Chapter II

REVIEW OF LITERATURE
2.1. Introduction

Transport is a fundamental pre-condition for the take-off of an economy. "The transport industries which undertake nothing more than the mere movement of persons and things from one place to another, have constituted one of the most important activities of men in every stage of advanced civilization." Since it constitutes an important item of infrastructure for economic growth, a great deal of effort has been made in the research and documentation on the subject. Following is a brief review on the research and literature on different aspects of transportation, both within and outside the country. A further clarification is attempted to discuss separately studies on different aspects like history and role, policy, planning, forecasting, investment, performance, safety etc.

2.2 Studies Abroad

2.2.1 History and Role

Since time immemorial, means of transport have been changing according to changed conditions and particular requirements. In the days of yore, human beings themselves transported their commodities from one place to the other. This had rather become a custom that the male used to carry his weapons and the female the load of a number of
commodities on her head. As Eaton (1925) says "perhaps it was woman who, on seeing a forked branch lying broken from a tree, figured that a heavy load could be put on the branch and dragged with less difficulty than when carried across human shoulders." In those old days roads did not exist, and people used to walk along tracks. As a result of progress in trade and commerce, pack animals began to be used which travelled in caravans. Even in that stage of economic development roads did not exist, but wide tracks were automatically made due to the movement of hundreds of animals together. Dogs, oxen, horses, camels etc. were used as beasts of burden, and even today in some parts of the world, their importance has not diminished.

Before industrial revolution - The transition from subsistence farming to commercial farming and the growth of the manufacturing activities in towns before the industrial revolution took place, widened the scope for the development of the means of transport. Wheeled traffic could be accommodated after the latter were technically much improved. Even in the 18th. century the condition of the English roads were very unsatisfactory. Mr Arthur Young wrote in 1760 about roads in Oxfordshire as being "in a condition formidable to the bones of all who travelled on wheels." It was very difficult for coaches to move smoothly on roads. The number of passengers who travelled by coach in 1763 between London
and Edinburg was estimated by Mr Landner at not more than 25 per month. Even when roads in England were much developed, the number did not exceed 140 per day in 1835.

*Industrial revolution and after* - When the industrial revolution took place on the European continent, workers had to travel daily to and from the factories, which increased local passenger movements by rail. At the same time the development of industry and trade required speedy movement of goods. Though at this stage the four forms of transport (road, rail, air and water) were developed yet the old forms of transport were still required by men to serve the purpose of transportation.

In the 20th. century the outstanding feature of transport is the development of mechanical transport which on account of its fast speed, has facilitated the movement of men and materials over long distances. The circle of movement widens with an improvement in speed. To quote the observation made by Mr Lardner (1850) in this connection - "It is evident that any improvement in transport which will double its speed, will double the radius of this circle, an improvement which will treble its speed, will increase the same radius in a three-fold proportion. Now, as the actual area or quantity of soil included within such a radius is augmented, not in the simple ratio of the radius itself, but in the proportion of its square, it follows that a double speed will give a
four-fold area of supply, a triple speed a nine-fold area of supply, and so on. How great the advantages, therefore, are which in this case attend increased speed, are abundantly apparent."

More than a century ago, due importance was not attached to transport because people generally believed that only manufacturing industries, banking and agriculture could develop national economies. As Mr Callender (1909) has observed, "Historians have generally failed to appreciate the importance of this factor in American development. Much more attention has been given to the growth of manufacture, to currency and banking system but none of these matters has exerted the title of the influence upon our economic growth that has come from improvements in transportation. In fact since 1815 one most conspicuous economic achievement have depended directly upon this factor."

Colin (1972) analysed the transport revolution by private operators in Britain. He noted that 200 years ago, the revolution took the form of development of a nation wide system of canals. A hundred years ago it was the creation of a national railway network. This time the revolution was not the emergence of motorized road transport as such but the facility it has brought with it, viz. the chance of every family to have or aspire for his own car and for every industrial and commercial firm to run its own fleet of
freight lorries. He also observed that private vans and lorries are used extensively in retail and other distribution work. As a result private operators account for 70 per cent of the total amount spent on freight transport in Britain which is roughly about seven cents of the total cost of sales.

Stokes (1968) commenting on the effects of the Tajeries Valencia highway in Venezuela notes that in the areas of Valencia and Maracan "the highway had the effect of shifting the role of the city from that of a processor of local production into national manufacturing centre dependent heavily on national markets of supply and demand." He further showed that in Equador, the upgrading of the Santo-Domingo Esmeralda road to a paved all-weather road, 174 km. highway would bring 17,000 hectares of "new land" under cultivation. Similar figures can be quoted in other areas in less developed countries, it is quite a usual phenomenon to have regions where land is not being productively used due to insufficient accessibility both for approaching it and carrying away the product.

Lunback (1976) in a study of three rural areas in Peninsular Malaysia mentions that after the opening of new roads in Megat Dewa areas, the influence of the traditional doctor had decreased sharply and clinic attendance increased. Improved accessibility increases the potential for
communicating information and ideas by enabling more direct contacts between rural population and regional on national centres.

According to Ogburn (1946), "Transport the de facto barometer of economic, social and commercial progress has transformed the entire world into one organized unit. It carries ideas and inventions to the people of different countries, and has considerably contributed to the evolution of civilization."

According to Prof. Lamer (1979) the construction of new transport infrastructure is of prime importance for the rapid development of an under-developed area. He showed that the construction of the Adriatec Highway in 1960, as well as the construction of other modern routes (in Opuzen) and the construction of railways has given these villages (Primosten and Hercegnovi) the opportunity for the development of agriculture so that by 1961 immigration to other regions has ceased and population started to rise.

Lowe (1959) gave a fascinating account of the transportation and communication system in Japan during the Tokugawa period (1600 - 1686) and pointed out how the main features of this system laid the basis for Japanese modern development in the field of transportation.
Inove (1969) discussed the role of transportation in quickening the tempo of rapid economic growth and urbanization in Japan.

According to Dr. G. Gannopoulos (1979), due to the construction of 130 km. highway from Korinth to Pateas in 1972, land uses in a 2 km. highway had changed from predominantly agricultural to approximately 10 per cent light manufacturing and another 10 per cent various other land uses (primarily hotels) within the first three years of the opening of the highway. He also observed that the opening of new transportation lines increased the export potential of the region and made production more market oriented rather than subsistence oriented. In certain regions of Greece, for example, he observed that where the agricultural products were the main output of the region, the general provision of an adequate road network serving these areas meant an increase in the tonnage of exported agricultural products which primarily were left in the field due to the inability to carry them in time and with the right cost of their potential market at home and abroad.

Hajerstand and Henntorp (1976) showed that increased mobility in public transport has two effects. Firstly, given the same extent and spatial distribution of activities as before, travel time is reduced so that more activities may be accommodated in the time budget. Secondly, because of the
lower expenditure of time per unit of distance, the distance to possible places of activity is increased, so that spatial dispersion of activity becomes greater.

2.2.2 Policy

Though transport policy is a very vast subject, very little attempt has been paid to study its relevant aspects. Payne (1975) observed that the European transportation system was evolved on the concept of free competition analysing the major implication of the Treaty in Rome on Transportation.

The broad policy issues governing the role and functioning of the World Bank in building up infrastructure for transportation in developing countries were examined by Ratter (1973). He observed that one-third of the World Bank lending since its inception in 1946 has been on the transport sector.

Quin's study (1974) brought to light the hazards of community legislation in U.K. passenger transport industry. The rationale for statutory regulations on the transport of potentially dangerous commodities was examined by Bealbey (1974).

Smith (1975) provided rich insights into the problems faced by local government in administering public transport and provided modus operandi for a rechange in policy and administrative set up.
Ribat (1975) examined the interaction between government and private sector in planning and developing a multi-model transportation model.

Joy (1974) suggested an ideal framework of objectives to evolve a proper policy for promoting a healthy transportation network.

The study conducted by the organisation of Economic Cooperation and Development (1971) reveals that Paris exhorted the need for governmental legislation granting protection against urban traffic noise.

Adverting to common transport policy Featherstone (1974) called for comprehensive harmonization of the influence of state on transport operation through appropriate legal and other regulations.

The guidelines consisting urban expansion needs on transportation requirements were considered by Poole (1974). His study confined to Stockholm dealt with different aspects of regional planning.

Rudgers (1977) stressed that since transport is for the people it should cater for changes of the people's need. He says there should be more financial support for buses and less for road construction.

In 1976 and 1977, there was a significant development in transport policy in the U.K. with the publication in April 1976 of a Consultation Document (Department of Environment,
1976) which sets out current governmental thinking on transport policy as the basis for discussion and comments. After receiving comments the government published a policy statement in the form of a White Paper in July 1977. This approach based on consultation was a new departure for transport policy making although it has been in other spheres (e.g. speed limits) in the U.K., but White Papers on transport policy have been a regular feature of the post-war period.

In this context, the Consultation Document is also notable in several respects, for its contents, summarized by Lee (1977). It suggests that subsidies be reduced although not eliminated and that the remaining subsidies be directed towards services providing a basic need (e.g. in a rural area) or towards income redistribution objectives, which the Consultation Document claims, would entail eliminating certain rail subsidies (e.g. those to long distance commuters in London).

