

Review on Key Elements of Traffic & Transportation Planning Approachs for a Mid-Sized City

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ABSTRACT

The fastest growing urban world need a reliable traffic & transportation planning to cope with various transportation problems. The problem of traffic congestion & accidents have become a major challenge in these recent times. The main cause of these problems is the sudden growth of population & road user leads to more road/vehicle demand with proper road. Traffic survey is considered as a key element for the transportation planning process. The statistical data of traffic survey comprises of traffic volume, capacity, density & level of service (LoS), traffic forecasting, etc. have a great importance for the transportation planning process and reduction in traffic congestion. Speed study is a prime element for the analysis of spot speed and helps in enforcement measures of speed limits leads to reduction in accident rates. Parking facilities demand is on high in this urban world. To ease the transportation planning process, multimodal transportation integration is an excellent method to reduce the congestion & increase the connectivity. The simulation of the transportation planning model with SUMO helps a lot to simulate the urban transportation system.

Keywords: *Forecasting, Planning, Traffic, Simulation, Survey, etc.*

1.INTRODUCTION

The rapid growth of vehicles has become a major challenge to the motorists as well as pedestrians. To the traffic engineer and planner, such growth poses serious problems. Mumbai, Kolkata, Chennai, Bangalore and Delhi are classic examples. [NTPC, 1980] It has been the thinking of the planners and administrators that the growing urbanization should be catered to by fostering the growth of medium and small sized cities. The small and medium-sized cities in India with 1 – 10 lack population have grown in a rapid rate over centuries. No thought has been given to the planning of the street network and traffic requirement of such towns. But in view of the likely shift in emphasis in favor of development of such cities, the traffic planner should have an idea of the needs of these cities, and how they can be met with. [JUSTO C.E.G., KHANNA S.K., 2011] It has been described that the problem of traffic congestion and accidents in urban roads is being viewed with grave concern in the recent years. The main causes of this problem are improper planning of road network and other roadway

facilities and poor traffic planning. Hence traffic functions now occupy a good position in Corporation and Municipalities. The functions and duties of traffic engineer units were initially limited to traffic surveys and control devices. But now this branch of engineering has developed considerably and include many other activities like design, regulation, planning and administrative functions. In municipal organizations, a full-fledged traffic engineering unit can be entrusted to look after public safety. [SINGH S. K. ET AL, 2016] It has been described that various types of statistical analysis of traffic related data are necessary for the planning of traffic & transportation system for small or mid-sized cities such as traffic survey, accident records, District Transport Office vehicle record, Spot Speed data, public questionnaires, etc. Traffic surveys are an essential constituent of a widespread traffic and transportation planning. Gratefulness of existing traffic and travel physiognomies is tremendously significant for the improvement of widespread traffic and transportation plan.

II. TRAFFIC SURVEY & ANALYSIS

To begin the traffic survey, inventory information related to traffic planning is very must. Information related to land use, economic activities, population, travel characteristics and transportation facilities are collected through a series of survey. For inventories purpose, the mid-sized area under this study is sub-divided into a number of small zones. Detailed surveys are organized to assess the existing activity levels and traffic facilities. The different type of surveys is carried out and the information collected are analyzed with respect to past trends and future expectations forming the basics for future travel demand analysis. If survey data is to be used to develop predictive models of travel and activity behavior, it therefore appears that longitudinal data, which can account for dynamic changes in behavior, is the preferred type of data to collect [HENSHER, 1982] for further arguments to this effect.

[BATRA U., MANDAR V. SARODE, 2013] Traffic surveys are an integral component of a comprehensive traffic and transportation study. So, to perform a traffic survey, various methods are adopted with respect to some specific duration of time for the area of survey. The various traffic surveys can be conducted for appreciating the existing traffic and travel demand characteristics and to prepare the transport infrastructure improvement plans such as Road inventory survey, Classified traffic volume count survey, Origin and destination survey, Household interview survey, Speed and delay, Parking survey, Pedestrian survey, Intermediate public transport operator survey, Intermediate public transport user survey.

