Chapter 2

TRANSPORT OPERATIONS AND TRAVEL DEMAND

2.1 INTRODUCTION

Transport service considered a partial public good in economic sense entails both private and social costs in its operations. While the private cost can easily be reimbursed from the users, the costs borne by the society, termed, as externalities are difficult to be accounted and estimated for.

2.2 THE EFFECT OF EXTERNALITIES

These externalities have both a positive and a negative impact on the society. By ensuring enhanced linkages among various areas resulting in their development and thus increasing the land-value, transport exerts positive impact on the society. Again, transport usage entails social costs brought about by the environmental pollutions of the atmosphere besides accidents and congestion—all of which are clubbed together as negative externalities.

Thus without a knowledge of transport service cost, the efficacy of maintaining such service to its optimum suffers. Hence, it is essential to have a more-or-less precise knowledge of such costs or in other words externalities of transport. Such externalities are usually positive and negative in nature. The positive externalities are considered helpful in achieving an optimized societal welfare and the negative externalities causes a drift from the efficiency objectives. It is therefore necessary to utilize the positive externalities to the maximum advantage and to limit the effect of the negative ones within a permissible level so as to achieve such optimal welfare. Herein the Govt. steps in by taking steps to fulfill the aforesaid objective, specified by the common dictum—the transport plan

2.3 THE EFFECT OF NATURAL MONOPOLY IN TRANSPORT OPERATION

Before initiating discussion on the transport plan, a critical analysis of the basic aspect of transport operation that itself acts, as an impediment in achieving optimum welfare is indispensable. Transport operations leads to a situation of natural monopoly. It arises from the logistics of operations involving production and distribution and are of the following types
a) extensive economies of scale  
b) sunk capital cost  
c) lack of co-ordination among agents  
d) affordability of the consumers  
e) lack of information  
f) non-storable services

An elucidation of the types and the influence they exert on the transport operation helps in grasping the problem.

**Economies of scale** arise of high capital intensity along with a high fixed cost to variable cost ratio in the short run. Accordingly, the average cost declines over the relevant range of output. Thus, an edge in supplying the requisite demand at a price, far less than that charged by new entrants intending for a share in the market, is ensured. Transport facilities that are highly capital-intensive in nature e.g. rail-beds, railway station, runways, harbours and ports, etc. are all subjected to economies of scale of rather steep degrees. Road infrastructure however does not have a high degree of scale economy.

**Sunk costs** are capital costs that are immobile in nature. Hence, they cannot be withdrawn after investment. All fixed infrastructural facilities utilized in transportation e.g. roads, rail-beds, harbours, ports, runways, etc. are developed with capital that are sunk in nature. Thus they act as deterrent in the entry of other market players leading to a monopoly situation.

**Proper co-ordination** between the stages of operation of the various agents involves proper planning of activities. Such planning ensures natural supportiveness of the agents besides ensuring complementarities in supply. All road transport networks especially in urban areas survive operationally with proper co-ordination, the lack of which brings in a situation of monopoly by the dominant players.

Affordability of the consumer in selecting substitute may also be a source of monopoly. A choice between a luxury and an ordinary mode of travel is irrelevant to a traveler who can afford to spend an ordinary mode alone.

**Lack of information** on products or services leads to dominance of the sellers or providers of services leading to a situation of competitiveness. In the perspective of transport services, such a problem can be found in road transport operations where
unreliable knowledge about the characteristic of the various modes e.g. quality of services may lead to alteration of choice by the consumers.

Finally the non-storable feature of a product or service that exhibit temporal pattern of demand leads to their non-optimal usage. The peak hour demand for public transport if meted out with supply that corresponds to average demand leads inevitably to under-utilization of capacity. In such a situation, a profit maximizing private entrepreneur may ignore the peak demand and invest in creating capacity to the extent to meet base-load-demand for ensuring high capacity utilization and a high rate of return.

The above causes of natural monopoly inherent in transport operations have an add-on effect on the negative externalities discussed earlier and a further drift from the optimal state.

