CHAPTER 1: INTRODUCTION

1.0 GENERAL:

The problems which arise in attempting to meet a given demand with sustainable transport facility have been closely studied, and transport policy and planning are the two principal issues which need to be addressed. In order to tackle ongoing transport problems – both at the urban and inter-urban level – such as delay in travel, lack of coordinated capacity, demand concentration, congestion, pollution, road accidents etc, a great deal of attention has recently been paid to new issues emerging in transport system analysis. As a consequence, innovative models / methodologies have been geared to create new tools and technologies to cope with these spatio – temporal transport changes in transportation system analysis (from both the demand and supply side) (Reggiani 1997).

The causes for these problems are multifold ranging from low operational performance of networks to irregular land use planning. Major urban problems consist of large number of non conforming land uses and structures resulting from the lag in control of urban design behind economic development (Wright Hiat 1989). Structural policies such as well planned transport infrastructure expansion, planned deconcentration and comprehensive management of land use structure can help in providing long term solution to the urban transport problems but they require careful coordination of transport policies within a broader city development strategy. This thesis work focuses on development of a scientific approach in the design and
planning of road network to improve the operational performance and promote functional and hierarchal connectivity.

Policy decisions and strategies to solve the urban transport problems are not adaptable to the economy and the existing system. These decisions are crucial for an economy as they change the urban structure (Yakov Zahavi 1978). Since transportation policies seek to encourage the fullest use of existing infrastructure before committing substantial additional capital investments (Stephen R. Alderson and Yorgos J Stephanedes 1986), an approach to design the supply system with optimal utilization is attempted.

1.1 POLICY BACKGROUND:

An overview of the current National and International urban transport issues and policies are presented below. The review offers a critical assessment of the contemporary efforts made at different scales and in different countries in trying to produce transport policies which are politically, socially and environmentally acceptable.

1.1.1 INTERNATIONAL POLICIES:

1.1.1.1 DUTCH URBAN TRANSPORT POLICY:

Dutch physical and transportation planning practice is characterized by a plethora of concepts, rules, regulations and instruments aimed at reducing the growth in car mobility. The spatial mobility policy (1960 – 1990) was based on four key elements: (1) location of new developments in existing urban regions, (2) good public transport connections for new developments, (3) mixed housing, employment and services on the scale of the urban region and (4) location of
employment in the immediate proximity of railway stations (Danielle Snellen et al 2005). These key elements were to result in shorter travel distances, and an increase in the use of public transport and non-motorized transport modes like the bicycle. The role for spatial planning in policy from Transportation Planning Perspective 1979-1995 was to reduce the need for travel through adequate coordination and integration of areas for housing, jobs and services. The policy intention for the National Traffic and Transportation Plan published in 2000 [NTTP 2000, Ministry of Transport, public works and water management (TPWWM)] holds similar views on the relationship between urban planning / urban form and travel and transportation.

The focus is no longer on the reduction of mobility, but on mobility management; in other words, on finding ways to accommodate the need for travel and transportation while reducing their negative impacts, such as pollution and risk. The role of urban planning and design is to contribute to a more efficient use of infrastructure and to attain better accessibility and mode choice. Locations that are visited on a daily or almost daily basis should be located in walking or cycling distance, while new residential or work locations should be developed near nodes of road and public transport infrastructure.

Basically, these policies can be divided into two categories: policies that aim at controlling the location of activities and policies that aim at improving connections between activities by different transport modes (multi modal transport systems).
1.1.1.2 SINGAPORE TRANSPORT POLICY:

Singapore is one of the successful cities in Asian cities on urban land transport management. It has vibrant economy, small land area, large population, high demand on peak hours and about 31% modal share of cars. The review of urban policy indicates an integrated approach based on economic issues (Lim Lan Yuan 1997). The solutions suggested include supply system enhancement, demand management linking demand utility over a space, alternative urban structures with decentralization of land use and intermodal coordination.

