear high density mixed development associated with mass transit. It is the combination of compact development, mix landuse development, pedestrian friendly environment and development of mass transit corridor. The proposal and the recommendations mentioned for structural axes concept will help the city to overcome its difficulties regarding integration of landuse and transportation which will give city a move towards Smart Growth Development.

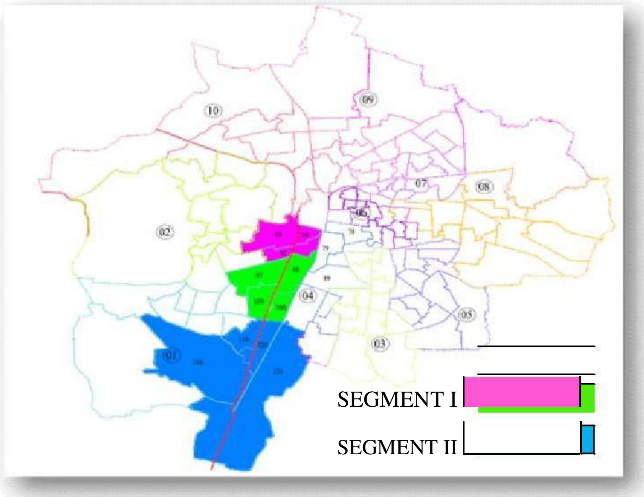
IV. METHODOLOGY OF CURRENT RFSEARCH

For conducting primary surveys effectively the corridor from zero mile sq to NMC boundary is divided in three Segments as follows:

SEGMENT I – FROM ZERO MILE SQ TO RAMDASPETH SQ

SEGMENT II – FROM RAMDASPETH SQ TO CHATRAPATI SQ

SEGMENT III – FROM CHATRAPATI SQ TO NMC BOUNDARY AT SOUTH



SEGMENT III

The entire analysis is carried out to test the measures developed from the literature studies to integrate landuse and transportation and to create a base for development of transportation corridor. Data generated through observation survey for existing land use details are analysed by GIS mapping tool in ArcGIS. This model is analysed in three steps using correlation analysis, regression analysis and GIS mapping.

4.1 URBAN FORMFACTORS ANALYSIS WITH NON URBAN FORM FACTORS

The urban form factor is analysed using landuse mix in ArcGIS. The land use mix index also known as Entropy index is determined for each segment to calculate the level of land use mix in that segment analysis zone. Land use mix refers to locating different types of land uses (residential, commercial, institutional, recreational, etc.) close together. This can occur at various scales, including mixing within buildings (such as ground-floor retail, with offices and residential above), along streets, and within neighborhoods. It is measured with a scale ranging from 0 to 1 with 1 representing the highest level of mixing. The index is based on following equation: Six-category mix, fromFrank et al. (2006)

Land use mix=−A/(ln(N));

where area = A = (b1/a)*ln(b1/a) + (b2/a)*ln(b2/a) + (b3/a)*ln(b3/a) + (b4/a)*ln(b4/a) + (b5/a)*ln(b5/a) + (b6/a)*ln(b6/a)

a = total square feet of land for all six land uses present in buffer, b1- b6 measure areas of land use for: b1= Entertainment, b2= Industrial/Manufacturing, b3= Retail and Services, b4= Office, b5= institutional (Educational), b6= Residential, N= number of six land uses with area > 0

4.1.1 INTERPRETATIONS

The level of land use mix in Segment I is 0.834, which shows that there is good proportion of six land use present in that segment. The level of land use mix in Segment II is 0.65, which shows that there is moderate proportion of six land use present in that segment. The level of land use mix in Segment III is , which shows that there is poor proportion of six land use present in that segment which means that any one of the six land use is dominated in this segment. According to the table of Segment III the Residential Land use is dominant in this segment.

4.2 TRAVEL BEHAVIOUR FACTORS ANALYSIS WITH NON URBAN FORM FACTORS

4.2.1 CORRELATION ANALYSIS

In this section, the relationship between household/employment density and each factor under the category of land use structure and transportation measure is explored

4.2.2. REGRESSION ANALYSIS

In this section, the relationship between household/employment density and each factor under the category of land use structure and transportation measure is explored to find out the threshold of the interlinked parameters.