2.2.3 Energy

Ongut (1979) studied the transportation system of Turkey and pointed out that 70 per cent of goods transport and 90 per cent of passengers are carried out through the road transportation which uses very expensive imported energy. The critical energy situation seriously influenced not only transportation system but also transportation
volumes. Since the possibility of transferring people or goods from one system to another was fairly limited, the energy problem creates other problems such as reduced demand in transportation. Such falls in demand affect the distribution of products which in turn brings major changes and variations in prices. He suggested that the growing transportation requirement in Turkey should be met not only through road transportation but through new railways and increase in maritime services.

An OECD study sponsored by Leach (1973) indicated that in view of the minimum estimates of ultimate conventional oil reserves, the growth in gasoline demand was liable to cause serious tension on the oil market owing to the inevitable imbalances in consumption. Studies conducted by the Hudson Institute of Technology showed that the rapid rise in energy consumption and particularly the demand for fuels are liable to give rise to serious problems.

Bayliss (1975) says of the petroleum products consumed in the transport sector about 70 per cent is used for passenger movement and 30 per cent for freight movement and over four-fifth of the total consumption in the transport sector is accounted for by road transport.

The Netherlands Road Transport (1977) carried out an overall study at the request of the Commission of the
European Communities, to work out the energy consumption for each means of transport, both for passenger and for goods.

The Commission of the European Communities (1974) suggested to limit oil consumption where it can economically be replaced by other energy sources.

In a highly aggregative study by Malliaris and Strombotne (1973) energy efficiency calculations for individual modes were made by dividing the total national passenger miles of each mode by the fuel consumed by each mode, and similarly for ton miles. On the basis of these calculations, it was suggested that the movement of 50 percent inter-city road freight to rail would lead to a 3.4 percent fuel consumption.

In a purely theoretical study, Baumgartner (1973) showed that "cars consume between two to five times more petrol than the fuel required by a first and second class express train, and the energy consumption of rail is generally two to four times less than that of lorries carrying the same volume of transport."

According to a survey conducted by Battelle (1974), "the consumption of energy per passenger mile (of the bus) is often lower than or the same order as that of the train and is three to four times lower than that of the private car. A heavy goods train is also remarkably efficient. It seems hardly disputable that on average the train uses four times
less energy that the lorry per ton transported.

According to Foley (1973), rail transport is about four times as efficient in energy terms compared to roads. On longer journeys there is a greater advantage to rail in terms of its fuel costs.

Studies by Edwards and Bayless (1971) have shown that there are substantial economies of scale associated with large goods vehicles - on average a 10 per cent rise in vehicle - only results in a 7 per cent increase in operating cost with fuel economies being one of the constituent savings. Although, therefore, there may be environmental grounds for preventing the growth in large freight vehicles, from the energy aspect this movement towards large vehicles should be encouraged.

Ribat (1975) suggested that a combination of pricing and fuel rationing is the best solution. There are two ways of implementing such a policy, either all motorists can be allowed to buy an equal amount of petrol at the regular price, i.e. they would be given petrol coupons for the amount and any additional petrol can be bought at much higher prices, or petrol coupons can be made legally transferable. Both systems would be aimed at achieving the identical saving, and under this constraint the second system is preferable to the first. If the consumer is allowed to sell all or part of his petrol to motor himself or sell his
coupons at more than regular prices of petrol and use the income to do something preferable to motoring.

A number of studies have been carried out in the United States in recent years on price elasticity of petrol varying from a single equation model to seven equation models. In spite of the diversity in the model specifications the results have been remarkably similar and without exception have shown demand for petrol to be inelastic in both the short and long-run.

The Rand Corporation (1974) five equation models used various dependent variables (car price, car ownership per household, vehicles travelled by households) and showed the price elasticity of demand for petrol was \(-0.37\).

Research carried out at Lockheed and General Motors of U.S.A. (1971) reveals that hydrogen can sometimes be used as an alternative form of energy, and its use in aircraft could have advantage of 22 per cent of energy utilization.

Rogers (1974) explains how urban transportation planning can be used to conserve energy.

2.2.4 Planning

The studies on metropolitan transportation received wide attention.

Jones (1974) explored the development and application criteria to evaluate metropolitan transportation planning. He also reviewed the past attempts on the subject.
Stuart (1969) analysed the problems in urban transportation planning with the aim of mathematical programming.

Hutchenson (1975-76) made an indepth study of the urban transport strategic planning with a systematic framework. He also evaluated the recent advancement in the subject and estimated travel demand created by a given land and traffic arrangement.

Lauchlen (1975) described the typical characteristics of city in regard to its transportation infrastructure.

Thomas traced that throughout history societies have devised ideal parameters for the cultural and physical organization of their urban places and advocated the need for the organization of land transportation system.

Parkinson (1971) studied the transportation structure in Cardiff in late sixties and evolved a Master Plan projecting upto 2001 AD and enumerated guidelines for public transportation policy.

William Bingle (1964) observed that in urban areas the resource allocation process for transportation was complicated by the rapid growth of cities and presented a case for balanced transportation planning in metropolitan areas.

A study conducted by the Ministry of Transport (1966) in London highlighted the need for planned improvement of
urban road system to ensure free flow of traffic at reasonable speed. The measures suggested by it include (i) prohibiting or restricting on primary district distributors, (ii) taking urgent action to provide off-street parking accommodation, and (iii) constructing secondary means of access to enable goods to load and unload at nearby points.

Marc's (1969) dissertation stressed on land-use planning from the transport view-point.

Another study by Derbyshire (1974) focuses on the application of transportation planning for rationalised pattern of land-use.

Samuel (1966) examined the problems in appraising the economic impact of a transportation improvement.

Fredric (1975) analysed that public transportation received better attention in several studies and researches on transportation planning.

McKinley (1975) developed five alternative state plans for the funding of public transportation in Colorado.

Lim's study (1974) presented a case for integrating urban freight transportation planning with economic and land-use planning.

According to Lamer (1979) in drafting general socio-political plans, regional planning is gradually becoming more and more important. The expansion of the capacities of the
transport infrastructure must be planned in connection with the needs of the transport system. Special attention must be paid on seeing whether improvements in traffic flow can only be obtained by the new infrastructure. This is particularly important as a new infrastructure is often very expensive and lower prices and higher quality can also be obtained under specific conditions by a whole range of other resources, e.g. by better use of the existing infrastructure, national transport policy etc.

2.2.5 Investment

Transport, constituting an important element of infrastructure, its influence on economic development does not require any exaggeration. Consequently, expenditure on transportation services are viewed as investment for augmenting economic growth. Alexander (1975) estimated that in U.K., the share of transport in GDP was 15 per cent and 11 per cent of the consumer expenditure were accounted for by transportation costs.

Charles (1967) examined the economic and social effects of investment in transportation. However, he conceded that cost-benefit analysis of social infrastructure projects like transportation facilities in underdeveloped areas is rather difficult. Consequently he asserted infrastructural investment are based more on faith than anything else.
Charles made another study in which he developed an equity evaluation model for urban transportation cost-benefit appraisal.

Gillinder (1975) reviewed, cogently the important contribution to the study of the problems raised by investment in transport and the use of cost-benefit analysis.

The lack of a sound theory on the prerequisite and the workings of economic development processes when effecting transport investment has been much deplored, particularly by British and American authors (1975).

With regard to the use of transport investment as perhaps, the most important traditional of regional development policy since mercantilism, the words of Hans A. Alder, Chief Transport Economist at the World Bank, are still true. It is frequently assumed that all transport improvement stimulate economic development. The sad truth is that some do, and some do not, and that even some of those that do may not be economically justified in the sense that there may be better investment opportunities (1979).

Giannopaulos (1979) observed that transport investment can have wide ranging effects both for the users of the facility and the regions as a whole. The magnitude and extent of these effects depend of course on the nature of the investment itself, but the same transport improvements can have different effects in different regions on countries.
Giannopaulos further observed that transport investment on regional economy can be both positive and negative depending on a number of factors which exert their influence within the particular regional or national levels of each country. The positive effect mainly comes from the fact that transport improvements in general lead to a reduction in the total resources required to produce and distribute a given volume and pattern of economic output and thus they release resources which increase output and stimulate further regional economic growth. Negative effects such as environmental damage, unbalanced national growth pattern through over expansion of some regions has been pointed out by him.

Jacob (1977) says some countries have adopted the principle of applying cost-benefit analysis, before taking any decision on investment. This does not necessarily mean that investment thereupon becomes a reflection of economic needs but the improvement of the decision-making process has undoubtedly helped to eliminate or postpone certain projects. He further observed that investment policy with regards to inland waterways, roads, railways, urban transport systems, airports etc. has been viewed from an analytical angle and has thus led to duplication of investment. He showed that on the Antwerp-Brussels-Charleroi corridor a motorway, and a
pipeline for refined products operate side by side in addition to airport facilities.

Hicks-Kaldor (1977) postulate states that a project is a good thing if its benefits exceed its costs to the community, provided that the winners can compensate the losers.