1.1.1.3 CHINA TRANSPORT POLICY:

The technological advancements in developing country like China resulted in conditions of road congestion, more average travel time, pollution, accidents, confusion of transport order, and lower usage rate of road area. Supply enhancement measures for addressing these problems included road development covering 6.6 sq.m/person from 2.2 sq.m/person and functional road development. The strategies adopted could not succeed in a congenial urban environment in China due to lack of integrated planning, unbalance in supply and demand, unreasonable hierarchy in transport structure making the transport policy not adaptable to the system (Wen Du 2003). Hence the counter measures included policy decisions and formulations on supply enhancement, integrated strategies, traffic planning, equilibrium of supply and demand, traffic structure optimization for a sustainable development.
1.1.1.4 SEOUL TRANSPORT POLICY:

Seoul’s transportation was focused on surface trams in 1945 which shifted to public transportation after 1960 comprising of rail, bus and taxis. 22% of the nation’s vehicles are concentrated in Seoul with a travel demand of 2.3 million vehicles per day having 20.2 % of roads in city area. The Seoul transport policy has been changing over last decades as the traffic environment has changed. Prime directions of the transport policy (2000) are improvement of public transport, effective control on private cars, expansion of infrastructure through circular and radial expressway construction, introduction of Intelligent transport systems (ITS), integration and coordination of transportation systems and encouraging green travel modes (Gyenchul Kim and Jeewook Rim 2000). The policies are directed towards balanced application of demand management and supply management strategies. However, the latter independently could not mitigate the urbanization problems / traffic congestion as new construction of infrastructure generated additional demand.

1.1.1.5 INDONESIA URBAN TRANSPORT POLICY:

Indonesia’s population is rapidly growing and rapid motorization has led to dispersed settlement patterns, high demand for travel, severe and growing congestion and associated problems of safety and pollution. Private car ownership levels are still low and most people depend on public Transport. The policy statements eventually covered the following; Institutional Framework, Land Law, Central and Local
Government Funding, Role of Private Sector, Integrated Land Use and Transport Planning, Travel demand Management, Traffic Management, Infrastructures, Public Transport, Safety, and Environmental Management and Pollution Control (Sutanto Soehodho 1999). On infrastructure planning side, supply system enhancement is integrated with demand management to meet the demand. Before undertaking new construction, Government has ensured the fullest use of existing infrastructure. The overall transportation plan is framed based on the road hierarchy study. A road hierarchy review is carried out for each city, to identify shortcomings in the functional road network. The country planning on infrastructure is based on road utility with a lead to enhancement of system coordination.

1.1.1.6 RUSSIAN URBAN TRANSPORT POLICY:

Russia’s urban population contributes to 73.3% of the total nation's population and the capital of Russian Federation, Moskow is reckoned to be one of the 12 biggest cities in the world. Urbanization has stopped since 1980’s and the focus of transportation policy has shifted from meeting the demand to maintaining the existing system and improving the service operations. The current strategies for sustainable development are improvement of existing infrastructure, traffic management control, improvement of transport service quality, promotion of public transport and green modes, use of new technologies for better service and efficiency, regular monitoring and auditing of land use and infrastructure through road user tracking,
introduction of ITS with need based planning on environment friendly transportation system (Vadim Donchenko 2004)

1.1.1.7 VIET NAM URBAN TRANSPORT POLICY:

Vietnam is an Asian country separated from China and is influenced by the Chinese urban planning. The dominant mode of transport in urban cities in Vietnam is two wheeler traffic (56%) and supply system configuration is spread over 8% of the total area. Rapid development has led to traffic congestion and inadequate supply. Key policy suggestions made for sustainable development include improvement of traffic management strategies, public transport, supply system enhancement providing road network of 300 m / 1000 people and providing adequate infrastructure facilities to cyclists and pedestrians (Luu Duc Hai 2003).

