

Design and Evaluation of Composite Transportation Networks in a Multimodal System for Travel Demand Management in Urban Areas

Broad Area

Planning and Policy

Need for the Study in the Context of Future of Cities

In the past decade, India has experienced enormous urbanization and subsequent growth in motorized vehicle usage. With the development in economy, there has been a tremendous growth in the purchase and use of private vehicles, such as cars in large (e.g., Kolkata, Mumbai) and medium sized (e.g., Bhubaneswar, Ranchi) cities and two-wheelers in the small cities and towns (e.g. Kharagpur, Midnapore). Three-wheeler modes, such as auto-rickshaws and tempos, should ideally act as feeder modes to the major public transport services such as bus or rail. However, there has been a large scale use of tempos along inadequate and narrow roads in small cities and towns while, in the large cities, auto-rickshaws operate on the same route along with other common carrier passenger transportation modes such as buses. Hence, urban India display a clear picture of lack of transportation network planning resulting in increasing demand-supply imbalance leading to aggravated pollution, congestion and safety issues.

Realizing the magnitude of various transport related problems, the Central and State Governments have taken up several major initiatives such as National Urban Transport Policy 2006 and Jawaharlal Nehru National Urban Renewal Mission to achieve sustainability in urban transport. In all these initiatives, major emphasis has been made on improving the quality and quantity of urban public transport service. However, the success of public transportation does not only depend on the quality of public transport service alone. As public transport does not provide door-to-door travel, hence, in order to ensure a self-sustainable transportation infrastructure in urban India, one of the most important requirements is to introduce a comprehensive planning of a well networked public transportation system, giving due consideration to access and egress to public transport services and integration with other modes in a multi-modal urban transportation environment. This can be achieved by improving the aggregated generalized cost of travel in an integrated

Design and Evaluation of Composite Transportation Networks in a Multimodal System for Travel Demand Management in Urban Areas

public transportation environment comprising of all other types of mode including feeder modes such as autos and tempos and non-motorized modes such as walk and bicycle. In order to improve the overall network performance, it is also necessary to reduce the number of competing modes for a particular route by restricting the domain of operation of different transport modes in urban India. This is extremely relevant in urban India as there are significant numbers of modes of transport and the feeder mode has a vital role to play for the success of the mainstream public transport mode.

Objectives:

The broad objectives are:

- To design and develop an optimal composite network consisting of primary public transport service and other feeder modes including non-motorized transport (walk and bi-cycle) for the purpose of introducing a convenient and sustainable door-to-door travel concept of urban commuters
- To evaluate the impacts of the proposed optimal network on commuters

In order to achieve the aforementioned objectives, the scope of the present study is to address measures for designing an effective and efficient composite network for a convenient door-to-door travel of urban commuters. The study will encapsulate public transportation (or Para-public transportation) mode(s) as the primary transportation service(s) for major legs of the journey. During the design of door-to-door composite network, the study will consider integration of feeder mode services including non-motorized modes with the main network of public transportation service. While designing of the composite network, the main objective will be to minimize the generalized cost of travel of commuters for all legs of their door-to-door trips. Initially, the generation of various composite networks, which are likely to satisfy the current travel demand with the minimum possible transfer time, maximum usage of major public transportation service and also on shortest possible journey time, will be evaluated for the existing road network. This type of problem can be called as identification of public transport service routing problem in composite network environment. In this environment, a transfer from one route to another is possible, only if the routes have a common node in the network. Once the network is identified, the efficiency and success of the transportation service largely

Design and Evaluation of Composite Transportation Networks in a Multimodal System for Travel Demand Management in Urban Areas

depends on the optimal fleet size distribution of public transportation and feeder services and their schedules. An efficient utilization of the fleets on various routes of the network depends on proper scheduling. The work will undertake an effort to develop simultaneous or sequential model for fleet size distribution and schedules of public transport and feeder services. In this regard, due consideration will be given to the minimization of waiting time of a passenger at stop of public transportation service, the transfer time from one route to another and the access or egress time, for defining Level of Service (LOS). A complex form of mathematical model both during network generation and fleet distribution-scheduling will be developed, which might be difficult to solve by traditional method. The established literature shows that in many cases of transit routing and scheduling problem, researchers finally resorted to heuristic procedures. In the present study, the application of Genetic Algorithm shall be undertaken to obtain near-optimal solution for such type of complex mathematical formulation. The work will separately study the travel demand management for peak and off-peak hours on a typical week day, when schools are in session. An impact assessment of the proposed measures will be carried out.

