Chapter II

Review of Literature

It is universally recognised that infrastructure development plays a critical role in initiating and accelerating the process of economic development and that it is a powerful instrument for realization of the objective of balanced regional development. In a developing country like India, infrastructural facilities are weak and inadequate. Many people, especially the rural poor and areas do not have access to minimal infrastructure services. If the nation aspires to improve the socio-economic development of the people, it must give a big push to the upliftment of the facilities of infrastructure. Various researchers have tried to analyze the contribution of infrastructure in different aspects of different countries and economies. So, in this chapter an attempt has been made to review the existing literature on the following aspects.

1. Impact of infrastructure on industrial performance
2. Relationship between infrastructure and Foreign Direct Investment
3. Impact of infrastructure on economic growth of India
4. Impact of infrastructure on pollution

Section 2.1

Impact of Infrastructure on Industrial Performance

Ganguly and Sharma (1988) emphasized that overall industrial growth of India has been largely dependent on infrastructural development. This fact assumed even greater significance in this context, given the growth-oriented industrial policy, huge stock of trained manpower and high rate of savings and capital formation. They have tried to show in an empirical manner the impact of growth of infrastructural sectors, viz., electricity, coal, steel, crude petroleum, petroleum products, cement, railway, etc. on the overall industrial growth. The authors felt that from the standpoint of economic policy making, this study would be of great practical relevance because for achieving a particular level of industrial growth, matching level of infrastructural capacity becomes an imperative necessity.

Shah (1988) attempted to quantify the impact of public infrastructure on private sector productivity in Mexico by taking the data for 34 industries for the period 1970-
83 and applied the technique of restricted cost function approach. The findings showed that the level of public infrastructure in Mexico was close to the level desired by the private sector and was weakly complementary to both private capital and labour. The long run multiplier effect of public infrastructure on output, as measured by the output elasticity of public infrastructure, was positive and significant, suggesting that better upkeep of existing infrastructure would have positive impact on labour and product markets. The rates of return to the industrial sector from its involuntary and indirect investment in public infrastructure have been roughly comparable basically because of the existence of excess capacity. The occurrence of excess capacity was attributed to reasons like subsidies to capital, technical change, regulation, sector specific capital, scale economies, trade barriers and product demand expectation.

Feltenstein, A. and J. Ha (1995) examined the relationship between the provision of infrastructure and private output in 16 sectors in Mexico by developing an econometric analysis of the sectoral elasticities of these sectors. They have taken three types of stocks of infrastructure i.e. transport, electricity and communication. Then they estimated sector-specific cost functions in which the cost of output depended on wages; the cost of capital, represented by the interest rate; and the nominal values of the stocks of the three types of infrastructure. To estimate the effects of public capital on productivity and production structure of the industries, they specified a translog production function augmented by the nominal stocks of infrastructure. Taking data for the period 1970-90 their study concludes that infrastructure in electricity and communication generally reduces the cost of sectoral production, but transportation infrastructure tends to increase costs of sectoral production. They further include the Mexican public expenditure on electricity and communication has enhanced the productivity of private production, but expenditure on transport might actually had detrimental effect on private output.

Gayithri (1997) stated that industrial development of a region is guided by various factors of which infrastructure facilities play a key role in the industrial development and performance of a region. The high positive correlation observed in the case of Karnataka between the infrastructure and industrial development highlighted the need for the availability of adequate infrastructure facilities in promoting industry. Concentration of industrial development in four districts-Bangalore, Dakshina
Kannada, Belgaum and Mysore, in terms of the value added, despite the continued measures of government to disperse industrial development across all districts, also speaks of the infrastructure facilities. It was made clear that the so called tax holidays, incentives to disperse industry to backward areas etc. were not considered seriously while investment proposals were made. On the other hand, it was the infrastructure, especially the power supply which was given considerable importance and the reasons entrepreneurs cite for the deceleration of industrial growth in Karnataka has been due to power crisis. These aspects attain special importance in the context of ‘New Industrial Policy’, wherein the industry in the liberalized regime has to sustain global competition. Hence, the focus has to be more on enhancing the efficiency of the industry by giving adequate infrastructure support rather than spread industry to all nooks and corners of the state. Alternatively, the focus could be on gearing certain clusters with good industrial potential to prospective industrial growth centres by providing them with the necessary infrastructure.

Duggal et al. (1998) incorporated infrastructure into the production function as part of the technological constraint rather than as a discretionary factor input. Their theoretical model specified a technological growth rate as a nonlinear function of infrastructure and a time trend, the latter capturing the effect of all other variables on the growth rate in technology. The time trend and infrastructure were modeled so as to be interactive rather than additive. The functional form estimated allows for a ‘S’-shaped production function which embodied not only the properties of a long-run production function but also those exhibited in the short run. Their results suggested that infrastructure plays an important role in determining the level of productivity. They validate the Aschauer results in that his estimates of infrastructure's output elasticity fall within the range identified in this study. Additionally, by specifying infrastructure as part of the technological constraint, their study demonstrated that the impact of infrastructure was not constant. It has been made clear that the significance of infrastructure cannot be overestimated as a major determinant of productivity. It was worth emphasizing that infrastructure's importance will only increase as it interacts with higher levels of technological innovations. By using a core definition of infrastructure, this study only scratched the surface of infrastructure's total contribution to productivity gains. As the information super highway becomes a reality, cutting infrastructure does not appear to be a wise decision. Even though
much of the investment in the information sector is private, it depends strongly on public licensing, regulation, and support in being a common carrier' that serves industry and the population at large, just as infrastructure, in the broad sense, is supposed to do.