Hence, proper intervention through development of transport plans, that take account of both externalities as well as natural monopoly, so as to limit their influences within reasonable limit, helps in achieving the objective of maximizing economic efficiency

2.4 ADVENT OF URBAN TRANSPORT PLANNING

The Romans were the first to introduce the planning of transportation facilities on recognizing the importance of well-planned roads in charting out the courses of battles. However, after the prominence of the Romans faded out, a period of stagnancy ushered in transport planning. The industrial revolution in Britain led to the establishment of urban areas and the emergence of multifarious urban activities both within and outside the domain of these urban areas. Thus, interest in urban planning was given a serious thought and with it planning of transport. However, in keeping with the need of times, planning of transport was viewed as isolated set objectives like the planning of highways, railroads or mass transportation facilities without aligning them to have a macro-plan of the urban area. The manifold increase in activities (both human and economic) in the post World War II period had its manifestations in expanding urban areas along with a substantial rise in automobile ownership. To cope with such new and involved transportation problems the earlier individualistic approach had to be shredded out to make way for a more comprehensive plan that takes care of all activities through maximum utilization of all existing and potential facilities.
2.5 OBJECTIVES OF A TRANSPORT PLAN

To direct actions in conformity with the perceived objectives, the need to secure transportation system that eases travel frictions within constraint of safety, economy and desirable development of land-use becomes indispensable. In a nutshell, the goals of such a plan need to be viewed in a broader realm of ‘community welfare’. Such goals are directed toward promoting general welfare by increasing productivity through efficient specialization of activities brought about by increasing speed of physical connectivity and at the same time keeping the impeding forces within limits. To achieve such objectives it requires the following:

(a) enhanced speed
(b) proper safety
(c) lower operating cost
(d) economizing infrastructure construction
(e) minimizing disruption
(f) better land development

To set the stage for adopting relevant planning procedure, a detailed analysis of the above points is necessary.

Enhanced Speed: Apart from enjoying a trip only for its own sake, in no other occasion does time play an insignificant role. From a social point of view, speed induces economic gain—a traveller by arriving at his destination ahead of schedule contributes more towards personal as well as social benefits. Again a faster freight delivery ensures speedy inventory build-up thus providing benefits to the subjects concerned. In urban areas, demand for a faster means of transport is evident in the willingness of the traveller to pay more, ignoring inexpensive slow travel modes.

Proper Safety: To ensure proper safety it needs to reduce the social costs especially accidents, the costliest adjunct of travel. The trauma of injury and death of the near and dear ones apart from the monetary loss sustained in an accident makes its assessment an imperceptible one by any logic. Hence, minimizing accidents must be a most sort after objective from both individual and social point of view.

Lower Operating Costs: The set of private costs incurred in enabling a person to change his/her place of location is usually ascribed as ‘operational / operating cost’. Such costs range from fuel charges to transport workers’ salary. From an individual as well as societal perspective, the rationale of minimized operating cost is found to be true. The public dissent subsequent to fare rise for public transport bears testimony to the above
proposition. The design and quality of the facilities over which vehicle move contribute immensely towards such costs. Thus, elimination of sharp bends saves distance while reduction of multiple crossing saves time.

**Economizing in Infrastructural Construction:** The prohibitive capital requirement needed for the construction of new transport infrastructural facilities is derogatory towards the welfare of the people in developing countries, as they have to sacrifice basic necessities of life towards accommodating them.

**Minimizing Disruptions:** Construction of transportation facilities involves disruptions of a varied nature. Land acquisition for right-of-way causes relocation of houses and business-establishments resulting in financial losses apart from being annoying as well as time-consuming. In a wider perspective such disruption entails costs that defy solution.

By providing due weightage to the above constraint, a more flexible transport plan keeping with the objective of attaining overall economic efficiency can be framed. Transportation demand analysis provides the elementary as well as the primal framework in chalking out such a plan.

Transportation demand analysis is the process of relating the demand for transportation to the socio-economic activities that generate it. In it, the type, level, and location of human activities are related to the demand for movement of people and goods between the different points in space from where such activities are generated. By such a process, an understanding of the determinants of demand and of the manner by which they interact and thus affect the evolutions of traffic volumes comes to the fore. The framework to such a process is expressed through the help of models referred to as transport demand models.