1.1.1.8 AUSTRALIAN URBAN TRANSPORT POLICY:

Australian cities are low density cities with high car ownership rates and high trip lengths in the world. The car dependency is about 95% in urban areas and public transport is less which makes the entire system having less access to economic and social activity. Moreover the land use planning has assumed car dependence and the prevailing taxation policies encourage car ownership. Hence policies and strategies were directed towards improvement in access by public transport service. The policy responses include funding strategies for enhancing public transport utility, development of transport
infrastructure to improve access, monitoring the operations etc in the interest of social advantage (Graham Curie 2009).

1.1.1.9 UNITED STATES (US) TRANSPORT POLICY:

US transportation poses heavy chronic congestion to 90% of the road users who travel to work by car inspite of low population density. 45% of the users have no public transportation service options and the congestion delays in metropolitan areas add upto more than 4 billion person hours to lost time each year. 1938 – 1956 was an era of enhancing the supply system by constructing new roads and highways. From 1991, focus has shifted to public transport development and demand management strategies through congestion pricing. US Transport Policy (2009) is directed to preserving and enhancing the infrastructure and systems that already exist. The transportation system is centered over five over – arching goals a. Economic Growth, b. Connectivity, c. Metropolitan Accessibility, d. Energy Security and Environmental Protection, e. Safety. The federal programs are categorized into two categories: 1. Formula-Based System Preservation Programs to ensure connectivity, preserve existing metropolitan systems through maintenance and improving accessibility and 2. Competitive Capacity Expansion Programs to expand the supply capacity in metropolitan areas (National Transportation Policy Project NTTP 2009). Mobility and Accessibility in the network is treated as a function of connectivity with user based conceptualization in US transport policy.
1.1.1.10 UNITED KINGDOM (UK) URBAN TRANSPORT POLICY:

UK is the fourth largest economy in the world where the link between traffic growth and economic growth has weakened in recent years. An increasing proportion of journeys are made by car which has increased from 79% in 1980 to 85% in 2002 posing greater challenges to climatic change. In the 1950s and 1960s, the first transport planning strategies were developed aiming at promoting use of the car through new road construction and improvements to existing congested pockets in road network by predict and provide policy. By the mid-1970s, a new system of transport planning was introduced which made local authorities recognize other factors such as the environment, land use and social equality in access to transport. The 1980s was a decade of changing policies with increasing public awareness of environmental issues, and this is probably linked with the final few 'first-generation' motorways. In 1989, National Road Traffic Forecasts predicted a 142% growth in traffic levels between 1989 and 2025 which initiated the policy change to alternate route development and improve the existing supply system. In 1994 'UK Strategy for Sustainable Development' and 'Planning Policy Guidance Note 13’ were released addressing integrated transport and land-use planning. In 2000, the ten-year plan was published with 'anti-car and anti-motorist label' and there was a shift in policy back, to include road construction. The latest policy change was made in 2004 which provides a balanced approach in relieving congestion and provides the strategy for the networks till 2030 (Future of transport: Network for
2030 by Department of Transport, UK). The policy aims to improve safety in the network, deliver promptly additional road capacity where it is justified – balancing the needs of motorists and other road users with wider concerns about the impact on the environment, including the landscape; achieve greater performance out of the road network through improved management; facilitate smarter individual choices about the trips, giving people alternatives to use their car, particularly for short journeys; and support and promote these choices by ensuring that new ways of paying for road use make practical options (UK Transport Department Policy and Planning, 2004). The strategy charts a course over the next 30 years by enhancing the capacity of the road networks, introducing ITS and adopting demand management strategies by road pricing, carpooling etc.

1.1.1.11 GERMAN TRANSPORT, LAND USE AND TAXATION POLICIES:

Germany adopts a five folded policy for transport sustainability in Germany (Eco-Logica 2009).

- Taxes and restrictions on car use help limit car use and mitigate its harmful impacts.
- The provision of high-quality, attractively priced, well-coordinated public transport services offers a viable alternative to the car for many trips, especially in large cities.
- Infrastructure for non-motorized travel has been vastly improved to increase the safety and convenience of walking and cycling.
• Urban development policies and land use planning have encouraged compact, mixed-use development, discouraged low-density suburban sprawl and thus kept many trips short enough to make by walking or cycling.