Goel D.(2003) focused on the productivity impacts of the provision of infrastructure on the registered manufacturing sector in India. This has been analysed by estimating the cost elasticity of infrastructure inputs. For this purpose a variable cost function model for the manufacturing sector with cost as a function of the prices of the variable inputs, levels of output and infrastructure stocks have been taken. Variable inputs include capital, labour and intermediate input. Infrastructure is assumed to be quasi-fixed inputs since its provision is done mainly by the public sector and it cannot be instantaneously adjusted in the short-run. The cost function model estimated consists of the variable translog cost function and the cost share equations for the variable inputs. The time series data pertaining to the period 1965-1999 have been used. Twenty-three infrastructure variables were used in the study which were aggregated using Principal Component methodology. Three alternative specifications of the quasi-fixed inputs were explored. The alternatives were economic infrastructure, social infrastructure and aggregate infrastructure. Estimated results suggested that infrastructure provision enhanced the productivity in the manufacturing sector and it helped to lower the costs in the sector. Apart from this it also had several bias effects with respect to the variable inputs.

Srinivasan et.al. (2008) tried to examine, whether infrastructure tends to generate spillover externalities, as has been the assumption in much of the development literature. The study says that one may reasonably look for evidence of such indirect effects in the accounts of manufacturing industries. Empirical support of this assumption has so far been ambiguous. The analysis of Indian data, however, revealed substantial externality effects from the states infrastructure to manufacturing productivity. The analysis separated the direct effects of roads and electricity, as mediated by the infrastructure services purchased by manufacturing industries along with other intermediate inputs, from the indirect effects, as measured by the impact of infrastructure capacity on the Solow productivity residual. He concluded that in the 20 years from 1972 to 1992, growth of road and electricity- generating capacity seems to
have accounted for nearly half the growth of the productivity residual of India’s registered manufacturing.

Section 2.2

Impact of Infrastructure on Foreign Direct Investment

Shah (1992) estimated a translog (transcendental logarithmic) cost function for the Mexican economy in a restricted equilibrium framework to examine the contribution of public investment in infrastructure to private sector profitability. He considered a restricted cost function in translog form which treated labour and private capital and public sector capital stock in transportation, communication and electricity as quasi-fixed inputs. The study estimated a system of non-linear equations comprising variable cost function and derived input using data from 1970-1987 for twenty six Mexican three-digit manufacturing industries. Empirical results characterized the Mexican industrial structure as having increasing returns to scale, short-run deficient capital capacity, involuntary unemployment and declining productivity growth. The study found a small degree of complementarity between labour and infrastructure. The study also found that factor demand response to input price changes was quite limited and technical change was capital-using and labour-saving variety. Public infrastructure was observed to have a small but positive multiplier effect on output. The private sector was observed to have earned substantially higher returns from its direct and voluntary investment in physical capital than from its involuntary and indirect investment in public infrastructure. The shadow price of private capital was also higher than the opportunity cost of funds. The existing levels of private and public capital stocks were below their static equilibrium values. A highly regulatory regime, uncertain political and business climate and severe strains on the economy caused by servicing a high level of foreign debt might have been contributing factors for this disequilibrium. Thus it was emphasized to remove disincentives to domestic and inward foreign investment and to upgrade the public infrastructure in Mexico so that scale economies could be exploited in the near future.

Creightney (1993) analysed the impact of transport on productive activity particularly in case of developing countries. It was observed that transport has both direct and indirect impact on production. In direct effects, it was seen that in order to maintain productive capability, the manufacturers in Nigeria had provided their own
transport services despite the high cost of doing so, which indicated the importance of having reliable infrastructure input. It was also observed that high quality transport services and infrastructure in a particular area could lead to spatial concentration of firms and the benefits of agglomeration. Also it was observed that for the countries in the early phases of development, good quality infrastructure was preferable to tax incentives for attracting foreign investment. Further, it was opined that transport infrastructure can also influence production indirectly through various mechanisms like price, technology difference and credit which affect the survival of firms and entry of new firms into a market.

Nadiri and Mamuneas (1994) examined the effects of publicly financed infrastructure and research and development capital on the cost structure and productivity performance of twelve two digit U.S. manufacturing industries. Pooled time series cross section data for the period 1956-1986 was used to estimate the model. The results suggested that there were significant productive effects from two types of capital included in his study. Their effects on the cost structure vary across industries. Not only is the cost function shifted downward in each industry generating productivity inducement, but the factor demand in each industry was also affected by two types of public capital suggesting bias effects. Two main points drawn from the study were: (a) the public infrastructure capital affect the cost and productivity of the private sector industries. (b) other types of publicly financed capital such as public investment in R&D, significantly affect the cost and productivity of different industries and had high social rates of return.

Bagchi (2001) pointed out in his study that accessing of capital market funds for financing capital investments in urban infrastructural services by the city governments is not beyond their capacity. However, it would need certain financial, structural, institutional, administrative changes and restructuring of city governments. Moreover, in the initial stages, it would remain confined to larger corporations only. To make such initiatives successful, the measures would be:

1. Providing certain revenue sources at the disposal of local governments that have the reflections of the cities income as octroi;
2. Transformation of the urban governance system as a whole, where state government would exercise limited control over finances and administration of city governments;
3. Certain changes in the capital market structure which would make it possible to generate long-term sources for the urban infrastructure sector;

4. More coordination between the financial department and engineering department of the municipal entity.

5. Development of the physical aspects of the project prior to mobilising resources from the market.

Greater coordination between the elected representatives, the municipal commissioners, executive officers and the state governments was a necessary precondition to bring about certain changes in the existing municipal legislation and adopting harsh measures.