Further exposition of the principles of cost-benefit analysis has been given in Mishani’s cost-benefit analysis (1975).

Harrison’s "The Economies of Transport Appraisal" (1974) provides a useful link between theory and the practical applications of cost-benefit analysis to transport investment.

Sugden and William’s "The Principles of Practical Cost-Benefit Analysis" (1978) is an introductory text on the subject.

There is the Report of the Advisory Committee on Trunk Road Assessment under the Chairmanship of Sir George Leitch (Department of Transportation, 1977) which offers a most lucid analysis of the problems in applying cost-benefit analysis to trunk road schemes. It includes a number of sensitivity tests and makes recommendations for improvements in a number of the Department of Transport evaluation procedures.
The ideal practice in an investment appraisal is to discount all the cost and benefit to yield a unique net present value, but it is not always possible to calculate such a scene. One obvious problem is that the future is uncertain, so that the analyst must accept the possibility of a range of outcomes rather than a unique solution. Since transport investments are typically long lasting, it is especially important to take account of risk and uncertainty, an area that is a major subject in economies with extensive literature (e.g. Horne 1977, Biomwick 1976).

Barker and Buttons (1979) case study in cost-benefit analysis gives analysis of five cases including the Victorian Line and the Third London Airport.

2.2.6 Demand Analysis

Several studies have been made by several authors on traffic forecasting.

The demand for transportation by individuals and the community for urban transportation was studied by Kelly (1974). He has tested some new transportation demand models, viz. a traditional binary choice and model split, to examine the influence exerted by a few economic variables on consumer travel choices.

Sasuka (1974) estimated the demand for barge transportation. He suggested some forecasting models for estimating the future output for firms utilising coal as a
factor of production, estimating the effects of future technological alteration on coal demand and then calculating the future demand for coal to be furnished in 1980 and using discriminant analysis for improving the mode section.

The methodology used by Norbert (1969) for predicting urban travel demand is somewhat different from that of others. He analysed the similarities in personal characteristics and urban environment. He observed that these will form a basis for predicting urban travel demand. The study was carried out by using the results of a survey of 1018 residents of the San Francisco Bay Area.

The model developed by Chese Econometric Associates (1974) was designed to forecast demand for different types of car. The demand for public transit in Montreal was studied by Faredy Marc (1971). He has taken up two markets, viz. adults and school children, for forecasting the public transit trips by using monthly time series data on relevant variables.

An econometric model of demand for transportation was developed by James (1969). He viewed the demand for transportation as an application of general theory of substitute goods when the demand for each individual product depends upon the supplies of other competing products as well as the overall demand for general class of goods. The central assumption of this study is that each of the quality attributes can and should be expressed as a cost associated
with shipment of goods. Using this assumption an econometric model of the transportation market is developed. The idea is thus converted into an empirical form, and estimating equations are derived. Equations of these modes of transportation expressed the transport rate as a function of product as well as transport attributes.

Quite a few studies have been made to predict the future demand for urban area transportation. The report submitted by Martin (1961) and others presents the results of a pilot study into the current principles and techniques of predicting future demand for urban area transportation. This report is essentially a compendium of the presently available and utilized methods for predicting urban transportation demand.

Alexander (1964) made a demand forecast for North Atlantic Travel for the year 1975. The author felt that the socio-economic, psychological, technological, political and functional factors affect the demand for North Atlantic Travel. He has also taken into account the factors like rising consumer income, reduced fares, longer vacations, fashions, social prestige, culture and education. He made projections for two base periods, i.e. 1948-1963 and 1959-1963. To arrive at the total forecast of 75, the statistical projections were modified subjectively by qualitative and quantitative factors.
The demand for public transportation was studied by Sullivan (1974). He has developed a model to predict the amount of use that would be made of any new service that might be introduced. The author has adopted the standard produce mix problem to the transport situations and developed short cut ratios for evaluation.

A market model of transportation demand at industrial cities was studied by Dawson (1974). His study analysed the factors which influence the volume of trunk inducement from urban manufacturing sites. He proposed a marketing model utilising data gathered by a personal survey of trunk movement over a period of one month.

According to Kessel and Afheldt (1977), demand for transport is increasingly regarded as a partial aspect of an overall social and transport system. Simple forecast are replaced by system forecast. Evaluation of the consequences of particular conditions of demand is added to the forecasting of demand. So in addition to the problems of forecasting there are problems of evaluation. This means that more is demanded of the techniques. They also added that purpose of travel is one of the most important feature in the analysis and forecasting of demand, it is by the factor that individual behaviour as respect model choice, length of journey, duration of journey and the incidence of demand in tune is very largely determined.
In the OECD study, it was reckoned that between 1970 and 2000 private short trips would increase by 90 per cent and holiday traffic by 63 per cent. Business traffic was expected to rise by 188 per cent, this however being relatively evenly spread over the week and the year. On the other hand, it was expected that traffic problem as regards leisure trips would worsen, particularly at the beginning and end of holiday periods and at the weekends.

K. Bez's study (1979) is devoted to the theory and estimation of demand for passengers and freight transportation in the Netherlands. He says that demand for travel is a function of income, prices, population and the number of cars in circulation which in turn is a function of income.

2.2.7 Pricing

A remarkable amount of studies have been carried on pricing transportation services.

Armins (1974) dealt with the economies of transportation system with major focus on pricing. The study presented a minimal cost design and cost allocation to users in transportation network. A non-linear approach was suggested in pricing.

A study by Bayliss and Edwards (1970) of freight charges in the U.K. showed that consignment weight was far
the most significant factor determining road and rail charges, accounting, in fact, for about four-fifth of the variance. In another study on operating cost in road haulage, Edwards and Bayliss showed that hours on road were a much more important factor in determining costs than mileages worked.

Tyson (1975) considered the issue of raising the bus fares at the perk hours. He also studied the effects of differential bus fares in Greater Manchester for the period 1970-75. The factors accounting for fare differentials were (i) number of passengers travelling, (ii) length of the journey, and (iii) time when they travel. The study was based on passenger travel one day before and one day after the policy change. The data was collected from way bills. The study revealed that surcharge on the fares during the peak periods did not have any adverse impact on the traffic.

Karl (1969) suggested five major alternative pricing policies for railways marginal costs pricing, marginal cost, a uniform increment price discrimination, out of the pocket cost pricing and fully distributed pricing.

Paul (1973) made an economic analysis of the future air transportation requirement of Niagara frontiers and suggested the application of regional cost pricing to landing service to reduce congestion in airports.
The Highway Research Board (1973) examined the relevant issues to price subsidy in urban transportation.

Andrew (1968) considered some aspects of the decision making process in rate fixation.

Hinkle (1968) compared the cost differentials between district owned and private owned transportation services.

Kentner (1972) showed that the primary aim of changing the use of infrastructure is to make the user bear the cost of congestion which he causes. However, this definition gives scope for possible interpretations of the idea of road pricing. Kentner gives few distinct interpretations: (i) a general levy for the use of infrastructure directed as costs, (ii) a levy for use bringing supply and demand into balance, and (iii) a special levy designed to reflect the congestion cost caused.

S. Glaister (1976) thoroughly investigated congestion pricing for seasonal peaks in the context of the Channel Tunnel. He concludes "it seems rather that either price variation as a method of mitigating the problem has not accused to them or the gains to be had from such policies are grossly underestimated."

In a study by Little and Mcleod (1972), the British Airport Authority has devised a pricing policy for the use of airports which is based on the principle of congestion pricing ("always charge enough to avoid excess demand").
Heggie (1974) points out that the price elasticity of demand for port service is very slight. He says that there is nothing to prevent the introduction of congestion pricing for the use of port facilities.

Many efforts have been made to translate noise nuisance and air pollution into money terms. The study of the Third London Airport (1979) is only one of many in which certain rules were proposed for treating such factors in such a way that they would neatly fit into a regular cost-benefit analysis.

Klassen (1981) says that road pricing should be one of the elements of general pricing system, in which not only activities in the sphere of traffic but all negative effects on the environment should also be taken into account.

Thomson (1967) has discussed the feasibility of parking charges and daily licenses in Central London and estimated the charges necessary for both schemes, suggesting a supplementary parking fee charge of about 4 per cent per hour or a daily license fee of 30 p. per day as optimal for Central London at 1964 price levels.

The Transport and Road Research Laboratory has worked on both technical and economic problems of direct charging. A summary of its work and of alternatives to the present pricing system can be found in Maycock (1972).
In the 1976 Consultation Document, the Department of the Environment has considered that changes in the existing taxation system should be used to help to equalize the ratios of revenue to the cost of road provision, that charges on heavy goods vehicles should be increased to cover environmental costs and the traffic congestion should be dealt with not by pricing but by direct restraint (e.g. bus priorities, control of parking provision, banning cars from central areas). These schemes suffer from many of the criticisms of parking charges and supplementary licences, but they might at least offer improvement on the present situation in the short term when road pricing and supplementary licensing are too complex and too expensive to be justifiable for most cities, at least in the next decade (Department of Environment, 1976).