• All of these policies have been fully coordinated to ensure their mutually reinforcing impact.

1.1.1.12 EUROPE TRANSPORT POLICY:

European countries are facing a decreasing trend of mass transport utility from 60 – 70% to 20 -25% with 98% of transport depending on oil. Transport policies were made in 1995, 2001 and 2005. Policies in 1995 and 2001 were focused on infrastructure requirements for improved mobility and integration of system. European Policy (1994) strided a balance between economic development and the quality and safety demands made by society in order to develop a modern, sustainable transport system for 2010. Main strategies were intermodal coordination, corridor improvement, new demand management strategies, use of green technologies and effective transport management strategies (European Transport Policy 1994, European Commission). The major problems which were prevailing even after the policy initiations in 2001 were congestion, safety, pollution, lack of functional infrastructure, public transport etc. A European Union National Transportation policy was framed for 2006 – 2025 (National Transport Policy for 2006-2025, Ministry of Infrastructure, European Union, 2006) from social, economic, spatial and ecological aspects for a sustainable development with substantial
improvement of the quality of transport system. The main strategies for 2006 policy were improvement in accessibility, efficiency and transport quality, development of integrated transport system, enhancing safety and reducing the negative impact of transport on the environment and conditions of living (National Transport Policy for 2006-2025, Ministry of Infrastructure, European Union, 2006). Majority of the strategies for mobility improvement were on supply system with enhancement implementation requisites through functional corridors development, alternative path development, better use of existing infrastructure and traffic management.

1.1.2 NATIONAL POLICIES AND INITIATIVES:

India’s urban population is 30% of its total population with only 16% of road network in developed cities and meeting the demand is the challenge many Indian cities are facing (Sanjay K Singh 2005). Public transport systems have not been able to solve the urban transportation problems due to increase in personalized mode of transport and Intermediate para transit. The aspects of an urban transport policy have been articulated by a number of committees and expert groups. Important amongst them are the recommendations of the Metropolitan Transport Team (1970), the National Transport Policy Committee (1980), the study group on Alternative Systems of Urban Transport (1987), the Steering Committee of Transport (1988) and National Commission on Urbanization (1988) (Ranganathan 1995). They have all noted the growing urban travel demand, stressed its importance for the
overall development and identified a number of policies and programmes for its development. Some of the major urban transport initiatives are presented below

1.1.2.1 JAWAHARLAL NEHRU NATIONAL URBAN RENEWAL MISSION (JNNURM) 2005:

Jawaharlal Nehru National Urban Renewal Mission (JNNURM) 2005) aims at encouraging reforms and fast track planned development of identified cities with a focus on efficiency in urban infrastructure and service delivery mechanisms, community participation and accountability of Urban Local Bodies/parastatal agencies towards citizens. Redevelopment of inner (old) city areas including widening of narrow streets, shifting of industrial and commercial establishments from non-conforming (inner city) areas to conforming (outer city) areas to reduce congestion, urban transportation including roads, highways, expressways, Mass Rapid Transit Systems, and metro projects; Parking lots and spaces on Public – Private participation basis are some of the key areas of JNNURM.

1.1.2.2 NATIONAL URBAN TRANSPORT POLICY – INDIA (NUTP, GOVERNMENT OF INDIA 2006):

National Urban Transport Policy (NUTP) was approved in 2006 to help in addressing the unprecedented increase in transport problems that the major cities in the country are facing. It focuses on the development, construction and operation of better transport systems / facilities to encourage public transport and improve access of
business to markets and the various factors of production. The main focus is to bring about a more equitable allocation of road space with people, rather than vehicles. The major thrust areas included integrated planning, a rational share between public and private modes, choice of appropriate and relevant technology for public transport systems, optimal use and management of available resources (road network and operating systems), restructuring of monetary and fiscal policies to encourage and promote urban transport and establishment of institutional arrangements, at all levels of governance, particularly at the city level, for the planning, development, operation, management and coordination of urban transport systems.