**Dandekar and Mahajan (2001)** conducted a survey of the Mumbai-Pune expressway which pointed out that delivery of infrastructure like roads and highways totally through the private sector was different. The interest was to critically examine the model for incorporating the private sector in physical infrastructure development that was emerging in the Mumbai-Pune expressway, and made an assessment of benefits as well as concerns. This project brought online an essential and long-overdue piece of physical infrastructure. The new form of public/private joint sector effort was evolved, appeared to be dynamic, flexible and open in its approach. MSRDC appears to have developed a lean, efficient, contemporary organisational structure, acquired the necessary technical skills and developed the necessary enterprising spirit, capable of and supporting decentralised decision making. Maharashtra State Road Development Corporation (MSRDC) also demonstrated an ability and readiness to cooperate and coordinate with the contemporary private sector constructively and way that was responsive to its concerns.

The public-private joint sector model of liaisons proved to be effective and appeared to be able to successfully deliver the necessary infrastructure. The reservations and caveats about this approach centre around the question of whether this organisational structure was able to withstand the forces of bureaucratisation, maintain financial viability, and was replicable and sustainable financially and institutionally over the long term.

**Kumar (2001)** analyzed the role of infrastructure availability in determining attractiveness of countries for FDI inflows and their export-orientation. The study found that investments by governments in providing efficient physical infrastructural
facilities improve the investment climate for FDI by subsidizing the cost of total investment by foreign investors and thus raising the rate of return. The study utilized the a single composite index of infrastructure availability of transport infrastructure, telecommunications infrastructure, information infrastructure, energy availability, etc. because of lack of a comprehensive indicator of different types of infrastructures. The role of an infrastructure index in explaining the attractiveness of a country as a host for foreign production by MNEs is evaluated in the framework of an extended model of foreign production that was based on the gravity model of foreign trade and theories of international investment. The study suggests that infrastructure availability does contribute to the relative attractiveness of a country towards FDI by MNEs, holding other factors constant. Furthermore, the export-orientation of production of MNE affiliates, especially when the production is meant for third country markets, was significantly related to infrastructure availability. It is clear, therefore, that besides its direct contribution to growth, infrastructure investment contributes to improvement of overall investment climate in the country and helps attract FDI. The study also suggests that infrastructure development should become an integral part of the strategy to attract FDI inflows in general, and export-oriented production from MNEs in particular. The findings of research reveal that rather than getting sucked into competition with developed countries by offering investment incentives, governments of developing countries would do well to focus on development of physical infrastructure in their countries. This would help to mobilize the domestic as well as foreign investments and help in expediting the process of their development.

Ranade (2001) analysed recent trends in spatial distribution of foreign direct investment on the Western coast of India after completion of Konkan Railway – a major infrastructure project along the Western coast. She investigated the impact of Konkan Railway on Foreign Direct Investment (FDI) in infrastructure and other sectors in its adjoining areas. FDI proposals approved by the Government of India to be located on the West coast South of Mumbai, up to Kerala after the commissioning of Konkan Railway, i.e. from January 1998 to January 2000 were taken into consideration for the study. The study revealed that infrastructure development had a positive impact on FDI on the Western coast. With the commencement of construction of Konkan railway, several other infrastructure projects were also undertaken. The hotel and tourism sector attracted the maximum attention among all
the sectors. Out of 77 FDI proposals approved in India during this period, 35 are located in the western coast. These are primarily located at Mumbai, Goa and Kerala. This suggested that the investors were seeking locations in or around the capital or the core region in order to gain access to local market and to minimize cost involved in accessing the local market. The Western coast of India had also attracted FDI in computer software, chemical and pharmaceutical industries, natural resource based consumer goods, miscellaneous manufacturing industries, hospital and other services. The spatial distribution at various locations were spread over the Western coast and it revealed that foreign investors do not necessarily select the capital or core region, but rather choose location outside the capital where production costs were lower. Transport and other infrastructure has been playing a crucial role in the choice of location. Konkan Railway; a major infrastructure project, has proved to be a new asset for regional development and an instrument to attract FDI in the Western coast of India.

Zhang and Fan (2003) aimed to quantify the driving forces behind the observed divergence of Indian economy. The result showed that in a closed economy with agriculture as pre-dominant mode of production, the comparative advantage was mainly determined by difference in land quality and climate across regions within a country. However, when the economy opens its doors to the rest of the world, region’s comparative advantage is evaluated in a broader global context. Therefore regions adjacent to more developed economies or with better infrastructure such as ports, airports, enjoy a far better location advantage for trade and development than landlocked regions. More investment in physical infrastructure such as roads will bring the interior regions closer to the world markets and reduce regional disparity. Among all the factors considered, education is the only equalizing factor to regional development.

Annez (2006) examined the role of Private Participation in Infrastructure (PPI) in mobilizing finance for key urban services since the early 1990s. It was found that in terms of numbers, Private Participation in Infrastructure (PPI) for urban infrastructure had mobilized little private finance. There were a number of features that raise the risk profile for urban infrastructure for private investors. PPI is inherently limited in scope for financing urban infrastructure for private investors. PPI is inherently limited in scope for financing urban infrastructure for the wide array of non-commercial infrastructure services cities need. Even for commercial services like water supply,
subsidies are prevalent all over the world, and in many of the poorest, most rapidly urbanizing countries, it will be difficult to attract private finance for necessary expansions of the water network while restructuring subsidies to make them financially sustainable and socially acceptable. Local governments need good sources of public finance to fund those services, and some form of government borrowing is needed for major investments in these areas to avoid inter-generational inequities. Experience thus far suggests that PPI has more potential to improve efficiency than to mobilize new finance. Private suppliers have limited their financial exposure in urban PPI even in financially strong developed country cities. The results suggested a more pragmatic and selective approach to the focus on private participation in infrastructure as a source of finance, and more focus on the array of some of the fundamental steps required to make urban infrastructure viable propositions.