Research by Tyson (1975) in Greater Manchester has revealed that the price elasticity of demand of off-peak traffic was almost unity. Thus a deficit on peak operations could be eliminated by a fare increase, while a surplus in the off-peak could probably be eliminated by a fare reduction. Tyson's original study of peak cost (1971) concludes that an increase of 20 per cent in peak fares, with constant off-peak fares would be needed to eliminate the cross subsidization and meet the pricing principle.
Mohring and Turvey (1975) have suggested that price should equal the short-run marginal cost of individual passenger's journey comprising the cost of the ticket and of stopping the bus to allow passengers to go on and off.

Munbys study (1968) contains several papers on pricing problems.

Beesley (1973) has analysed both subsidies and road pricing in considerable depth and provided the best recent survey of both issues.

The Consultation Document (Department of Environment, 1976) includes an interesting appraisal of policy options and the results of considerable research on matters such as allocation of track costs and their implication for pricing.

2.2.8 Performance

The working of different transport systems have received considerable attention and consequently some research studies have been made on their performance.

In a study conducted by Foley and Bouladon (1973-74), it was observed that rail was about four times as efficient as road in the use of fuel for the movement of freight, and that in passenger transport, bus and rail were similar and both were superior to car.

Thomas (1979) and his colleagues have made a comprehensive study on the performance appraisal of urban
transportation system and provides a framework for cost-benefit analysis of the operation of a transportation system.

Reeks (1976) tested out six principal factors which influence the degree of reliability of a transport system. They are equipment, maintenance, personal and industrial relations, operational plan, external influence and organisation.

Harrison (1974) examined the new techniques for controlling transport operations.

Ward (1975) studied fleet utilization for the nature and characteristic of a personal rapid transit system.

John evaluated the rail road passenger service for the period 1950-65 and compared the working of Atchinson, Topekar, Santa Fe with South Pacific Company. The study identified the reasons why the Santa Fe continued to provide passenger service while the Southern Pacific did not, and appraised the profitability of the two undertakings.

Some case problems in transport management with major focus on performance were presented in the work of Baker and Germane (1978). It covered diverse topics like selection of equipment, locational selection, allocation and scheduling of equipment, pricing, merchandising, marketing research advertising, control finance, labour relations and organisation.
The Annual Bulletin of Transport Statistics for Europe shows that in USSR in 1972, 77 per cent of ton mileage worked was by rail, in 1968 the respective figures for both were 79 per cent. This substantial divergence in the tonnage and ton mileage proportions is typical of a number of East European countries.

Several studies carried out in U.S. by Mayer, Kain and Wohl (1979) aimed at working out the traffic threshold beyond which railway system would prove more economical than bus.

The Austrian survey (Schuster, 1978) shows for example, that where the journey to the shops is less than 1000 metres, about 95 per cent of the shopping is done on foot and only about 5 per cent by car. On the other hand, where the distance is over 1000 metres, only about 28 per cent of the shopping is done on foot and 72 per cent by car.

According to Klaesen (1977) comparing the generalized transportation costs of private car and public transport, he observed that particularly for the smaller distances, the private car is preferred to public transport, because of its low time cost, inspite of its high money costs, while for long distances, public transport is often preferred because it is cheap in relation to travel time.

In their research into long distance day trips in the recreational zones of south-west England, Edwards and Denniss (1976) analyse the influence of car ownership and
improvements in the road network on the number of trips. In a household with cars, the average number of trips is 2 to 3 times than of households without, and 5 times as great in case of trips over 25 miles. According to their calculations, improvement in road network between 1970 and 1975 brought about 11 per cent to 17 per cent increase in traffic.

K. Bez in his thesis "Demand for Energy for Transportation in the Netherlands" (1978) says that the size of consignment and the type of commodity is considered to be the most influential factor for choosing a mode of transportation. For bulky goods, rail and ships are the most favoured means of transportation. On the other hand, he says that experiences with freight transportation in the Netherlands (in land) does not clearly support the view that the type of commodity is the most important factor determining modal choices. The records show that since the sixties, the share of ton-km for road transportation exceeds that of water and rail transportation put together. Only a small portion of agricultural products was transported by rail, about 60 per cent to 80 per cent of the ton-km for the agricultural products was road borne. In 1960, of other goods, about 18 per cent went by rail, 40 per cent by road and 41 per cent by water. Between 1960 and 1970, the share of road transportation increased from 40 per cent to 54 per
cent, and as a result, both rail and water transportation lost, viz. 10 per cent and 3 per cent respectively.

2.2.9 Safety

Though transportation is one of the most important contributor to economic development, yet it is often associated with hazards on human life.

Hunter (1975) made an incessant plea for proper understanding of good and evil aspects of the role of modern transport systems contribution to the quality of human life.

Johnson (1975) exhorted that the accident statistics for any city is a measure of the performance of traffic management in that city and cautioned against the tendency to allow things to drift.

Among the research institutes engaged in pioneering research work on accident prevention in transportation, mention should be made about the Road Research Laboratory in Oxford University. The Laboratory is carrying our research on various aspects on safety in transportation. The Transport Group at the Laboratory helps to answer questions like what kinds of transport system are best suited to British needs and can the adverse effects on road transport be mitigated, the Engineering Group examines questions like how can the road system be best planned, built and maintained and the Traffic and Safety Group answers questions like how can the road system be used most efficiently and safely. The present
work at the Laboratory may be broadly defined as an extended study of the methods for safe, efficient and convenient movement of people and goods. The continuing growth in road traffic explains the importance in having the most effective road network to carry the expected traffic with greater safety.

Walter (1943-53) analysed the trends in motor vehicles accident rates and motor vehicle insurance costs in Maryland.

In his study Prof. Kolaric (1975) observed that continuous barometer readings on the line from Belgrade to Kosovo Polje, the locomotive crew is subject to a pressure of 42' for 6 hours of the journey, and then has to start another journey from Kosovo Polje after only 2½ hours rest. Such changes have an adverse effect on human equanimity at work at times when complete concentration is demanded. They also aggravate certain complaints. The research showed that there was some correlation between certain weather condition and traffic accidents.

Dr. Her Nando (1975) observed that 57 per cent of the death due to traffic accident in urban areas of Spain was pedestrians. Accident suffered by the pedestrians and the anxiety that some people suffer when crossing the street, are factors in favour of "pedestrian only zone."

According to Transport and Road Research Laboratory, U.K. (1979), it is estimated that road accidents accounted
for about 17 per cent of all deaths in developing countries. There are also accidents causing serious physical and mental disability to victims. Growth in the rate of such accidents particularly in big cities and in highways has been of grave concern and has helped create greater awareness of road safety regulations.

Glimar (1975) says that the creation of models for the installation of signalling and automatic block working produce increased line capacity and greater safety. Many railway undertakings have already introduced either a method relying on fixed installations (fixed signals for every block) or train through circuiting.

Rebat (1975) says of the constraints which man will have to adopt in the future and the conflicts of interest that he will have to resolve, the first to come in mind is that of transport safety, since this is clearly a matter of life and death. Public opinion has been made alive to these problems and demands increasingly safe transport. But this desire is reflected in various restrictions and legal, technical and medical regulations, e.g. are speed limits, traffic bans, stricter conditions for the issue of driving licences, improved infrastructure, equipment and vehicles, automatic braking and warning systems, automatic coupling of railway wagons, more specific train traffic signs and signals, the use of increasingly sophisticated often costly
apparatus, requiring more highly skilled man power, strict medical inspection and so on. He further says that transport workers are often drawn from the rural areas and this is an important cause of accident as in 80 per cent of the cases, the primary cause is human failure, i.e. negligence of safety rules, drunkenness, reduced alertness, deficiencies in sense perception or bodily control.


Cantilly (1954) made a statistical evaluation of traffic accidents severity.

2.3 Studies in India

2.3.1 History and Role of Transportation

According to Srivastava (1953) Indian history abounds in references to road construction activity undertaken in the past and the road policy adopted by different rulers. Excavations at Mohenjodaro and Harrappa, have established beyond doubt, that the Indians were adept in the art of road building even 4,000 years B.C. Kautilya, the celebrated economist of the Mauryan period, has observed that in his times city roads were 24 feet wide, roads leading to battle
fields and villages were 48 feet wide, and those leading to the burial grounds 7½ feet in width.

In the reign of Chandra Gupta Maurya, there was a transport department, and a grand trunk road connected Patna with the North-West Frontier Province. Mr Strato confirms that the two Greek travellers, Megasthenes and Irastathenes travelled in northern India along this road. During the regime of Emperor Ashok there were good roads in India, a mention of which has creditably been made by the Chinese traveller, Fahein. Muhammud Tughlaq had constructed a trunk road from Delhi to Daulatabad which, according to Ibn Bhaluta, was traversed in 40 days. Sher Shah was very famous for the construction of roads. A monumental volume Tarikhe-Shershahi reveals that in his times, roads were looked after and managed by the state. He had constructed several roads of which the roads from (1) Punjab Fort to East Bengal upto Sunargaon, (2) Agra to Burhanpur, (3) Agra to Jodhpur and Chittor, and (4) Lahore to Multan were very important.