### 2.6 THE IMBALANCE IN TRANSPORT DEMAND AND SUPPLY

As highlighted in the introductory chapter, the importance for the establishment of a stable relationship between the demand for, and the supply of traffic infrastructure and transport services through transport planning is indispensable for smooth traffic movement in urban
areas. In both the developed and the middle-income countries like ours, there have been a lop-sided relationship between demand and supply in the sense that transport demand have outstripped both investment outlay and institutional ability to deal with the complexity of the problems attached to the renewal and expansion of transport infrastructure. Such a contrast in traffic growth and infrastructure investment led to transport bottlenecks in cities of these countries.

Again, inadequate assessment procedures about the nature of such traffic growth or in other words, the transport demand shall lead to over-sizing or inappropriate design of investment, which implies unnecessary financial burdens on the project entities concerned. The above features bring into prominence, the necessity and the importance of the transport demand estimation. In urban areas, the greater weights of passenger transport demand, e.g. the travel demand over freight demand calls for appropriate estimation of the former. Since such travel demand estimation emanates from passenger traffic growth, it requires a complete knowledge of the modal availability and consequently their choice. This again varies from developed to middle-income countries and within them from city to city, i.e. from cities of different denominations or sizes. The following part is a concise effort to bring to light the above points in some details.

### 2.7 THE DIFFERENCE IN TRAVEL PATTERN BETWEEN DEVELOPED AND DEVELOPING COUNTRIES

A look at the travel pattern in developed and developing countries showed such pattern to differ in modal-mix, modal ownership and land-use pattern between them. In developing countries, diverse varieties of modes ranging from mechanized to non-mechanized ones ply within the urban conurbation. The streets of these cities have modal varieties ranging from the most modern mechanized vehicles to the most primitive vehicles like the hand pulled carts, bicycles, cycle rickshaws, IPTs, etc. The labour-surplus character of the developing countries greatly influences such diversity of the modes, since trips undertaken by different strata of citizens (rich, middle-class or poor) are fulfilled by these various economically consistent modes. The modal-mix of the developed countries does not have such diversity. In those countries, private cars dominate the roads and account for the major source of the negative externalities like congestion, pollutions and accidents. On the other hand, in developing countries, the mix of slow-moving non-mechanized and fast-moving mechanized modes results in chaos and gives rise to the above externalities.
Besides, difference in the residential location of the citizens between the two groups of countries, results in different trip-characteristics. In developing countries, majority of the commuters mostly middle-class in nature live in the periphery of the towns and hence have to commute to the Central Business District (CBD) regularly. In the developed countries, usually the owners of private transport live in the periphery. Thus, the modal choices of the citizens of these two groups of countries are subjected to wide variations. Lastly, the land-use patterns of the developing countries differ very much from that of the developed countries. The cities and towns of most developing countries are characterized by tortuous lanes and bye-lanes, which are only accessible, by modes like the IPTs. The Western countries which are economically developed have wide motorable roads favouring modern mechanized modes.

Within the developing countries, city-size to some extent, defines the diversity of the modes. While big cities with greater economic bases and with better road infrastructure planning supports greater mechanized modes and lesser non-mechanized ones, the smaller ones with somewhat low economic progress and haphazard land-use planning are better suited for Intermediate Public Transport (IPT). However, in developed countries, the modal-mix remains more-or-less the same for different cities with heavy dominance of private-car ownership.

However, diverse is the modal-mix in the cities of the developing countries as compared to the developed ones, the common problems like congestion, pollution and accidents do not differ in these cities. From the introductory chapter, it can somewhat be perceived that an imbalance between demand and supply of transport services is the epicenter for such problems. Such imbalance however are more pronounced in the developing countries where there are added pressure of high population growth along with the fluid condition of their economy, both of which stretches transport operation to its limit.