Rehman and Ilyas (2011) analysed the effects of infrastructure on FDI inflows and on some other important variables, market size and exchange rate by using time series data from 1975 to 2008 and by applying autoregressive distributive lag (ARDL) approach to cointegration, and found that a significant positive impact in short and long run of infrastructure on FDI inflows in Pakistan. In short run, one percent increase in infrastructure results in uplifting FDI by 1.03 percent and in long run, one percent rise in infrastructure enhances FDI inflows by 1.31 percent. It was also observed that other variables, market size also have positive significant relationship in short and long run whereas, exchange rate has negative significant impact of infrastructure in short and long run. The study suggested that the international donor agencies like UNO, ADB and IMF and Pakistan’s friend countries should primarily focus on infrastructure reconstruction as it will result in twofold benefit, first is rehabilitation and second is in maintaining and uplifting FDI inflows. Moreover, the government policy makers should also pay key consideration to infrastructure along with other factors while making policies in respect of FDI.

Anitha (2012) analysed that FDI plays an important role in the long-term development of a country not only as a source of capital but also for enhancing competitiveness of the domestic economy through transfer of technology, strengthening infrastructure, raising productivity and generating new employment opportunities. The study explained that India emerges as the fifth largest recipient of foreign direct investment across the globe and second largest among all other
developing countries. The huge market size, availability of highly skilled human resources, sound economic policy, abundant and diversified natural resources all these factors enable India to attract FDI. Further, it was found that even though there has been increased flow of FDI into the country during the post liberalization period, the global share of FDI in India is very less when it is compared to other developing countries. It was also found that lack of proper infrastructure, instable government and political environment, high corporate tax rates and limited export processing zones are considered to be the major problems for low FDI into the country. It was suggested that in order to overcome this situation, the Government should revise the sectoral cap and bring more sectors under the automatic route.

Section 2.3
Review of Literature on Impact of Infrastructure on Economic Growth of India

Shah (1970) analyzed the aims and objectives of private sector, added that the private enterprise usually takes investment decisions on the basis of expected profitability which generally tend to shun the infrastructure activity. This tendency on the part of private entrepreneurs was further strengthened by the fact that the infrastructure activities have not only long gestation period but also a further period of several years, if not, of operational losses. Usually the private entrepreneurs are not prepared to wait that long, they prefer that the profits should start flowing much sooner. Therefore, if the construction of infrastructure is left exclusively to the private sector, the job would remain by and large undone.

Prakash (1977) attempted to analyze the regional inequalities in terms of infrastructural facilities in India during 1951-71 with the objective of determining the extent of existing inequalities and identifying the lagging regions. The important indicators like population size and density, literacy rate, urbanization, power, irrigation, banks, communication, transport, industrial and agricultural implements were included in the study. By using cumulative frequency technique it was concluded that there is unequal development in all the regions / states of India. Even the developed states like Punjab, Maharashtra, Tamil Nadu, Kerala and West Bengal were underdeveloped in some fields.

Rao (1977), using Composite Index of Development ,developed through Factor Analysis, identified the backward states of India on the basis of 24 variables
pertaining to agriculture (5), industry (8), education (5) and banking (6). The study covered 15 major states of India for the period 1955-56 and 1965-66. Composite Index of Development (CID) figures showed that none of the states was developed in all sectors. The coefficient of variation of overall CID of the states declined from 19.7 percent to 13.75 percent during the study period, indicating general decline in absolute differentials between the states. This decline in degrees of disparities was not shared by all sectors, while industrial and banking sectors moved in favourable directions, agriculture and education sectors moved in opposite direction.

**Gosal and Krishan** (1984) tried to identify disparities in the levels of economic and social development in the different parts of the state of Punjab in terms of

1. Agriculture development
2. Industrial development
3. Social development (in availability of educational, medical and other facilities) and
4. Demographic development (as reflected in various characteristics of population) by taking tehsil as basic unit.

According to them the striking feature of Punjab’s industrial development was its highly centralized distribution with most of the medium and large scale industrial units confined to six places namely Amritsar, Ludhiana, Rajpura, Jalandhar, Phagwara and Gobindgarh situated on the Amritsar – Delhi railway line / G.T. Road. By contrast the distributional pattern of unregistered factories, all of which were in small scale, was much dispersed practically over all towns and many villages. In case of social development, as indicated by educational facilities, northern and central parts of Punjab were developed than the Southern and South-western parts. Medical facilities were also not uniformly distributed as Amritsar, Jalandhar, Ludhiana and Patiala were having higher concentration of hospitals and other facilities than rest of the State. Same was the case for other variables like railways, banks, post offices etc. except in case of roads which have played a vital role in reducing disparities in economic development of the state.

**Chhipa and Sagar** (1981) studied the regional differentials in India with reference to banking development, by applying Modified Factor Analysis for the year 1977, selecting 11 banking development indicators. On the basis of Factor analysis results, they classified the states as highly developed, moderately developed, low developed
and very low developed. Index values of highly developed groups comprising Kerala, Punjab, Maharashtra and West Bengal varied between 5.436 to 6.421. While the very low developed group, comprising of Rajasthan, Assam, Madhya Pradesh and Orissa had index values varying between 1.697 to 2.076. They also applied the technique of regression analysis to measure the influence of non-banking variables like per capita state domestic product, literacy rate, infrastructure development and urbanization etc.