1.1.2.3 11TH FIVE YEAR PLAN ON URBAN TRANSPORT BY PLANNING COMMISSION (2007 – 2012):

Working Group for the 11th Five Year Plan on Urban Transport, constituted by the Planning Commission of the Government of India in 2006 proposed an integrated land use and transportation planning with land use and transport interventions. 11th plan has identified the need of effective road network planning in a systematic and hierarchical manner which should aim at a topology that provides alternative routes of movement. The guidelines for promoting a hierarchical road network system consisted of:

♦ Cities with a population of more than 1 million could plan for Ring Roads with partial access control and having a maximum right of way of 60 meters.
Arterial Roads with partial access control and a maximum right of way of 45 meters could be planned in cities with a population of more than 5 lakh

Other major roads with a maximum right of way of 30 meters could be planned in cities with a population of more than 1 lakh

Distributor / Collector Roads with a maximum right of way of 30 meters could be planned in all other cities

1.1.2.4 TRAFFIC AND TRANSPORTATION POLICY AND STRATEGY STUDIES FOR URBAN AREAS IN 2008:

Traffic and Transportation Policies and Strategies in Urban Areas in India was conducted in 1994 to establish the urban transport scenario and forecast the anticipated issues that would most likely crop up in the future. A similar study to 1994 was conducted in 2008 on traffic and transportation strategies in urban areas in India to update the transportation information and projections made from the previous study and review NUTP 2006. As a part of the study, several performance evaluators were developed such as accessibility index, congestion index, walkability index, city bus supply index, safety index, para-transit index, slow moving vehicle index, on-street parking interference index and transport performance index which were computed for 30 cities out of 87 cities in India (Traffic and Transportation Policies and strategies in urban areas in India 2008). Transport infrastructure requirements were computed to Rs 4,35,380 crores for all the 87 cities for the next 20 years. Small
and medium cities are planned for smooth and safe traffic flow by ensuring travel by non-motorized modes to continue to be safe by proper Non–motorized transport (NMT) management, improvement / development of urban roads, various traffic management measures, implementation of bus transport along major corridors for cities without public transport (PT) currently and augmentation of bus services for cities having PT in the next 20 years. Larger cities would need largely the same interventions as small/medium cities with the difference that these cities have to plan for medium to high capacity mass transport systems and terminals. The central policy suggestions that have emerged from the study are mass transport supply, non-motorized transport, traffic system management, transport demand management and ITS, information system development and integrated transport – land use planning (Traffic and Transportation Policy and Strategy studies for urban areas in 2008).

### 1.1.3 DISCUSSION ON REVIEW OF INTERNATIONAL AND NATIONAL URBAN TRANSPORT POLICIES:

An overview of the understanding of current National and International urban transport issues and policies are presented below in the table 1.1.