Road construction in British period - Srivastava says "although roads were built principally from the administrative and strategic stand points, yet it must be admitted that the pace of road construction activity was accelerated with the advent of the British rule in India. The East India Company - mainly a commercial corporation did not evince any interest in road making. Lord William Bentinct
revived the idea of constructing roads by connecting Peshawar, Delhi and Calcutta. In his times, military boards used to look after their maintenance. It was only during the regime of Lord Dalhousie that a Central Public Works Department was created. In 1855, such departments were created in provinces also, eliminating military boards. The Report of the Royal Commission on Agriculture in India (1928) remarked that “alongwith railway construction, also road building was necessary to feed the railways, leading to a demand, which remains today far from being completely satisfied, for bridged and metalled roads at right angles to the railways and giving access to them in all the seasons of the year.”

The progressive policies of Lord Mayo and Lord Rippon acted as a stimulus to road development in India as local affairs came under the direct control of local boards. During the Second World War road construction activity increased. It was considered urgent to repair and build new roads in the frontier for the movement of military and materials.

Road development in modern period - Though the first motor vehicle was driven on Indian roads in the year 1898, yet until the First World War a good number of vehicles did not ply on Indian roads. While the history of road development in India goes back to the early ages, organized efforts at road development at the national level in the
recent past may be traced to the year 1929, when the Jayakar Committee considered schemes for improvements of the road system in a comprehensive manner. It was on the recommendations of the committee that the role of the Central Government in this regard to the development of road system was recognized. Later in 1943, Chief Engineers in charge of road system in the country met at Nagpur to consider requirements of the road system over a twenty five year period beginning December 1943. The Nagpur Plan classified roads as national Highways, State Highways, District roads and village roads and prescribed standard norms and targets for road development of various categories. Soon after Independence, the pace of road development in the country was enhanced so as to achieve the targets of the Nagpur Plan, but there were serious deficiencies in respect of road surface, cross drainages, bridges, etc., and as such the second attempt for preparing road development plan on an all-India basis was started in 1958, and the 1961 and 1981 Road Development Plan, known as the Bombay Plan, was formulated, with a target to achieve an over all density of 32.5 km. of roads per 100 sq. km. of area, 44 km. of roads for developed agricultural area, 19 km. for semi-developed areas and 12 km. for underdeveloped areas.

According to Dhakharia (1921) increased tempo of economic development has necessitated improvements in the
infrastructure for the mobility of man and materials, cheaply, efficiently and quickly every day. Transportation is an essential infrastructure in the development of economy and every rupee spent on its development has a multiplier effect on the economy.

Dr. Pathak and Tiwari (1981) says that transport is the basic element of infrastructure of economic development. There is need for according high priority to transport sector in India from the size of the country as well as from the geographical dispersed natural resources. Thus the basic necessity to achieve the social and economic objective of the National Plans for economic development and social reconstruction is the provision and maintenance of adequate and efficient transport.

According to Mehta (1952), the most important factor which contributed to the initial concentration of cotton textiles industry at Bombay was the availability of excellent transport facilities both in regard to raw materials and consumers market.

According to Amba Prasad (1960), transportation is an indispensable part of culture as the hallmark of civilisation.

According to the New Popular Encyclopedia, "The road is of the greatest fundamental institutions of mankind. Its history dates back to the dawn of recorded history and
beyond. It develops with man's advance, it retrogrades with the breakdown of a social order. A people without roads would be people without intercourse with the outside world, without the attributes of civilization. Man - the road builder, thus cannot be separated from man - the builder of civilization."

That economic development requires adequate and efficient transport services is axiomatic. Sinha (1959) in his thesis studies about the inter-relationship between transport and economic planning.

Balsara (1972) traced the evolution of the public conveyance system in Bombay along with the rapid urbanization and industrialization of the present day metropolitan city.

Ramanadhan (1948) studied about the role and problems of nationalized road transport undertakings.

Writing about the road transport system, Mathew (1972) was critical about the step-motherly treatment given to road transport as compared to railways in India. He further highlighted the complementary role of roadways and railways and suggested coordination between the two through (i) taxation, (ii) regulation, (iii) unification, and (iv) nationalization.

Tiwari (1946) and Shajwalker (1958) have studied about history, role and problems of railways in modern India.
There are also few studies about the history and role of air transport in India. Dhekney (1949) studied about the evolution of commercial air transport in India during 1944-49.

2.3.2 Policy

Transport policy is a vast subject and it includes economic planning with reference to transport sector, issues of investment, finances, nationalization, organizational problems etc., but very little attempt has been made in India to study its various aspects.

Singh's (1973) study is based on transport policy relating to investment. He asserted that the transport policy of a socialist society has some basic features. First, development of transport is to be coordinated with the needs of rapid economic development. Second, the public sector has to come forward for catering to the needs of the quick, time-saving transport to the urban and rural people. Third, there is progressive nationalization of the private sectors, and the pre-industrial means of transport, driven by animal and manpower are replaced by power-driven vehicles. Fourth, in response to the low income of the masses, priority is to be given not to the so-called "people car" but to the inexpensive and quick public transport and inexpensive scooters, autocycles and bicycles for private use. These
features also provide the framework for investment in transport in socialist countries like India.

Some studies have dealt with the rationale of nationalization of transport undertakings. The problems of loss of revenue by nationalized transport undertakings were considered in a seminar (1974).

The association of transport vehicle manufacturers and operation also deliberated on the shape of the transport policy at various seminars. For instance, the motor industries association made valuable suggestions concerning road development plan in the fifth Five Year Plan (1975).

Carlin (1967) illustrated the usefulness of a sectoral approach to developmental constraint on the transport sector of the Indian economy. He analysed the constraints on some of the major sub-sectors on different modes of transport and concluded that the best way to coordinate transport policy is by the operation of competitive market force.

Ghosh (1967) explained a model for optimum pattern of regional production and exchange of commodities between various regions of India. He claimed that the model would minimize the national cost in the transport sector. Taking transport capacity as a constraint, he compared actual and optional flows.

Ramanadhan (1957) in his book "Nationalized Road Service in Andhra Pradesh", shows some evidence on the
efficiency of road-rail coordination resulting from the organisational, integration of road-rail services. He also studied the economics of rail-road policy in India and contrasted it with the public policies generally adopted in different countries, specially U.K. and U.S.A. He suggested the creation of a Transport Commission to take charge of the Transport Policy in its entirety.

Rao (1968) conducted a survey of the traffic potential of Andhra Pradesh and recommended for the setting up of State Sponsored Corporation to make finances available to private motor transport operators at reasonable rates of interest.

In evolving of an integrated transport system the NTPC (1980) members recommended that in India we are primarily guided by the realization that transport agencies are not competitive, but complement and supplement to each other. The measurement of resource costs is one of the broad approximations in this direction. They say that it is to their being complementary rather than substitute which should be the aim in India, where each agency is inadequately developed and there is ample scope for all to advance within the overall resource constraint. Further they say that the three central issues to be considered in evolving an integrated framework for transport policy are (i) determination of the size of total transport investment,
i.e. quantum of resources—capital, foreign exchange, scarce materials and manpower—which should be devoted to development of transport sector as a whole, (ii) distribution of these resources between various modes of transport, and (iii) tariff for transport services, taking into account the return on investment made therein.

They further added that in framing a long term transport policy for the country, one should not ignore the adverse impact of transport on environment. In India there is a general lack of concern about environmental implications in regard to growth of transport, especially of road traffic. The problem is acute in our cities when travelling vehicles generate noise, fumes and other hideous visual intrusions, and result in accidents, personal stress and physical damage to the fabric of urban society. Where heavy lorries use approach roads or roads in residential areas, conditions worsen for the people. They said that much can be done to mitigate these nuisances. For example, appropriate regulations on lorry size and weight, noise and fumes can be an effective protection against environmental pollution. Similarly, sound traffic management and parking policies can reduce traffic congestion in the urban areas and bring about significant environmental gains. Effective land-use policies, which may promote desirable shifts in population and employment, can also improve the quality of urban
environment. They suggested that in our inter-city routes there is also a great opportunity for improving the quality of environment by planting trees and providing adequate wayside amenities, and the members urged upon the authorities, especially the State Government and local bodies to devise schemes for safeguarding the environment both on urban and inter-urban routes and integrate them with planning for development of a future national transport system.

The NTPC study pointed out that a major handicap faced in framing an integrated transport policy in India is lack of reliable data on inter-regional traffic flows and comparative transport costs by different modes. A few surveys were conducted in the past to fill these data gaps, but none of them was comprehensive enough to provide meaningful information for evaluation of transport proposals for regional economic analysis. Recently, however, the Planning Commission entrusted to Rail India Technical and Economic Services Limited (RITES) to study on comparative modal costs and traffic flows as part of a U.N.D.P. Transport Policy Planning Project. Information collected for this study has given us valuable insight into the pattern of commodity flow by the three modes of transport, namely rail, road and coastal shipping, and thus comparative movement costs.
2.3.3 Energy

The transport sector uses mainly a third of the country's total commercial energy and more than half of its oil supplies. Among the principal modes of transport only the railways use all the three forms of commercial energy, i.e. coal, petroleum and electricity. All other modes, including road, air transport, and coastal shipping, depend totally on petroleum fuel for traction energy. Rail and road together account for as much as 95 per cent of fuel oil used in the transport sector.