**Aschaver, D. A. (1989)** had estimated the impact of infrastructure on economic growth where the dependent variable is output with in some area or of a country, and the independent variables are the stock of infrastructures such as power, telecommunications, paved roads, access of safe water and constant level of technology. He estimated the Cobb- Douglas production function where stock of various elements of infrastructure were assumed to be capital and labour as the other input he found that military capital has insignificant relationship with productivity. But the ‘core’ infrastructure of streets, highways, airports, mass transport, sewers, water systems etc. has most explanatory power for productivity.

**Bawa and Mehra (1991)** in their analysis on “Sources of Regional Disparities in Rural Infrastructure in Punjab” showed that even in a state like Punjab which is considered to be most prosperous among Indian states and which has relatively equitable distribution of income, the availability of rural infrastructure is quite inevitable among districts. This can be one of the major causes of inter district variation in agriculture as well as general economic development. It may be added that a developed rural infrastructure can go a long way in rural industrialization and hence in more equitable distribution of gains of economic development among rural and urban areas as among various regions of the states.

**Bruinsma (1993)** examined the position of 42 major European cities in three infrastructure networks: roads, rail and air. A ranking of cities in terms of a gravity based accessibility index was produced. Also the effects of planned or possible future developments in these networks were studied. The effects of changes in the air and road network on average accessibility were expected to be rather small. In the rail network, the introduction of high-speed links would have considerable impacts on average accessibility. In the rail system, the further introduction of high speed links will increase existing inequalities by reinforcing the position of the cities in the North-Western part of Europe. In the road system on the other hand it will be the peripheral
countries which will benefit most. An analysis of non-physical border-related barriers to accessibility revealed that attention should not be restricted to improving physical infrastructure network.

**Harris and Ramsey (1994)** examined the mechanism by which infrastructure contributes to the process of economic growth. A network had been used to estimate changes in revenue and passenger time resulting from the possible failure of key part of infrastructure. The aim of this study was to estimate the passenger disbenefit side of the equation, for input into the engineers strategy. U.S. data from manufacturing industries suggest that there may be a positive correlation between core infrastructure and specialization, as well as a negative correlation between the average output of interested in intermediates and infrastructure. The results highlight the importance of infrastructure accumulation especially for poor countries. The results from this modeling of passenger demand had been fed into an engineering strategy which takes into account the profitability of infrastructure failure. It also enables the engineers to make a more informed decision on the ‘big bang’ versus ‘softly softly’ approach to maintenance.

**Carin and Oakley (1995)** studied the politics of infrastructure. They investigated political institutions and process underlying the decisions for public infrastructure spending. They applied the framework of strategic models of fiscal policy and developed an empirical model to analyze the substantial states. Robust regression Analysis was used to derive the results. The results of the study indicated that institutional and political conditions influenced public capital decisions in the states. The stability of party control in the legislature was found to be negative and the volatility of the state electorate positively correlated with state public capital. It was concluded that the marginal productivity of public capital across political jurisdictions and over time depends in part on the interplay between the existing institutional arrangements and the strategic use of infrastructure.

**Ghosh and Chattopadhyay (1997)** empirically investigated into the relationship between Infrastructure Development Index and Per Capita Net State Domestic Product (PCNSDP) over different time spans. Infrastructure Development Index is computed from six commonly used indicators of infrastructure. Sixteen states had been taken keeping in mind four regions, East, West, South and North. In order to examine the current position of Indian states after fifty years of independence, the
cross section data of 1995 was compared with those of 1981 and studied the relative position of the same 16 states in two different time spans. It was concluded from this study that the Eastern states have lagged behind the Western and Northern States although there was some degree of heterogeneity among the states. Some Southern states like Tamil Naidu, Kerala and Karnataka have also improved their position considerably. Moreover, the position of the Indian states has remained largely unchanged during this period.

Das (1997) investigated the nature of infrastructure facilities available in the states of India in an inter-temporal framework, taking fourteen major states of India. Composite Index of Development was developed using Principal Component Analysis out of the various infrastructural indicators, which included:

1. Surfaced roads per thousand kms;
2. Number of motor vehicles;
3. Per Capita consumption of electricity;
4. Net area irrigated to net area sown;
5. Number of industrial workers per lakh of population;
6. Male literacy per thousand of males;
7. Female literacy per thousand of females;
8. Number of hospital beds;
9. Negotiated loans from Life Insurance Corporation, General Insurance Corporation etc. and banks and lending institutions. and
10. Commercial bank credit.

Comparing the ranks assigned to the states at different time periods, it was observed that high income category states like Punjab and Haryana has improved their position. Gujarat maintained its position but Maharashtra came to second position from first which was occupied by Kerala. Among low income states, condition of Bihar was worst while that of Uttar Pradesh and Madhya Pradesh had improved.

Guha (1998) in a study relating to economies of infrastructure in West Bengal, divided infrastructural facilities into three categories:

1. Financial infrastructure and capital markets,
2. Social infrastructure including housing, education, public health, sanitation and sewerage, solid waste collection and disposal, supply of drinking water etc., and
3. Physical infrastructure, including all forms of transportation and communication generation and distribution of electricity, ports, irrigation etc. for attracting foreign investment.