**Table 1.1: Review of International and National urban transport policies**

<table>
<thead>
<tr>
<th>SNo</th>
<th>Country / region</th>
<th>Core policy issues – Supply and Demand</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Dutch</td>
<td>Improvement of infrastructure by controlling the activity levels between / among nodes</td>
</tr>
<tr>
<td></td>
<td>Country</td>
<td>Approach Description</td>
</tr>
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</tr>
<tr>
<td>2</td>
<td>United States</td>
<td>Demand – Supply – System Coordination based integrated approaches analysed over spatio – temporal frames. Multifaceted objectives configures and controls the land use permission and infrastructure development</td>
</tr>
<tr>
<td>3</td>
<td>United Kingdom</td>
<td>Social equality, environment and land use are the hallmarks suggestive in framing the urban policy</td>
</tr>
<tr>
<td>4</td>
<td>Indonesia</td>
<td>Road utility enhancement - Dynamic changes of demand by coordinating existing infrastructure in an optimal manner</td>
</tr>
<tr>
<td>5</td>
<td>Germany</td>
<td>Compact and mixed use development – micro level land use transportation planning</td>
</tr>
<tr>
<td>6</td>
<td>Europe</td>
<td>Demand management with sustainable networks</td>
</tr>
<tr>
<td>7</td>
<td>China</td>
<td>Infrastructure optimization through demand – supply equilibrium</td>
</tr>
<tr>
<td>8</td>
<td>Singapore</td>
<td>Supply system enhancement, Demand management, Integrated urban planning</td>
</tr>
<tr>
<td>9</td>
<td>Seoul</td>
<td>System oriented planning - Balanced application of demand management and supply management strategies</td>
</tr>
<tr>
<td>10</td>
<td>Russia</td>
<td>System oriented planning with need based development - Performance evaluation and Operational improvements</td>
</tr>
<tr>
<td>11</td>
<td>Vietnam</td>
<td>Supply system enhancement with Index / Empirical based planning</td>
</tr>
<tr>
<td>12</td>
<td>Australia</td>
<td>Accessibility as main criteria with demand based planning by policies orienting towards social benefits and intermodal coordination</td>
</tr>
<tr>
<td>13</td>
<td>India</td>
<td>Integrated transport and land use planning, Systems integration</td>
</tr>
</tbody>
</table>

Majority of the policies address an integrated planning approach to solve urban transportation problems with a variety of supply
enhancement, demand management and system integration techniques. The strategies to achieve the policies are varied based on the pace of economic development which are well defined for demand management and system integration. Supply system enhancement strategies include new construction approaches and improvement to existing system approaches. There are no scientific approaches framed in the policy guidelines for implementation of these supply based strategies to enhance the supply system capacity.

1.2 DYNAMICS OF URBAN SPATIAL FORM FOR AN UNDERSTANDING OF SUPPLY SYSTEM COMPLEXITY:

Supply system is an integral part of urban spatial form and the dynamics of urban form are complex with a wide spectrum of land use / transport activities interacting to serve different purposes (Vedia F Dokmeci et al 1993). Land use system considers the level of spatial accumulation of activities and their associated levels of mobility requirements representing demand. Land use is commonly linked with demographic and economic attributes which result in traffic generation and attraction. Transport system considers the set of transport infrastructures (node, link, paths, and network) and modes that are supporting urban movements of passengers and freight. It generally expresses the level of accessibility, connectivity and mobility of the supply system. The spatial interactions between the land use and transport systems vary with respect to time and space and consider the nature, extent, origins and destinations of the urban
movements of passengers. They take into consideration the attributes of the transport system as well as the land use factors that are generating and attracting movements. An understanding of the dynamics of urban change is shown in the figure 1.1.

An efficient planning of the urban spatial form can help in achieving sustainable transport that can solve the multifacets of the urban transport problems. Hence, the research in urban spatial structure has emerged as an important area of research as urban planners increasingly attempt to bring conceptual order out of the complex relationships of different types of land uses (Vedia F Dokmeci et al 1993). This work deals with an analysis of the supply system
with respect to demand and planning the urban infrastructure to meet the demand. The conceptualization of this study is lined in parallel to achieve the urban transport policies that attempt to minimize delay, maximize accessibility, revitalize central cities, reduce environmental impacts and lessen the social burdens of transport decisions that currently fall hardest on the disadvantaged.