To get an edge over the crisis, two feasible solutions can be thought of. One, is to expand the supply to meet the rising demand and the other is to adjust demand to supply. However, in the former case, expanding the supply of modal service gets bounded by the capacity of the infrastructural capacity like road or railway lines as unbounded growth of modal service shall lead to increasing private and social costs. To extend the bounds of the infrastructures, it is necessary to arrange for capacity expansion which again involves
provisions for space to accommodate such expansion, the time required for the construction of capacity and finally the arrangement of huge capital which are in all likely to be sunk in nature. In the developing countries, space shortage and deficient capital are considered the main hurdles towards expansion of capacity. The developed countries view time-costs as the main impedance in such capacity expansion. Regarding the second solution, i.e., adjusting demand in proportion to the available supply of service over the existing infrastructure, the outcome is welfare minimizing from societal sense. Squeezing demand shall in turn affect productivity that gets reflected in diminishing prosperity. Hence, despite it being a feasible solution is more or less impractical.

Reviewing the above two solutions with their potential limitations, it seemed best to focus on traffic engineering and traffic management options, at least in the short run, to best utilize the existing infrastructure in response to rise in transport service. Thereafter, creation of capacity can be planned for, in the long run. A necessary requirement that the above solutions and options require for applications is the estimation of travel demand.

In the developed countries, with ready availability of transport, household and socio-economic data, various travel demand models in the inventory were applied to estimate in the best possible way the travel demand. The developing countries with a deficient database, lagged behind in this regard. While in the big cities, where data availability is easier, some of the models were applied. However, the medium and small cities used naïve methods in estimating travel demand. In these categories of cities demand for passenger transport services are estimated from the growth of passenger vehicle fleet and from their Origin-Destination (O-D) of trips.

2.8 THE INDIAN PERSPECTIVE

In India, urban travel demand estimation was approached in a handful of ways. One estimate was in the form of passenger-km.s and the other in terms of trips. The first approach does not engage any travel demand models but utilized O-D surveys in their analyses. Further, such estimates were confined to five (5) metropolitan cities as per the Report of the National Commission on Urbanization (1988). The other approach initially utilized per-capita trip rates and population growth rates for its estimation. Thereafter, zonal transport data and socio-economic data were gathered and applied to aggregate travel demand models (discussed in Chapter 3) in various Indian cities for the estimation
of total trips demanded for an area. These models only established aggregate travel demand in terms of trips without any emphasis on the modal choice of the trip-makers. However, the absence of modal choice estimates, a vital ingredient in estimating passenger traffic growth renders such estimates insensitive to policies.

It is thus necessary to mould the travel demand estimates in a way, so that modal choice of the trip-makers gets prominence. To do so, a behavioral estimate of travel demand, i.e., taking account of the consumers' choice among similar alternatives is deemed suitable.

As is well known, India is on a full-geared drive to economic reform process with her secondary and tertiary sectors consequently maturing to levels that allures migration of more and more "agricultural-dependent" people to the nearest towns/cities in the hope of a prosperous life. The bulk of the pressure of absorbing such "city inward migration" have to be borne by the cities which in overwhelming majority are of medium and small sizes. Concurrent to such increased population is their heightened activities, which gets effectuated through spatial interactions. The travel patterns hence are highly elastic to their needs. To evaluate them, giving due importance to such patterns is obviously a desirable one. Standing in favour of such aforementioned hypothesis, the small and medium cities can be the best experimenting ground for application of this type of estimation. But the innumerable number of cities of the aforementioned denominations makes such an estimation procedure a mammoth one and an unsuitable one for a dissertation like this. Again, this dissertation could be trend-setter in initiating such an approach in its totality especially by the planning organizations.

The precarious state of transport situation in West Bengal (Please see Sec.3.14), where, Rail India Technical and Economic Services Limited (RITES) estimated the travel demand of some cities by utilizing the Four (4) stage aggregate travel demand models, led to selecting two cities of her, one, medium—Howrah Municipal Area and the other, small sized—Haldia Municipal Area for validating the edge of behavioral models over the aggregate ones. The chapter to follow tries to delve deep into the model literature to prepare a base for applying a specific one in this dissertation.