According to the projection of the Working Group on Energy Policy (1978), India's export earnings are expected to increase to Rs. 20,823 crores by the year 2000-01 A.D. of which 74 per cent are likely to be spent on oil imports, and they projected a grim solution of India's balance of payments position by the end of the century due to its rising oil imports.

The NTPC (1980) recommended that as India has limited oil resources, electricity which can be obtained from a variety of sources, ranging from nuclear fuels to hydro and solar energy should be used.

Little systematic evidence is available on energy intensities of different modes of transport in India. Earlier work in this area are the studies on energy intensities of road and inland waterways by H.C. Malhotra and NCAER (1974).
A study on energy was assigned on K.K. Murthy of National Institute of Training in Industrial Engineering (NITIE) (1978) at Bombay. Dr. Murthy's study has provided us with up to date and systematic information on energy intensities of rail and road transport. He did not examine evidence for waterways or coastal shipping. The NITIE finding show that a single occupant has the highest energy consumption, as opposed to suburban train which has the lowest. The broad conclusion which emerge from NITIE study are that for freight elective traction, railways is the most efficient form of transport in terms of energy consumption followed in that order by railways, driven by diesel traction, pipeline, inland waterway transport, diesel truck and railways on steam traction.

Studies by Kadiyali, Viswanathan, Bajpai and Sharma (1982) has demonstrated that considerable economy in fuel is possible by driving the vehicles at optimum speeds, and also an improvement in the smoothness of road can bring about considerable economy in fuel consumption.

In a research project sponsored by the World Bank and the Government of India, controlled experiments were conducted to determine the fuel consumption of trucks. The objective was to evolve a mathematical relationship between fuel consumption and the factors likely to effect the same. The paper describes the study carried out and presents the
results. It has been shown that speed and power of the vehicles and roughness of road affect the fuel consumption significantly. The results can be used in selecting optimum speeds for running the trucks and to choose appropriate geometric standards for roads with a view to save fuel.

As part of the Road User Cost Study, a research project jointly sponsored by the World Bank and the Government of India, fuel consumption experiments were conducted on an Ambassador car, Premier Padmini car and Mahindra diesel jeep. The objective was to establish a relationship between the fuel consumption and important factors such as speed, roughness of the surface and rise and fall along the longitudinal profile of the road. The experiments have established very high correlation between the fuel consumption rate of the above three vehicles and speed, roughness and vertical profile. The results have proved that there is an optimum speed for each vehicle at which the fuel consumption is minimum and driving at speeds lower or higher than the optimum results in a very high fuel consumption. The results have also proved that fuel economy is possible by improving the roughness of the roads and the vertical profile.

According to Dodiya (1980), rail road and air transportation consume 80 per cent of commercial energy and is the single largest sector in the use of petroleum based
energy. The cost of petroleum products is growing very rapidly. Moreover, the crude oil reserves may not be available in the required quantity. Our country is already dependent on imported oil and will continue to be so as our proven reserves are very limited. Even our coal reserves are not sufficient to meet the projected demands at 400 million tonnes per annum by 2000 A.D. Growth in thermal generation and of hydel generation is already receiving priorities in our national plans and will ensure adequate power. Electric traction though based on indigenous available resources is more economical in use of energy source compared to diesel traction. It is, therefore, necessary to consume energy, even under electric traction in operation. Road transport consumes more than 80 per cent of the diesel oil in the country and is fully dependent on oil as no viable substitute exists at present. Alternative road transport based on electricity needs to receive utmost attention.

Studies by Kisan and Agarwal (1980) show that diesel buses require petroleum products and a major portion of these products is imported. This causes a heavy drain of our foreign exchange resources. But the electric trolley buses do not require petroleum products and depend only on electricity which is produced by coal and replenishable hydel reserves.

According to Vishwamitter and Srivastava (1981) mobility, communication, and energy are essential ingredients
to the process and sustenance of urban civilization and development. Mobility promotes communication and both involve a dependence on energy in some form or the other. In this paper micro and macro aspects of urban structure are highlighted to indicate how each level has the inherent possibility of influencing transportation planning and functioning. Also the emphasis of the paper is to focus on the possibility of achieving an order of urban structure and land uses that promote a conservation on energy without losing desired levels of urban/functional efficiency.

Hashim's (1981) paper evaluates the relative economics of steam, diesel and electric tractions of Indian railways. Unlike the studies done with the main purpose of finding out the break-even level of traffic between diesel and electric tractions on the high density route, the present study tried to evaluate the relative economics with a more comprehensive approach. It was related to the Northern Railways. For examining the relative economies of the modes of traction, the differentiating operating and capital costs (both financial and economic) were evaluated per unit of transport output. It was concluded on the basis of the economic cost, that steam traction should be continued on low density routes of Indian railways and electric traction should be extended on all the other routes, whereas the use of diesel traction should be kept to its minimum.
2.3.4 **Planning**

Realising the importance of planning in transport, we find that various studies were carried out in the field.

Prakasan (1975) analysed the problems of transport planning consequent upon rapid metropolitan development. A regional survey of Andhra Pradesh was made at the instance of the Planning Commission to assess the existing facilities in different modes of transport. The study was made in response to overcome a situation where proper coordination in the transport system became difficult in view of the consideration of different modes of transport in isolation. The study made useful suggestions for devising ways and means for affecting a rational allocation of traffic among different modes of transport.

The NCAER studied various aspects of organization and planning of the Road Transport in Delhi Region. However, it was confined to goods transport only.

The Madras Metropolitan Development Authority proposed a Master Plan for Madras, projecting until 1991, for an estimate doubling of the population, construction of satellite towns and improvement in the traffic system connecting certain important places were recommended.

A study on Simla Region was carried out with a coordinated approach of economic development and transport planning.
In another study of urban transportation in Madras, Viswanathan (1972) suggested that better town planning is a prerequisite to ease the transportation bottlenecks.

The spatial pattern of interaction in Vijaywada city of Andhra Pradesh were studied by Prakashan Rao (1968) and his colleagues. The frequency, distance travelled and modes of transportation were analysed.

Srinivasan (1970) and his colleagues analysed the short-comings in the existing route systems in the public bus passenger transport in Delhi. For route recognition, a plan was worked out with the following criteria: (i) Route should be capable of meeting travel desires with minimum of inner-changes, (ii) Route should be normally cited beyond rather than at the conveying points of city centre, (iii) Route system should be such as to enable the trips to be presumed in not more than 60 minutes of journey time, (iv) Routes should be preferably kept off from highly congested and inaccessible places though one or two routes may be allowed to cater into those areas, and (v) All the neighbouring places of a locality should gradually be linked with it by direct routes.

Srinivasan (1972) considered the administrative and financial aspects of urban transport system and suggested replanning of the routes and schedules to maximize the utility of the existing equipment. He also reviewed the
research work done in India on urban traffic problems and observed that traffic planning techniques such as traffic projections, distribution, model split and assignment are yet to be developed. He also noted that considerable amount of research and development work in this field has been carried out in developed countries but cannot be applied directly to India due to differences in the traffic and other conditions prevailing here.

Bhardwaj (1960) made a study of the techniques of railway transportation planning.

Suryanarayana and Srinivasan (1967) conducted an origin destination study in Bangalore, by using home interview techniques. Certain travel characteristics were analysed by them. In a study of the inter-city origin destination travel in Delhi, Srinivasan analysed the choice and mode of transport.

Singh and Sundaram (1968) studied the problems of transport planning from the investment point of view keeping in mind the scarce resource position.

Patankar (1961) studied the relationship between growing sizes of cities and pattern of inter-urban transportation as a business proposition in specific urban areas.

Viswanathan (1968) observed that alignment of sub-urban expansion will have to be planned in advance from the
transport point of view - otherwise, he cautioned that colonies will develop deep in hinter land and require to be served by unprofitable bus routes.

Advani (1974) analysed the alarming problem of traffic growth in Bombay and observed that the time taken to reach the destination will be an important yardstick to assess the efficiency in scheduling. It will also influence the quality of service and the amount of fare charged.

The Metropolitan Transport Team of Planning Commission (1968) has recommended a series of measures for optimising the capacity of the existing mass transit facilities and preventing future deterioration of difficult traffic situation in the metropolitan area of Bombay. Addition to large capacity carrying buses, particularly double-deckers in sufficient numbers, establishing buses on certain short distance routes where heavy flows of traffic are present with few intermediate stops are the major recommendations made by the Team.

In a study of the traffic assignment techniques, the School of Planning and Architecture, New Delhi (1974-75) observed that the route choices of vehicular traffic are governed by length of travel, safety in travel and environmental factors on roads. It was suggested that traffic assignment on public transport system should incorporate weighted delays experienced at intersections, exchange points
and bus stops for achieving better loading forecasts and higher efficiencies in operation.

Viswanathan (1972) studied the problems of metropolitan road traffic enforcement and suggested four regulatory devices, viz. (i) control traffic movement and highway use, (ii) control on access, (iii) control on vehicle use and check of vehicle condition, and (iv) staggering of work hours.