1.3 PROBLEM CONTEXT:

Demand – Supply - System are the three dimensional frames which configure the directional growth of urbanization. An ideal supply system must be configured to meet the travel demand and incorporate the change of land use and socio-economic characteristics. The spatial configuration of the key elements of the supply system (nodes, links, paths, network) act as transitional fabric/surface for disseminating and shaping the demand profiles over time and space. These transitional entities are often dynamic in nature and are constantly subjected to the change in functionality due to the process of urbanization. The non-systematic planning and orientation of the spatial configuration of these entities makes the system to be non-functional and non-hierarchical posing a low operational performance of the supply system. Non-uniform spread of demand over the supply system due to the dynamics involved in the user preferences, trip lengths, trip orientations and existing undefined hierarchy and functionality of the supply system leads to underutilization of the supply system and non-uniform demand responsive system. Moreover, constant changes in demand created an imbalance
in land use and system characteristics and vice versa. It is difficult to control the dynamics of user preferences, trip lengths and orientations as it involves stringent urban policy decisions to the immediate effect. But hierarchy of the supply system can be defined and controlled by properly spreading the transitional entities uniformly. This strategy would give a lead in controlling the user preferences, trip lengths and orientations over a time frame. This strategy inherently develops a touch stone principle to make demand and supply in equilibrium by development of fractal / self similar transitional fabric to disseminate the demand and deconcentrate it over time and space. The planning can be done if the supply system is assumed as merely a system with no defined hierarchy and treating the nodes and links as equal demand transfer points. The user preferences are then imposed on the supply system to emerge a hierarchical system of paths and links. Similarly nodes can also be made hierarchical over a space which decentralizes the demand and maximizes the access to the area. This hierarchical system shall be oriented to develop a fractal system. When demand and supply weigh uniformly in the equilibrium condition and start exceeding the breakeven point leading to uneconomic travel, risk generation and poor environment conditions, transportation system coordination with demand and supply can be formulated.

1.4 NEED FOR THE STUDY:
Urbanization has resulted in new development which has created a major upward shift in travel demand (Stephen Alderson and Yorgos J Stephanedes 1986). The main urban transportation issue facing cities today due to urbanization is mobility that has specific problems of failing infrastructure, accidents, uneconomic travel, risk in travel, pollution and traffic congestion (Angelica Lozano and Giovanni Storchi 2001, Ting – Yu Chen et al 2001). Infrastructure failure / supply system failure is due to lack of proper orientation of the supply system to meet the demand, lack of capacity in supply system and demand concentration (Masuo Kashiwadani and Yasao Asakura 1995). Measures for alleviating these problems can be classified into three broad categories – Supply system measures, demand management measures and the measures that concern the development of alternative urban structures conducive to the dispersal of economic activities and improved physical integration between activities (Lim Lan Yuan 1997). An ideal urban transport policy should address the problem with an integrated approach considering all the three strategies mentioned above. The study attempts the supply side facilities to promote functional and uniform utility of the supply system as supply system in the city affects the user trip length, economy, safety (Anez J et al 1996). Urban planning from the supply side results in less transport intensive, less costly, more efficient and congenial environment (Lim Lan Yuan 1997). If the static supply system is fully utilized to meet the dynamic demand, a demand – supply equilibrium is attained. Hence an orientation to
supply system is required that consolidates the supply entities (nodes, links, paths, network) in a self similar, uniform and homogeneous manner to integrate with the neighborhood supply systems. This can be achieved by demand deconcentration uniformly in the supply entities.

1.5 OBJECTIVES OF THE STUDY:

Development of supply system planning strategies for its enhancement and maximizing its utility is identified as the potential gap in the policies to address urban transportation mobility problems, infrastructure and functionality issues; and hence is considered as the need for study. The objectives to achieve this are framed as follows.

1. Development of policy framework, strategies and implementation needs addressing urban mobility, infrastructure and functionality issues.

2. Development of an approach for an integrated supply system orientation with uniform spatial coverage and similarity that tend to demand deconcentration.

3. Optimization of existing facilities to provide improved accessibility to most of the road users.

4. Development of Supply system evaluation design and improvement guidelines for urban areas considering system wide impacts.
5. Development of demand and supply characterization analyzers for spatial planning of urban form through road user concepts.

1.6 LEAD TO THE STUDY:

Transport and Urban Land use are mutually dependant, which makes the coordination of urban development and transport activities difficult. Most transport plans take land use as given and determine the demand for travel; while urban development policies are driven by the existing transportation networks, i.e.; they assume the transport system is in right place and fit development around that infrastructure. An innovative view would be that the transport system could be changed to meet the needs of new development, rather than to force the land use to fit the transport system; while new land use development would be redirected to desired transport corridors. The development of new technologies has enabled urban planners and transport professionals to visually analyze transport projects in the context of whole area (Peter G. Gipps et al 2001).