III. TRAFFIC CAPACITY, VOLUME, DENSITY & SPEED

[VAN AERDE & YAGAR, 1983] analyzed the effects of traffic volume on speeds of 2-lane rural highways using a large data bank compiled in Ontario, Canada in 1980. These effects are examined for the entire practical range of volumes using two types of linear models. The first considers volumes of cars, trucks, recreational vehicles and other vehicles in the direction being analyzed, and the total volume in the opposite direction. The second model considered only aggregated passenger car units in the main direction and opposing direction. The 10th, 50th and 90th percentile speeds were estimated using each of the above models. [CHANDRA & SIKDAR, 2000] through an empirical study found that for a given road width, an increase in volume level of

heterogeneous traffic causes more density on the road resulting in reduced uniform speed of vehicles. [PANDA HARIBANDHU & PUNDIR R.S., 2002] analyzed traffic characteristics in Vadodara Ahmedabad section of the National Highway Number 8 to identify management measures that will lead to better traffic performance. [JIANG, MCCORD & GOEL, 2006] developed a method to estimate AADT on highway segments by combining the ground- based traffic data information with in-image traffic data information. [V. THAMIZH ARASAN & K. KRISHNAMURTHY, 2008] have analyzed the problem of measuring large heterogeneous traffic volumes. [RIJUREKHA SEN, 2013] presented techniques to measure traffic density and speed in unlaned traffic prevalent in developing countries by videography method and applied those techniques to better understand the traffic patterns in Bangalore.

[SARNA, JAIN & CHANDRA, 1989] emphasized on the need of developing highway capacity norms for Indian highways. They presented the results of a study to establish capacity norms for selected categories of urban roads in Delhi and Bombay. The main emphasis of the study was the development of simpler techniques for evolving capacity norms, based on observed data. An insight is provided into a new technical approach, the 'enveloping curve technique', for developing suitable capacity norms by adopting an appropriate level of service concept for Indian conditions. 24 locations of road stretch in Delhi and 13 locations in Bombay were selected for the study.

[LEONG, 1978] measured speeds and capacity at 31 sites on rural highways in New South Wales between the period 1963 and 1973. The sites had varying lane & shoulder width with gravel shoulders. The data were analyzed using multiple regression and it was suggested that speed increased with increasing shoulder width. The locations selected were on straight lengths of road having bitumen or concrete surfaces, with gradients ranging from 0 to 10 per cent, and with a prima facie speed limit of 50 mph. [KADIYALI ET AL., 1981] studied free speed behavior of vehicles on a four-lane divided highway. The speed distributions of vehicles were observed to follow the normal distribution with co-efficient of variation for car, buses and two wheelers being 0.11, 0.13, and 0.16 respectively. [KATTI & RAGHAVACHARI, 1986] developed speed models based on traffic data collected on sub-urban sections of three cities in India. The average speed of fast vehicles varied from 37.8 kmph to 51.5 kmph and for slow vehicles the variation was observed from 10.75 km/h to 15.83 kmph. Speed dispersion was high for fast vehicles and low for bicycles. Passenger loading and purpose of trips were considered responsible of higher order of coefficient of variation of 0.19 and 0.29 for auto and cycle- rickshaw respectively and a minimum value of 0.084 for bicycles. Speed data for fast moving vehicles followed normal distribution whereas log-normal distribution model defined the speed data for bicycles. [AL-GHAMDI, 1998] analyzed spot speed data on urban roads in Riyadh and found that obtaining the 85th percentile speed from regression modeling gives much better estimates than those from the normal approximation model. Nearly 42 percent of traffic accidents on urban roads in Riyadh, the capital of Saudi Arabia, were attributed to speeding. Compared to U.S. data, this developing country has 4.5 times more accidents due to speed.

IV. TRAFFIC FORECASTING

The costs associated with an under designed project arise when an additional project must satisfy the original inadequacies. Extra materials, labor and additional right-of-way attainment add to the cost of an over designed project [IRC: SP-30, 1984]. Usually, an estimation of traffic for 15 or 20 years after the construction date is considered. In India, National Highways are designed for 15 years after completion of the work.

[DHINGRA ET AL., 1993]. It is an essential input to start the planning and/or development phase of any major transportation project initiatives. It is the first step in defining the scope and geometry of such projects. In case of highways, the geometric and structural designs are based on forecast traffic volumes and the ESAL (Equivalent Single Axle Load) forecast. It is also used to assess the Level of Service (LOS) for the present and future traffic conditions.

Forecasting can also be used for other purposes such as corridor planning, systems planning, air quality analysis, safety analysis and other such special projects. Inaccuracies in traffic volume forecasts are responsible for the additional costs associated with over and under design [SKAMRIS and FLYVBJERG, 1997]. Traffic forecasting is a process predicting a dynamic variable. That is why a number of approaches may be adopted for traffic forecasting depending upon the situation at hand. Although there can be various methods for traffic volume forecasting, for this analysis the three most relevant methods were chosen for a comparative analysis due to data availability constraints.