For examining the nature of development of infrastructure, the entire state of West Bengal was classified into four separate regions on the basis of geographical location, Region A included 5 districts of Northern Region, Region B included 5 districts of Western Region, Region C included 5 districts of South and South Eastern Region and Region D was the capital city of Calcutta. It was seen that all forms of development strategies were Calcutta based and the figure of coefficient of variation rose alarmingly with an explosive high rate, when inter-district and inter-regional disparities were studied among all the four regions but were much lower when the study was confined to other three regions excluding Calcutta. This suggested that other three regions were more or less uniformly lagging behind Calcutta.

Kaur, K. (1997) tried to examine the relationship between infrastructure investment growth and Net State Domestic Product in 17 major states of India taking data from CMIE reports and Economic Surveys for ten years period from 1984-85 to 1993-94. More infrastructural facilities included were: energy, transport, irrigation, finance (represented in terms of bank branches), communication, education and health. These facilities were assigned weights according to their share in value of output. To estimate the effect of infrastructure investment on economic growth, regression equations with the current and one year lagged investment in infrastructure were fitted. Results of the equations showed that growth of infrastructure had a high potential pay off in terms of increase in Net Domestic Product but there were differences in the extent of the impact of infrastructure on Net State Domestic Product amongst different states with the least impact being on Jammu and Kashmir and Punjab.

Mohan (1997) made an attempt to investigate the implications for the domestic capital market in view of the possible volume of capital flows that could realistically be expected to flow into the country in such a way that the balance of payments remains sustainable, along with sound macro economic fundamentals enabling consistent credit ratings for India. The macro economic approach was used which pointed a feasible scenario for economic growth of the country over the next ten years. The main objective of this approach is to place the required infrastructure
investment within broad macro economic context and trends. It was concluded from
the study that infrastructure investment implied a sustainable growth for infrastructure
would have to emanate from domestic savings. Public sector savings must too rise
significantly over the next five to ten years. This macro-economic exercise suggested
that it was quite feasible for total investments in infrastructure to increase from the
current level of 5.5 percent of GDP to about 7 percent by 2000-01 and eight percent
by 2005-06

**Limao and Venables (1999)** studied the determinants of transportation costs, and its
dependence both on country’s geography and on their levels of infrastructure. The
model was estimated with 1990 data for a sample of 93 countries. Their approach was
to explain a high proportion of the cross country variation in transport costs. Using the
data set they showed how land distance was much more costly than sea distance.
Results were drawn by using three types of data sets including shipping company
quotes, the cif/fob ratios and Bilateral data in a gravity modeling exercise. It was
concluded that landlocked countries were disadvantaged. Analysis of Bilateral data
confirmed the importance of infrastructure. Elasticity of trade flows with regard to
transport cost was estimated to be high, at about – 2.5. Using these results and basic
gravity model to study sub Saharan African trade, both internally and with the rest of
the world, they found that infrastructure problems largely explain relatively low levels
of African trade.

**Amis and Kumar (2000)** describe the rapid economic growth in the city of
Visakhapatnam, the India’s largest port and an important industrial town and seaside
resort/retirement centre. The study highlighted how the city’s further growth was
constrained by inadequate investment in infrastructure- especially for water and
electricity- and discusses the political and institutional reasons for this. It then presents
the findings of participatory research on poverty, and the many dimensions of poverty
which were emphasized by urban poor groups, including inadequate incomes, lack of
assets ("no shelter, no property, no gold"), lack of support (especially for widows,
deserted women and the handicapped), illness and debt. He also discussed the direct
and indirect impacts on poverty of a slum improvement project, showing
improvements for low-income groups. The project’s impact was very significant in
terms of improvements in the “quality of life” and/or environmental dimensions of
urban poverty. The project was much less successful in addressing the problems of
survival and security, for example, livelihoods or income, ill-health and debt which were also identified as important dimensions. Nevertheless, the study provides very strong support for the provision of basic infrastructure to the poorest in India’s cities. This demonstrated the importance of infrastructure and service provision to poverty reduction within a wider recognition that this is but one important aspect.

**Akkina, K.R (2000)** undertook a study on the role of infrastructure and growth of per capita income across states in India. He used the secondary data for a period of 1970-90. He included three related variables; rail road length, road transport length per thousand square kilometers and percentage of electric power shortages in such states. The results showed that the railroad variable has little impact on the rate of growth of per capita income. Also the results suggest that the power shortages existing in different states in India during the period 1970-90, had a significant negative impact on the average rate of growth of per capita income.

**Bougheas et.al. (2000)** tried to explain plausibly the way in which stock of public capital can contribute to the process of economic growth. They have provided empirical results, using two different data sets, including U.S. Census data from manufacturing industries and cross-country growth equations, which were consistent with the theoretical predictions. The U.S. Census data suggested that there might be a positive correlation between core infrastructure and specialization, as well as a negative correlation between the average output of intermediates and infrastructure, both of which were unique predictions of their model. Cross-country growth regressions utilizing physical measures of transport and telecommunications infrastructure published by the World Bank suggest an inverted- U shape relation between infrastructure and the rate of economic growth across countries, with most countries in the upward sloping segment of the curve. Their results also highlighted the importance of infrastructure accumulation, especially for poor countries.