The Metropolitan Transport Project of Railways (MTPR) has conducted techno-economic and engineering studies of the network of mass rapid transit system for Delhi urban area. The Town and Country Planning Organisation has collaborated with MTPR in carrying out the necessary studies. A concept plan for Delhi urban area for the year 2001 has been developed indicating the possible directives of growth including population and urban form of distribution of economic population and economic activities, estimate for inter-zonal trips movement pattern and assignment of trips on the transportation network.

A study of the parking problems in New Delhi was made by Joginder Lal (1960). He conducted field surveys for the assessment of parking demand of private vehicles to find out maximum number of short time parkers, all day parkers and all urgent parkers.
According to Sarkar (1981), in India, in transportation planning — views of the citizens are not effectively utilised during the planning process. This paper describes why effective citizen's participation is important in transportation planning so that a consensus for action can be reached. Though it is very easy to conclude that citizens must be included in the planning process, it is a very difficult job to find out a programme where democratic goals are achieved without affecting the efficiency of the project. Without having some practical experience in executing citizen participation programme it is very difficult to have true knowledge of the problem. In this paper an attempt has been made to broadly touch some points which should be kept in mind to achieve democratic efficiency.

2.3.5 Investment

In India, the study of transport investment is very scanty. A study published in the Mobile Journal (1972) analysed the plan investment on road transportation in the first quarter century of the planning in the country.

Palivala (1972) pointed out that the investment in public sector outlays declined from 8.6 per cent in the first plan to 5.6 per cent in the fourth plan. He also observed that 30 per cent of the villages in the country were neglected except Punjab where all the villages were connected by roads. He suggested that as in the developed countries
like Japan and West Germany, the income from roads should be spent on their maintenance and improvement.

Meenakshi Sundaram (1972) observed that the demand for transport grows faster than that of the gross national product and recommended criteria for guiding investment policy.

According to NTPC report, "the central issue of investment policy is to allocate total resources assigned for transport development between agencies of transport system to meet transport needs of the economy at minimum cost to the society."

2.3.6 Demand Analysis

Several studies have been conducted in India on traffic forecasting but little has been made on projecting the traffic requirement of railways, waterways and airways. Several empirical studies on traffic forecasting have been conducted by some research organization and individual researchers. Prominent among them are Regional Transport Surveys conducted by NCAER for Mysore, Kerala, Madras and Pondicherry (1969). All these surveys assessed the future transport requirement of the region having regard to its potential for economic development. The passenger traffic projection have been based on the anticipated population and per capita income in the state. The estimate of goods traffic
have been made by separate projections of a number of important commodities such as coal, iron and steel, petroleum, cement, sugar, fertilizers etc. A historical review of the transportation situation of each individual modes of transport the nature, extent and disposal of agricultural and industrial production and per capita income have been made. On the basis of these projections, estimates of production and consumption were made by location of areas and predictions were made of the aggregate anticipated transportation taken by each mode. The anticipated traffic demands as the investment needed were worked out successfully.

Kalyanaraman and Sehgal (1968) have advocated two methods, (i) mechanical and (ii) analytical for estimating future road traffic. The mechanical methods simply project forward the past trends assuming that future experience is a direct function of past experience, analytical methods classify and analyse the several related components or influence the factors that have caused the historical trend pattern.

Nadkani and Deogirikar (1973) have assessed the demand for roads, as determined by economic factors like density of population and output. For this purpose, they have attempted a cross-section of all the districts in Maharastra through multiple regression equations.
Srinivasan (1969) studied the transportation planning in Bangalore city. In this, an origin-destination study was conducted by house interview and for this purpose 41 zones with homogeneous land-use characteristics were taken. A total of 10,000 households representing 5 per cent of the universe were enumerated. The data collected from the study along with the data on passenger traffic was utilized for traffic projection and distribution.

A traffic forecast for highways were made by Prasad and Agarwal (1964). They analysed the population growth, agricultural construction, industrial production, per capita income and total mileage of roads for forecasting the transport requirements.

Dalvi (1966) reviewed the current methodology for forecasting the future urban travel as five main analytical stages, (i) land-use models, (ii) trip generation model, (iii) distribution model, (iv) assignment model, and (v) evaluation model. He contended that land-use model, among all, plays a critical part in the forecasting of the future urban travel demand and hence in the design of the future urban transport plan. He found that the present methods of land-use forecast are entirely unsatisfactory and suggested the mathematical programming method for the destination of optimal land-use pattern in urban space.
The University of Roorkee carried out investigation to study various procedures developed for the estimation of the travel demand (1974-75). A probability model for estimating travel demand was established using the travel data of Ahmedabad metropolitan area. The study showed the applicability of the mode choice to Indian cities. A classification technique has been developed with a view to predicting the vehicle using capability of an individual for the known values of socio-economic factors, vehicle parameters and transportation system factors.

Since the entire planning of transport depends on traffic forecast, the NEC commissioned RITES during 1984 for updating the survey data obtained from the NCAER study and also for obtaining fresh projections upto 1993-94.

Among those who perceived clearly the close relationship between traffic forecasting and transport planning, Mahajan (1972) stands out. He advocated correlation index method and growth formula for predicting the demand for transport.

2.3.7 Cost Rate Structure

Study of the cost-rate structure of transport has far reaching significance. Satyanarayana (1969) observed that the cost of service of road transport depends upon the size of the fleet, the vehicle condition, the length and road condition. His study attempted to find out the
interrelationship between the above mentioned factors on the basis of the data collected from a representative sample of motor vehicle operation in Andhra Pradesh. He observed that the size of the motor transport per unit was a fundamental factor influencing the cost of operations of motor transport industry.

Krishnamurty (1971) examined the external factors influencing road transport. He observed that insufficient traffic layout and control would increase the costs. A seminar on road transport in Madras observed that savings in operating costs should be passed on to the consumer and transport users in the form of lower fares and freight and consequently lower prices for foodgrains and other articles.

Mittal (1962-68) studied the railway freight policy since Independence.

Ramanadhan (1950) probed into the economics of railroad policy. His dissertation of Indian Railway Finance provides an intensive analytical framework to understand the pattern of costs, rates, and profits in Indian Railways during the first half of the present century.

On the pricing policy, the NTPC members say that the first basic principle for pricing is that it must be cost based, the user to pay at least the full marginal resource cost of his transport. The more inelastic the demand, the greater is the opportunity for generating resources by
charging prices above the short-run marginal costs, and they say in no case would transport tariffs be lower than short-run operating costs. Another proposition is that all modes of transport should be treated equally for determination of an acceptable framework for pricing policy. They further say that once a pricing framework is designed and approved for transport agencies, there should be minimum intervention from the Government. They have suggested various pricing methods for controlling traffic in urban areas. These include daily or supplementary licensing, toll charge, metering for use of roads and parking fees.

There are some industry-wise studies on cost structure relating to transport sector. Gopalkrishna’s (1969) work which analysed the cost composition of different types of cars manufactured in India.

The need for collection and publication of information on transport costs was highlighted by the Committee on Transport Policy and Coordination (CTPC).

The Ministry of Railways have a small cell within the Directorate of Statistics in the Railway Board for the study of costs. However, the studies carried by this cell are only intended to provide estimates of financial costs to enable the railways to assess the viability of their different operations.
2.3.8 Performance

As regards the performance of the transportation system, studies on road transportation abound, followed by railways. Performance of water and air transport have received very little attention.

Periera (1975) made an analysis of Pallayan Transport Corporation and observed that the Corporation like any other metropolitan transport service was incurring loss mostly due to leakage of revenue, the magnitude of which varies from 8 per cent to 15 per cent of the total revenue on a modest estimate. He stressed that the financial viability of the transport system is dependent on the integrity and efficiency of the checking staff.

Reviewing the performance of the BEST service, Shyambhag (1972) observed that city transport (Bombay) was uneconomical because a large number of fleet was required to be maintained to take care of peak hour traffic.

Ramakrishna Naidu (1967) undertook doctoral research on the working of the passenger road transport industry in the Chittoor district of Andhra Pradesh.

Krishnamurthy (1969) presented a diagnostic study of Andhra Pradesh Transport Corporation. He presented an outcome of the genesis of the corporation and statistics relating to variable costs, gross income, net income, cancelled trips and number of delayed trips for different districts in Andhra Pradesh.
Pradesh. The review of the sector-wise analysis of the corporation made him reveal the local factors that were responsible for the difference in the performance at different regions. He also suggested some measures for improving their performance.

Some studies on performance, laid focus on punctuality too. A transport industry, Ramen and Ramen Pvt. Ltd., (1966) issued a questionnaire to the public and obtained information on whether the buses start on right time and reach the destination at the scheduled hour, whether the drivers and conductors are politely disposed towards the commuters and whether tickets are issued to all and the amount clearly shown to them.

Venkaji Rao (1981) suggested the managerial problems of state transport undertakings with special reference to Mysore state. He identified certain administrative problems which came in the way of improving the performance of a state transport undertaking. They are (i) balancing the transport requirement of the community as against other facilities served, based on costs, income and availability of finance, (ii) dealing with peak-loads, (iii) the most efficient utilization of vehicles and staff on the basis of the moving of given loads of passengers, and (iv) envisaging of traffic planning in future.
Some researchers highlighted the use of modern techniques of management to evaluate the performance of transportation system. Chandan (1969) discussed the role of operations research techniques in improving the productivity in passenger transport industry.