V. PARKING, PATTERNS & ANALYSIS

The demand by automobile users of parking spaces is one of the main difficulties of transportation systems. Obtainability of proper parking facility is the major factor for planning a good traffic system in the city. [WILLSON & SHOUP, 1990] The old paradigm assumes that parking should be abundant and free at most destinations. It strives to maximize supply and minimize price. [BRADLEY, 1997] Conventional parking standards are based on parking demand surveys but the analysis does not usually take into account geographic, demographic and economic factors that can affect parking demand such as whether a site is urban or suburban, and whether parking is free or priced. [EDWARDS, 2002] Management solutions tend to reduce most parking problems, providing a greater range of benefits and so are supported by more comprehensive planning. [CUDDY, 2007] The new parking paradigm on the other hand strives to provide optimal parking supply and price. [LITMAN, 2007] has also recommended an integrated parking plan which should be adjusted to reflect the needs of a particular situation. [CUDDY, 2007; VTPI, 2008] Better ways are now available to determine how much parking to supply at a particular site. [LITMAN, 2009] In order to provide optimal parking supply, it is the practice in conventional planning to determine how much parking to be provided at a particular site by planners based on recommended minimum parking standards published by various professional organizations. [SITESH KUMAR SINGH, 2014], this research explains about the parking analysis, development and study of patterns.

VI. TRAFFIC CONGESTION

[VUCHIC V R & KIKUCHI S, 1994] The concept of levels of service (LOS) is well established in highway capacity analysis procedures. In such a criterion, congestion occurs by judging V/C (volume over capacity ratio) when it exceeds a certain threshold. [LOMAX ET AL., 1997] Traffic congestion is travel time or delay in excess of that normally incurred under light or free-flow travel conditions. Congestion is an imbalance between traffic flow and capacity that causes increased travel time, cost and modification of behavior. [PUCHER ET AL., 2005] Summarize key trends in India's transport system and travel behaviour, analyze the extent and causes of the most India's urban transport crisis, severe problems, and recommend nine policy improvements that would help mitigate the problems. [DEWAN & AHMAD, 2007] Conducted a survey for car-pooling in Delhi and willingness of commuters for carpooling and they observed that car-pooling is one of the solutions to reduce the traffic congestion in Delhi. [GHATE AND SUNDAR, 2013] The average journey speed in Indian cities is also low, particularly in cities which have high car volumes causes to traffic congestions. [SEN ET AL., 2009] discussed the characteristics of the ITS techniques that need to be developed to cater the traffic conditions and congestion in developing regions and presented a brief description of a few efforts being made in this direction.

VII. TRAFFIC ACCIDENT & ANALYSIS

[HOLLNAGEL and GOTEMAN, 2004]. A key driver for the continued rise in analysis model and method numbers is the ever-increasing complexity of socio-technical systems (which are comprised of interacting human, technological and environmental components) and the resulting change in accident causation mechanisms. Understanding why accidents occur and how to prevent their recurrence is an essential part of improving safety in any industry. Gaining this knowledge requires determining why a certain combination of events, conditions and actions lead to a specific outcome, i.e. accident analysis [HOLLNAGEL ET AL., 2008]. Road traffic injuries are expected to become the third leading cause of global burden of diseases, escalating from ninth position in 1990 [WHO, 2008]. In order to conquer this problem, intelligent efforts for improving road safety need to be intensified. The importance and urgency of this issue is also articulated with a global initiative of the Decade of Action for Road Safety 2011-2020 [<http://www.roadafetyfund.org/Documents>].

A number of authors have developed Accident Prediction Models (APM) to facilitate such safety impact assessment for future. These models operate in a similar manner to demand forecasting models – each are different but often contain common variables. [EENINK, R and REURINGS, M, 2007] examined APM in the context of traffic volume, and segment lengths as well as turn pocket allocation. [SCHUELLER, H, 2011] examined 20,000 accidents to determine a speed behavior model that included speed ranges (free flow, mean and 85th percentile), components of land uses, intersection number and road sections, median demarcation, public transport and on street parking issues.