The objective of the study is to develop a spatial configuration of the supply system that generates equilibrium between demand and supply systems. The orientation and planning of the spatial configuration must accept the demand uniformly and similarly for maintaining a controlled environment in travel. The demand accepting supply entities likes nodes, links, paths and network must be disseminated uniformly with a self similar characteristic. These demand accepting supply entities would be highly functional and
hierarchical compared to their counterparts in a supply system due to the morphological and topological characteristics of the urban spatial supply system. Identifying these transitional entities in a supply system (network) and orienting to match the neighborhood characteristics is attempted with an analysis of dynamic demand profiles over the static network. Nodes and Links that are highly functional and that act as quick interchange points in transferring the demand between multiple nodes in a network must be identified uniformly for generation and processing of a fractal network.

The lead is extended from the observation that the roads are non functional, non hierarchical and treated in static form when demand profiles are configured on these with variable trip lengths, trip orientations and trip intensities over a time and space. To achieve demand and supply equilibrium, options that can be formulated fall into two categories: a) Configuration of the supply system to meet the demand and b) Demand management to match the supply configurations. The work addresses the first strategy to achieve an effective urbanization. The elements of supply system configuration are shown in the figure 1.2. Conventional practices for demand – supply equilibrium focused on location of origins, destinations, mode split, route assignment, purpose of travel, travel time etc. This approach attempts an analysis with the harmonious demand attainment variables in a network such as trip intensity in terms of static utility of nodes and links in a network, dynamic traffic flows,
trip orientation to signify the travel interactions and patterns between the traffic generating nodes, trip lengths to signify the user preferences in travel. The demand – supply equilibrium approach suggested in the study is valid until the attainment of the equilibrium level. As the equilibrium status progresses leading to urban disasters, an interference of transportation system coordination is warranted.

1.7 ASSUMPTIONS IN THE STUDY:

An analysis of urban spatial form characteristics comprising demand and supply entities is attempted with the following assumptions framed in the study.

1. Functional roads are assumed to represent traffic demand network. Functionality of road links are designated on the basis of outward representation of travel demand identified.
2. Travel between origin – destination (OD) pairs is restricted to take place solely along the user preferred paths.

3. Travel demand of trip interactions are loaded on the shortest paths which are assumed to be user preferred paths under ideal conditions of level of service.

4. The functionality of the transport system is assumed to be non-influential in assessing the demand interactions laid on network.

5. Traffic analysis zones were assumed to be delineated by ward boundaries for the estimation of OD matrix.

6. Euclidean distance is assumed to be the impedance factor considered in generation of user preferred path.

7. The spatial evaluation of network is proxy to the operational performance of the network without the real time dynamics of travel.

1.8 ORGANISATION OF THESIS:

This thesis describes the approach for solving typical transitional urban area transportation problems by addressing the network issues in similarity and decentralization concepts for Indian context. The design of the study and its results are reported in 8 chapters.

- Chapter 1 discusses the background of the study with the review of National and International urban transport policies and the objectives, assumptions, need and lead for the study.
• Chapter 2 outlines the literature at National and International level on urban form entities and identifies the research gap in the literature.
• Chapter 3 presents the research design of the thesis. It elaborates the supply system planning issues and discusses the conceptual framework underlying the study.
• Chapter 4 presents the operational decisions underlying the data collection and the selection of study area. This is followed by a discussion of the characteristics of study area in more detail. The data includes network and travel characteristics to operationalise the research thought.
• Chapter 5 presents the results of the data analysis when applied to the study locations.
• Chapter 6 presents the evaluation and validation of the approach.
• Chapter 7 presents the major findings of the thesis and their discussion.
• Chapter 8 presents the summary and conclusions.