The Mobile Journal (1968) highlighted the problems of suburban rail traffic and pleaded for the creation of an autonomous corporation for suburban railway with a handsome subsidy.

The 75th Estimate Committee of the Parliament made a strong plea for a thorough study of capacity utilization in Indian Railways along with the analysis of demand and supply positions.

Manjula Singh (1973) observed in her study that in India the operating ratio (revenue expenditure) was always about 100 for rail and less than 80 for road transport and recommended a well coordinated road transportation system on the basis of such factors as assessment of demand for roads on vehicles requirement, distance from main roads, coordination of local bodies, land surfaces, regional development and employment considerations.

Valharajani (1973) inquired into the commercial operations of the railways and made elaborate suggestions.

Studying the performance of various modes of transportation, the NTPC (1980) observed that the railways
accounted for 89 per cent of the total freight traffic and 74 per cent of total passenger traffic in 1950-51. They found that most commodity movements are economical by road for shorter hauls upto 300 to 350 kms but beyond this range, cost advantage lies with railways. The high value commodities like tea, cotton textiles and cotton are, however, an exception to this, where the comparative advantage lies with road even for longer haulage. For commodities like perishable fruits, vegetables and small machinery, roads have comparative advantage over rail upto 450 kms. For some commodities such as fertilizer, coal, cement, livestock, sugar and steel tubes, comparative cost advantage for roads is upto 200 to 300 kms.

According to a study conducted by RITES, it is estimated that of the total inter-regional movement of freight traffic in terms of tonne-kms, railways carry 82 per cent and highways 18 per cent in 1977-78.

The CIRT, Pune (1980), studying on the performance indicators of major bus undertakings observed that in the case of DTC, losses were the highest but the fare was the lowest.

2.3.9 Safety

Though the problem of safety and environmental hazards are present everywhere, yet the studies carried on the field is very scanty.
Sharafuddin and Srinivasan (1968) examined the role of pedestrian in pedestrian safety. They suggested that "cross-walking", markings, flashing signals and railway barriers would regulate pedestrian and vehicular traffic and ensure greater road safety.

Dhar (1964) conducted certain tests for drivers at a driver's clinic in Delhi to identify the factors concerning drivers which can increase the propensity for unsafe driving causing accidents. The tests used were simple reaction time, complex reaction time, visual activity, speed judgment etc.

Srinivasan (1971) estimated that on average every year, 21 lakh persons were killed and 7.50 lakhs were injured in road accidents. He also studied the economic cost of road accidents. He assessed the cost of different types of road accidents in Delhi and also inquired into the malpractices in finalising road accident claims. The data for the study was collected from the records relating to 200 accidents by using stratified sampling techniques. The average compensation awarded was Rs.55,994 for a fatal accident, Rs.3,096 for a severe accident injury and Rs.525 for a slight accident injury.

Hingorani (1961) made an analysis of the traffic accidents in Delhi and other metropolis.
Rao (1972) identified the accident prone areas in the city of Vishakapatnam and made detailed suggestions to correct them into safety zones for traffic.

We find that most of the subsidies have been carried on the field of road accidents, though railways and air accidents are so high, yet there are rare studies on those modes of transportation.

The problem of overcrowdness, noise, fumes and accidents are studied by the NTPC (1980) and they recommended various measures to solve the problem. They observed that road accidents per vehicle-km is higher in Asian cities, including cities in India, than elsewhere in the world. Road accident causalities in terms of absolute numbers have increased from 38,800 in 1960 to 1.05 lakhs in 1976, with every sixth or seventh casualty being fatal. However, accident rate in relation to growth in motor vehicle has shown a decline from about eight accidents per 100 vehicles in 1960 to four in 1976. The measures suggested for road safety are adequate space for footpaths, provision of subways or overbridges and zebra crossing on busy roads and adequate cycle tracks in big cities. They suggested road safety education and legal measures. Intensification of road safety drives, driver’s education and strict enforcement of traffic regulations, and accident prone section of road signs should increasingly be exhibited through visual aids.
The CRRI is studying about research in highways engineering in various aspects of road traffic, safety and transportation.

Dr. Srinivasan and Dr. Mahesh Chand (1975) shows that alongwith an increase in population the number of vehicles and the number of accidents have gone up. The level of accidents varies greatly from one state to another state. In this way, their paper has been directed towards the computation of accident rate index (ARI) for the states of India. ARI has been computed through the use of a set of accident ratios which have been considered by assigning to them certain weights. The study has shown that Maharastra is the highest accident risk state followed by Tamil Nadu and Kerala. Least accident risk states is Assam, followed by Punjab and Nagaland. The paper also identifies the factors which may influence the accident risk. Level of urbanization, proportion of three-wheelers and quality of roads are found to be the most predominant factor influencing risk accidents.

Talukdar and Justo (1981) by using the accident records maintained by the Traffic Police Department studied the accident rates in Bangalore city based on different factors such as population, number of vehicles, vehicle ownership, mobility and vehicle movement.

The above study shows that inspite of improper road network in Bangalore city, inadequate facilities for the
various traffic components and tremendous growth of human and vehicle populations, the accident rate (in terms of vehicles and population together) has not been alarmingly high as compared to other cities and other parts of the country. Moreover, it is heartening to note that the fatality rate has shown a decreasing trend during the period 1963 to 1979 though the total number of accidents have registered an increase year after year. This is obviously due to the increase in the number of vehicles on the roads, increase in vehicle movement or vehicular-kilometers and also increase in population without adequate increase in road facilities and enforcement personnel.

Some of the factors responsible for road accidents on rural highways in India are road geometry, pavement width, traffic volume and number of intersections per unit length of road. In a project study completed by the Central Road Research Institute, New Delhi, an investigation on a limited scale was undertaken to establish relationships between accident rates and some roadway and traffic volume factors. The study was taken up intensively on the Bombay-Pune road, which has a mixture of road geometry along its length. To supplement this study, another study on 34 roads in different parts of the country was also taken up. The analysis of data has clearly established that road geometry, width, number of
junctions and traffic volume determine accident rates to a significant extent.

Kadiyali and Gopalaswami (1983) has clearly shown that pavement width, curvature, vertical profile and frequency of junctions of a road are important factors that influence accident rates. By a careful selection of these characteristics while building new roads or while improving existing ones, the accident rate can be controlled.

According to S.P. Bagla (1993), road accidents are a matter of serious concern as they concern all. This is specially so when a majority of these road accidents are avoidable if the road users exercise caution and keep their temperament cool.

In the Fourth National Road Safety Week (January 1993), Jagdish Tytler, revealed that more than 70 per cent of the accidents are caused due to human error. He says that as the victims of road accidents are mainly pedestrians and two-wheeler drivers/pillion riders, it is necessary that the other road users have special consideration for them.

According to G.K. Pillai (1993), more than 57,000 lives were lost and over 3 lakhs injured due to road accidents in 1991. Such high causalities and injury figures are unacceptable and must be brought down. He says to do this, it is necessary that the concept of road safety of the consumers becomes a daily practice not only for other drivers of motor
vehicles but also for other users of the road, including pedestrians.

According to Dargan (1993), the vehicle density has shown an increase of about 30 times since 1950 and in about 2600 vehicles per lakh of population in 1993. The traffic density which was only 1.4 vehicles in 1950, three vehicles in 1980 has further gone up to 9 vehicles per hour on roads. Along with an increase in road vehicular population, it has also registered ten-fold increase in road accidents and more than 10 lakh persons have lost their lives in road accidents since Independence. On an average 155 persons die per day in road accidents in the country, in addition to 700 persons getting injured. There is an accident every second minute and a fatality on road every 9th minute in India.

The Government of India is concerned with the alarming increase in the rate of accidents and for this purpose had set up a Road Safety Cell in the Ministry of Surface Transport in 1986 to collect, compile and analyze the accident figures and formulate necessary programmes and schemes so as to spread road safety consciousness among the road users with a view to arrest the rising trend of road accidents. The Cell has made maiden progress and has been taking measures by involving all concerned agencies, whether in the government or private, by way of organising National Safety Weeks, various types of competitions for target
groups, specially children, youngsters etc. A National Road Safety Week is being formulated with the objective to bring down accident rate drastically by the beginning of the 21st. century.

Though training research and development have vital role to play in the evolution of an efficient transport system, yet a review of the existing training and research facilities in the fields of transport shows that transport studies have been comparatively neglected. A few specialized institutes set up by the government with individual agencies of transport fulfill specific training and research needs of the concerned needs. However, there is no institution which can impart training to those who have to look at transport system as a whole and plan for its future development in a coordinate framework to undertake studies in transport problems from a common outlook and approach. The need for establishing such institutions at the national level have been strongly felt. The NTPC recommend an institute which could frame a common approach to the problems of transport. It would also attract experts of recognition to serve on its faculty to promote original research and impact first-rate training.