[SANJAY MITRA, 2016] India is a signatory to Brasilia Declaration and is committed to reduce the number of road accidents and fatalities by 50 per cent by 2020. However, with one of the highest motorization growth rate

in the world accompanied by rapid expansion in road network and urbanization over the years, our country is faced with serious impacts on road safety levels. The total number of road accidents increased by 2.5 per cent from 4,89,400 in 2014 to 5,01,423 in 2015. The total number of persons killed in road accidents increased by 4.6 per cent from 1,39,671 in 2014 to 1,46,133 in 2015. Road accident injuries have also increased by 1.4 per cent from 4,93,474 in 2014 to 5,00,279 in 2015. The severity of road accidents, measured in terms of number of persons killed per 100 accidents has increased from 28.5 in 2014 to 29.1 in 2015.

VIII.TRANSPORTATION MODELLING

The landmark study of [MITCHELL and RAPKIN, 1954] not only established the link of travel and activities (or land use) but called for a comprehensive framework and inquiries into travel behavior. The FSM model have particular application of transportation systems analysis (TSA), a framework due to [MANHEIM, 1979] and [FLORIAN ET AL., 1988], which positions the model well to view its strengths and weaknesses.

The application of this modeling approach is near universal, as in large measure are its criticisms. These inadequacies are well documented. [McNally and RECKER, 1986]. [MICHAEL G. McNALLY, “Handbook of Transport Modeling”, 2007], describes the four-step model for traffic modelling, travel forecasting and planning as the history of demand modeling for person travel has been dominated by the modeling approach that has come to be referred to as the four-step model (FSM).

IX.TRAFFIC INTEGRATION

The next stage in the traffic planning for integration of traffic is the assignment of various trips between any two O-D pairs on different road networks. Integration of Paratransit and Fixed-Route Transit Service, TCRP Syntheses 768 [RICHARD WEINER, 2008]. This report examines the level of success experienced by several of the nation’s public transit systems with the integration of their fixed route and paratransit services in expanding the services provided and improving the efficiencies of their systems, including efficiencies in the delivery of ADA services. [IBRAHIM 2003] Routes are required to be connected from a network perspective to allow transit users to access a wider range of destinations. [CLEVER 1997; MAXWELL 1999] The aim of integrated timed-transfers is to interconnect the multimodal PT network such that the transfer times are minimized. [HIDALGO, 2009] A common global approach in the development of an integrated multimodal transport system has been fare and ticketing system integration.

X.TRAFFIC SIMULATION

Arena is a powerful interactive visual modeling and simulation tool and is principally employed for creating animated and dynamic models [D. A. TAKUS & D. M. PROFOZICH, 1997]. Arena 10 software used [D. SADOWSKI, V BAPAT, & G DRAKE, 1998] for modeling and simulation of the case study. By creating a computer model and moving it through time, simulation is generally delineated as the dynamic and powerful representation of the process of the actual world performed [S. T. JENG, 2003]. Simulation is recognized as the second mainly used technical instrument in the field of operations management [J. K. LEE, Y. H. LIM, & S. D.

CHI, 2004]. Traffic simulation has developed into a productive instrument to encounter the essential needs of transportation modeling and examination. Simulation has the capability in modeling the complex nature of an actual transportation system [CICORTAS & N. SOMOSI, 2005]. Traffic simulation has proven to be a useful and cost-effective approach for providing real time traffic information in support of incident discovery and incident analysis [E. LOPEZ-NERI, A. RAMIREZ-TREVINO, & E. LOPEZ-MELLADO, 2008].

[KOTUSEVSKI G. & HAWICK K. A., 2009] It depicts that good traffic management is necessary for economic and social developments and computer simulation provide environments to test scientific models in order to prove or disprove their feasibility and correctness. [KRAJZEWICZ D, ERDMANN J., BEHRISCH M., & BIEKER L. 2012] In this study Simulation of Urban Mobility (SUMO) traffic simulation tool is used. Efficient traffic management is needed in the present Indian scenario. Computer simulation on traffic management can provide a scenario of traffic and give idea to manage the traffic efficiently. SUMO traffic simulator is used to model the traffic of an urban city and analysis the performance.

XI.CONCLUSION

Traffic planning focuses upon the public provision and financing of transportation assets, particularly roads and public transit systems. There are different methods adopted in the traffic survey and traffic volume counts. The Four-Step Model provides an effective way for analyzing the traffic and helps in traffic planning process. Traffic forecasting have been considering an important measure to predict the future development in road used and hence taken an important factor for traffic planning. Parking analysis provides the optimization of parking problems because, parking is the major issue for traffic congestion. Traffic accident analysis provides the information about the effect of accident on road user and traffic conditions. Traffic accident should be considering at prior level because safety is the prime factor consider for traffic planning. The integration of traffic system for urban transport planning must be considered with proper simulation of the transport & traffic system to make it convenient & feasible.

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