4.2.3 INTERPRETATIONS

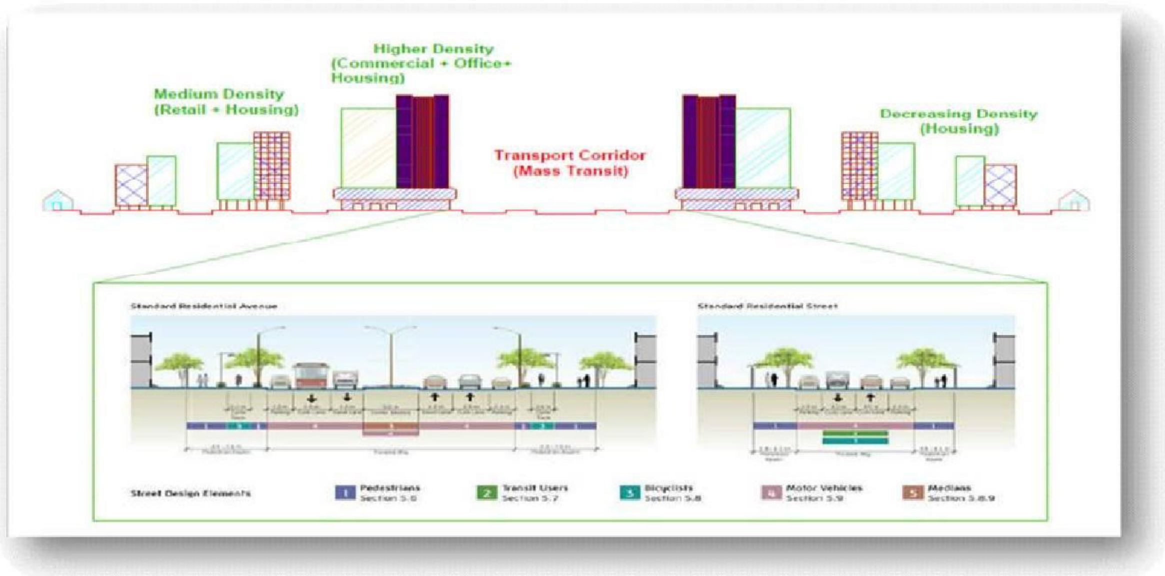
Household Density with Land use structure variable and transportation measures

Among all explanatory variables, office and institutional land use fraction, commercial land use fraction, industrial land use fraction, vacant land use fraction, other land use fraction, distance to major highway are insignificant variables because these variables have correlation coefficient values lower than 0.4, which is used to judge the strength of correlation in this project. Among land use structure variables, the residential land use fraction variable has the most significant relationship with household density, which has a correlation coefficient value of 0.87. This indicates that changing the residential land use fraction will have a significant influence on household density in this study area. Among transportation measure variables, travel time to city centre / downtown and accessibility show a strong correlation. Correlation coefficients show that households tend to live in more accessible zones; the zones closer to the city centre / downtown area have greater household density. It shows that total land use fraction can provide a better estimation for household density with bigger adjusted R square. The combination of dense housing, shopping and dense employment is probably associated with the greatest reduction in auto use. Landuse mixing reduces trip distance and travel time.

Employment density with Land use structure variable and transportation measures It is observed that there is a nonlinear relationship between employment density and residential land use fraction, distance to major highway, and travel time to downtown, all of which appear to have a inversely proportional curvature. This signifies that employment density decreases with the increase of residential land use fraction, distance to major highway, and travel time to downtown. Among land use structure variables, the commercial land use fraction is strongly correlated with employment density. Land use mix index also has a significant influence on employment density, which shows that employment density rises with the increase of land use mix. Among transportation measure variables, distance to major highway has the strongest correlation with employment density, with a correlation coefficient value of 0.70. It also is the most significant factor in all explanatory variables. Employment density tends to decline with an increase in distance to major highway, which suggests that employment has an inclination to locate along major highways. Employment density seems to decrease with the increase of travel time to downtown and increase with the increase of accessibility. It indicates that jobs tend to be located around the downtown area and in that analysis with higher accessibility. Living , shopping and working in denser environment is better than only working in dense environment when it comes to reducing motorized use.

V. STRUCTURAL AXES PLAN CONCEPT

This image shows the design plan of structural axes which is to be implemented on study corridor. Application Structural Axes Plan Concept on Study corridor



This structural Axes plan incorporates all the three transport efficient development strategies i.e. Compact development, Mixed use development, Pedestrian friendly Environment. The Trinary system development divides the road as per their hierarchy (e.g. collector, arterial, local etc). The various combinations of mixed land use vary according to the hierarchy of road segment. The distribution of density again moves parallel with the mixed use variation. In this way in a single plan concept all the three objectives of corridor development can be achieved. This concept is applied in some part of Segment II which is prepared in ArcGIS to show the physical appearance of the analysis zone after incorporating Structural Axes plan. The figure below shows the variation in land use mix along with the varying densities. The red colour line shows the road segment which represents NH-7 in this map. The right hand side of the road segment shows the regular urban form of city which is as per the norms and standards of a Nagpur city. The left hand side of the road is developed according to the Structural Axes plan Concept as described above.

VI. SOME FACTS

- As this studyis limited to NMC boundary of Nagpur city it is, the area surveyed is entirely a developed area hence no land for new development is readily available. In such a case the Proposals can be implemented under various other redevelopment programs like infill development, redevelopment of neighborhood, redevelopment of dilapidated structure etc.
- The Proposals can be easily implemented in the Metro Region of Nagpur city as it is outside the NMC boundary and there is scope of land development due to availabilityof vacant land.
- The surveys and analysis highly dedicated to the selected study corridor which may or may not be applicable to the other corridor of the city.

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