'Diversity' is the Road to Transport Sustainability

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The first car in India was run on the roads of Kolkata in 1897. The trend was later followed by Mumbai and Chennai but the usage of car was majorly confined to the elite in those days. It was in 90s that the inertia of car usage in middle-class was broken by the advent of economy cars like Maruti-800. The trend has now caught up with the entire nation and a large number of private cars plying in metropolitan cities are choking its roads. As a result, the transport sector in India is facing a plethora of issues that range from congestion, traffic, accidents, and delays to degraded air quality in major urban cities like Delhi. It is not an uncanny coincidence that out of top 20 global cities with worst urban air quality declared by WHO, 14 are from India. Apart from pollution, the estimated economic loss due to delay and congestion on roads cost around 9,000 million USD to Delhi alone.

Thus solving the transport problems while steering it into the direction of sustainability, seems to be the only way out of this fragile situation. Transport demand modelling is the procedure where the 'supply' and 'demand' of the transport is assessed and forecasted for future. It prepares the authorities and paves the way for proper management of the impending out-of-hand traffic situation.

In my study, I am working towards a holistic solution for the transport problems. I believe that the respite lies in developing an integrated method of travel demand modelling that incorporates the elements of 'diversity' in land-use pattern, multimodal system and integrated travel choice making procedure for various forms and stages of travel demand modelling.

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Including land-use diversity in transport planning process

Land use refers to the various uses a patch of land is put to. Generally, a land can be subjected to residential, industrial, commercial, recreational uses, etc. To understand the impact of land use on the transportation planning and modelling process, its effect was studied on how the perception of value of travel time by a traveller changes. *Value of Travel Time* (VoT) refers to the cost of (travel) time spent on transport.

For a better understanding, we can assume that Kamta is travelling to work and it takes him 25 minutes to reach his office by his car. The time spent in travelling to work by Kamta could have been spent in some other activity like finishing off his work or shopping for some house groceries. The cost Kamta is willing to pay to devote every minute of time spent in travelling to some other activity is the value of travel time he associates with that travel. In short, VoT is the cost Kamta is willing to pay to reduce his travel time.

VoT is crucial as it forms the basis of performance evaluation of different policies and scenarios in transportation planning like congestion pricing, fixing fares of bus/metro tickets, etc. It does take into account various factors like distance travelled, travel time, travel cost, age, gender and income of the traveller, transport mode used, etc. The land-use parameters and demographic parameters like population density and employment density are also included in the model. To account for the land-use diversity of the area under consideration, an index is calculated that gives a higher index value if the adjoining land parcels have different land-use patterns. For example, if a residential land parcel is surrounded by land parcel of commercial and recreational nature, then the diversity of the area increases and has a higher index. But, if the same residential land parcel is surrounded by other residential areas then the diversity of the whole area remains very low, hence a lower index.

Models were developed for each zone to account for the effects of land-use pattern and diversity on value of time. The estimated value of travel-time so estimated from the study depicts fluctuating values for different travel modes in different zones with varying land-use patterns. The study showed that larger tracts of land dedicated to residential land use leads to lowering value of estimated VoT. This effect is more pronounced in regions with higher population densities.

Including Diverse Travel Modes (Multi-modal) in transport planning process

The transport system constitutes of various modes of transportation including private cars and two-wheelers, public buses, metro, auto-rickshaws, bicycles and the pedestrians referred to as multimodal transport. The interaction of diverse transport modes give rise to complex travel patterns which is not easy to comprehend. Since transport planners have to deal with such complicated travel patterns while modelling of transport system, the factors that dictate the state of multimodal transport at individual commuter level must be studied.

A multimodal transport system apart from being sustainable also enables better mobility of the commuters by providing enhanced access to other services and opportunities. It enables efficient usage of public transit systems along with the usage of bicycle and walking as a means to

reach the bus stops or metro stations. Delhi has a multimodal transport system comprising of bus and metro services but the trips made by personalized modes of transport outweigh them both. The Delhi Metro System and bus services are undergoing extensive expansion. Such huge investments lose justification if they remain underused.

To understand and delve into the determinants deterring commuters to make use of multimodal transit services, it is pertinent to evolve and come up with an integrated urban transport system. The developed model suggested that the inclination of commuters towards multimodal transport is affected more by the travel time devoted to reaching to a public transit facility from home at start of the journey and reaching the destination from the public transit at end of the journey.

Say for example, if it takes a longer time for Kamta to reach the nearest bus/metro station from the starting-point of his journey (home) or the ending-point (office), he will be unwilling to use public transit and eventually would shift to using his personal car or two-wheeler that would provide him quick point-to-point solution. The model further suggests that under highly congested traffic conditions, when the travel time varies a lot due to jams, the commuters are hesitant to use their private cars. They instead shift towards multimodal system of bus or metro where travellers use their travel time in activities like reading, relaxing and socializing.

Towards Sustainable Transport

The results from the study indicate that an entirely new approach is required when we are planning our transport system for new cities or when we are introducing a new transit service in an existing system. The idea is to make the entire travel experience as seamless and as stress-free as possible. The planners should consider the short-term and long-term choices of travellers along with the changing land-use pattern of an area for an integrated travel experience. The travel demand modelling done by planners must have inclusion of feedback mechanism that establishes a synergy between the supply and demand. Integrating land use with transport planning is one of the requisites of 'smart growth' and 'sustainable development'. Integrating economic analysis in transportation planning will fetch economic benefits and cost effectiveness of transportation investment. Thus, integrating community interaction with transportation planning conforms to total well-being of the society.