**Das Gupta et.al. (2000)** in their study offered analytical description of the economic performance of Indian states as reflected in their Per Capita (Net) State Domestic Product. Statistical analysis of data for period 1960-61 to 1995-96 showed a clear tendency for Indian states to diverge in per capita state domestic product but convergence in share of different sectors in State Domestic Product. Explanations they had given were likely to have dual purpose. First they will help to understand that a disparity in itself is an objective to study. Secondly, they are likely to throw
some light on the overall performance of Indian economy and also provide guidance to policy initiation. By doing analysis of the growth rate, this study found that firstly there were large fluctuations in the growth rate of each state and secondly there was no state which did not experience negative per capita SDP growth rate. Looking at coefficient of variations, they found large fluctuations for Orissa, Rajasthan, Gujrat, Uttar Pradesh and Delhi. The size of coefficients indicated that the rate of change per unit of time period had been highest for primary sector followed by tertiary sector and then by manufacturing sector. It was found from the study that the divergence and convergence among Indian States itself is an interesting exercise. But they feel that a detailed analysis of the effects of education, human capital formation, health care and sector allocation are needed to be studied carefully.

Sahoo, S. and Sexana, K.K (2000) analysed the impact of various stocks of infrastructure on economic growth in India and also examined the long-run or equilibrium relationship through cointegration analysis. While examining the impact of infrastructure on economic growth two types of models, i.e., linear and log-linear are estimated. After identifying the relevant variables to be included in the model, their time series nature has been checked at first stage. It was found that all the variables were originally non-stationary in nature, but stationary in log-first difference. The conclusion from the production function could be drawn was that infrastructure, labour and technological progress have positive and significant contribution to output or economic growth. When the stock of infrastructure was taken in a segregated manner, transport, electricity, gas and water supply, communication was found having a significant positive effect on economic growth with increasing returns to scale.

Nagraj et.al. (2000) examined the growth performance of Indian states during 1970-1994. They first assessed the contribution of differences in the availability of physical, social and economic infrastructure to growth performance. More accurate estimates of growth impact of specific types of infrastructure were provided by combining Principle Component Analysis and panel data estimation techniques. The strong impact of primary education, health conditions, irrigation, roads and rail network, power capacities and financial development was highlighted. Moreover, evidence of conditional convergence of steady-state income levels was found. This did not rule out persistent income inequalities due to the dispersion of steady state income levels.
Such disparities were accounted for by differences, first in the structure of production, second in infrastructure endowments, and third in state specific fixed effects in the growth regression.

**Demurger (2001)** empirically tested the links between infrastructure investment and economic growth in China using panel data from a sample of 24 Chinese providences (excluding municipalities) throughout the 1985 to 1998 period. The estimation of growth model showed that besides differences in terms of reforms and openness, geographical location and infrastructure endowment did account significantly for observed differences in growth performance. The results indicated that transport facilities are a key differentiating factor explaining the growth gap and point to the role of telecommunications in reducing the burden of isolation. The regional classification gives a broad picture of the extent to which economic policy induced and naturally inherited elements combined to explain provincial economic growth differences. These findings have different policy implications in terms of both redistribution by the central government, and the related decentralization process, and public investment targeting. They suggest that economic policy measures that can improve infrastructure equipment may have a non negligible impact in promoting per capita income convergence among Chinese provinces. Moreover, setting policy priorities and targeting public investments toward those that have the highest growth payoff would help to improve regional as well as nationwide growth prospects. In this respect, expanding and upgrading the network of transportation, storage, and distribution services, as well as developing the telecommunication network, would be particularly useful in rural areas, to allow for the development of efficient, competitive markets and for the diffusion of economic growth.

**Walle (2001)** examined the link between the poverty and lack of infrastructure using the 1992-93, Vietnam living standard survey. The household indicated that in general access to infrastructure was not very different between poor and non-poor. The cross sectional variation was used to estimate the marginal impacts of converting non-irrigated annual crop land to irrigation. A policy of irrigating ten percent of currently non-irrigated annual land was stimulated based on a regression model for crop income which include irrigated and non-irrigated land as explanatory variables. The results showed that the highest total impact on net crop incomes would occur for Vietnam’s two poorest regions the northern uplands and the north coast, where the impacts also
show the most pro-poor distribution. The average annual economic rate of return of the irrigation investment considered would be at least twenty percent. It was also found that various constraints over and above that were presented by lack of irrigation appeared to diminish the benefits of irrigation to poor and non-poor alike. 

Sibal (2001) examined that urban transport is an important basic infrastructure on which the economic growth of cities depends. The demands of this sector are growing fast. This fact coupled with provision of insufficient mass transport and road infrastructure facilities and inadequate regulation has resulted in high congestion levels on roads, low journey speeds, high energy consumption on transport and increased vehicular emissions and accidents. The scenario for the future is bleak unless policy interventions are made to augment infrastructure in a planned way. This study attempted to peak into future urban transport scenario upto 20 years hence – both under assumption of Business as Usual (BAU) and under implementation of suggested policy interventions. The study suggested that urban transport scenario in the country will deteriorate with attendant increase in congestion, energy consumption and vehicular emissions unless corrective steps are taken on priority. Policy interventions were required to improve the modal split in favour of mass transport and NMT, to go in for integrated land-use transport planning, to augment road infrastructure and for TSM measures. These interventions have financial implications but will result in massive socio-economic benefits in improving mobility levels in urban areas, spurring economic activity, reducing consumption of petroleum fuel and improving environment.

Majumdar (2003) on the basis of regression analysis of the state level cross-section data for each of the years from 1971 to 1995 indicated that among various physical infrastructure, it was the transport infrastructure that significantly affected the agricultural output level and the agricultural development index. However, besides physical infrastructure, social infrastructure also had significant positive impact on the dependent variables. At the district level, from the regression analysis at three points of time viz., 1971, 1981 and 1991, the study observed that agricultural and transport infrastructure are important determinants of agricultural output and agricultural development index.