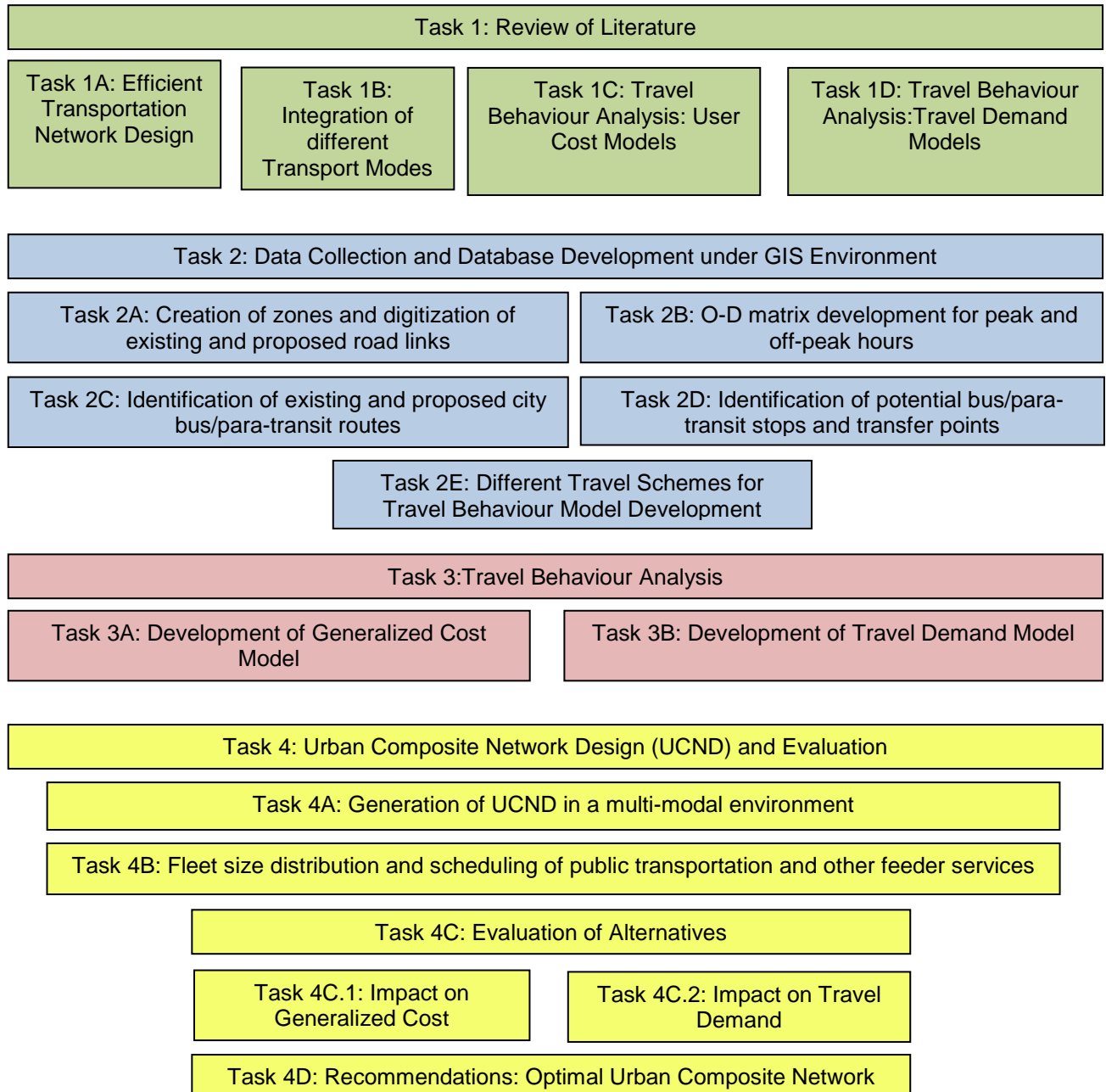
The work will be demonstrated with reference to two case studies.

- a) A town, where major emphasis will primarily be laid on para- public transportation services such as auto-rickshaws, tempos instead of town-buses: say, Kharagpur or Midnapore town in West Bengal.
- b) A city, where bus service, as a part of primary public transportation service, has recently been introduced. The city does not have a good-networked public transportation service and over a period of time, autos and personalized vehicles were the major transportation modes: say, the Bhubaneswar City in Orissa.

Design and Evaluation of Composite Transportation Networks in a Multimodal System for Travel Demand Management in Urban Areas

Methodology:

Tentative steps of the methodology of the proposed work are given below.



Outcomes/Deliverables

- Optimal Composite Transportation network and Policy measures for travel demand management
 - a) Generation of network
 - b) Fleet size distribution and their scheduling

Design and Evaluation of Composite Transportation Networks in a Multimodal System for Travel Demand Management in Urban Areas

- Effect of Optimal Composite Network and Policy Measures on (i) Benefits to trip makers, and (ii) Public transport ridership
- Warrants for operation of different passenger transport modes
- Guidelines for operation of the proposed transportation services

Team Composition

Principal Investigator	
Dr. Bhargab Maitra	Professor, Dept. of Civil Engineering
Co Investigators	
Dr. K. V. Krishna Rao	Professor & Head, Dept. of Civil Engineering, IIT Bombay (Proposed)
Dr. Debasis Basu	Assistant Professor, School of Infrastructure, IIT Bhubaneswar
Dr. Abhijit Mukherjee	Professor, Curtin University, Australia