Pethe et.al. (2002) in their study pointed out that private sector participation may accelerate the infrastructure sector, the government would still be playing a decisive
role as a buyer, seller or supplier. Given the aim to reach a higher growth trajectory for the economy, a concerted approach to encourage and enable private sector participation in infrastructure would be critical, and a vibrant and deep secondary market for debt would be crucial in helping to accelerate such a process.

**Thorat and Sirohi (2002)** attempted to analyze the impact of infrastructure on agricultural development using larger data set, both in terms of time period (pooling the data for four time periods, viz., 1961, 1971, 1981 and 1991) and coverage of infrastructural variables to include ten explanatory variables, viz., transport, power, irrigation, tractorization, research, extension, access to primary agricultural credit societies, regulated and wholesale infrastructure, access to fertilizer sale points and commercial banks, covering physical, financial and research infrastructure. The results indicated that transport, power, irrigation and research infrastructure are four critical components, which affect the agricultural productivity in a significant manner. However, between transport and power, the former emerged as a more dominant variable. There was complementarity between the transport and power in the sense that the accessibility to roads is normally followed by accessibility to power. With improvement in access to power, the irrigation infrastructure also improved particularly through energization of pumpsets. In turn, improved irrigation facilities coupled with research input enhanced agricultural productivity. The other infrastructural facilities like access to fertilizer sale points, markets, credit infrastructure, extension services, etc. also developed the development of transport infrastructure.

**Wang (2002)** proposed a production function framework for analyzing the interrelation between public infrastructure expansion and private growth and for identifying their externality effects. The framework consisted of two versions of the dynamic two sector model. Each sector was assumed to generate a spill-over effect on the other. Growth equations were derived and estimated for seven East-Asian economies over the period of 1979-1998. The empirical results indicated that both versions of the hypothesis about the existence of spillover effects cannot be rejected, although the influences of private production sector on Public infrastructure sector were relatively greater. This implied that keeping a balance between infrastructure expansion and private sector growth is crucial for rapid economic development. An
important issue regarding infrastructure is how efficiently the government manage the existing stocks.

**Bhattacharya and Sakthival (2004)** made an attempt to answer the question – “Has the regional disparity widened in the post reform period?” by analyzing growth rates of aggregate and sectoral domestic product of major states in the pre (1980s) and post reform (1990s) decades. The results indicated that while the growth rate of GDP had improved only marginally in the post reform decade, the regional disparity in the State Domestic Product had widened much more drastically. Industrial states were now growing much faster than the backward states and there was no evidence of convergence of growth rates. Even more disturbing was that there was an inverse relationship between population growth and SDP growth. The inverse relationship between was stronger for the per capita income growth among states. This had a very serious implication for employment and the political economy of India.

**Majumder (2004)** examined the veracity of the argument, ‘Imbalances in regional infrastructure availability have been a major reason behind lopsided development in India’ in the light of empirical results at the district level using a multidimensional approach with sub-sectoral, sectoral and composite indices of development and infrastructure availability. The interaction between infrastructure and development was explored using correlation and Regression and Discriminant Analysis. Significant association between infrastructure and development levels of regions was observed, though there was some decline in the magnitude in recent years. This association was different for regions at different stages of development. Lagged correlation method seems to show that the direction of causation is stronger from Infrastructure to Development than the other way round. Discriminant analysis showed that infrastructural variables can serve as ‘discriminating variables’ when the districts are classified according to their developments levels. The findings suggested that identification of specific requirements of different regions, benefit-cost analysis followed by infrastructural expansion were major planks of balanced regional development. Thus this study led to believe that the development level of a region was substantially determined by the level of Infrastructure available therein. Different types of infrastructure affect different facets of development and the interactions between them are such that infrastructure is the leader and development is the follower in most cases. Moreover, specific developmental stage of a region was also a
crucial factor that determines the nature and magnitude of the association between different components of infrastructure and development level.

**Flyvberg (2005)** focused on problems and their causes and cures in policy and planning for large infrastructure projects. He argued that a major problem in the planning of large infrastructure projects was high level of misinformation about the costs and benefits. A consequence of misinformation was massive cost overruns, benefits shortfalls, and waste. This study explored the causes of misinformation and found that planners and promoters deliberately misrepresent costs, benefits and risks in order to increase the likelihood that it is their project, and not the competition’s that gain approval and funding. It has been analyzed that as projects grow bigger, the problems with costs overrun and benefits shortfall also grow bigger and more consequential. Some megaprojects became so large in relation to national economies that cost overruns and benefit shortfalls from even a single project may destabilize the finances of a whole country or region. The author suggested two main measures of reform: (i) Better forecasting methods like reference class forecasting and (ii) Improved incentive structures, with the latter being the more important.

**Ghosh and Prabir (2005)** tried to find out the role played by economic and social infrastructure facilities in economic development across Indian states over the last quarter century. Infrastructure services have been indexed with the help of Principal Component Analysis. Both parametric and non parametric estimates were done to assess per capita income disparity. A comparative static framework was developed for testing the nature of movement of the development trajectory in income infrastructure plan over different time spans. The major findings include inter-state disparity in per capita income among Indian states, inter-state disparities in economic and social infrastructure facilities. The findings were statistically very significant to warrant new regional policies under the overall framework of globalization in order to remove rising regional disparities in both infrastructure and income. This has a strong bearing on the success of poverty removal politics under globalization as the poor were regionally concentrated in such diverse and heterogeneous country.

**Patra (2005)** made an attempt to estimate infrastructure multiplier of Indian economy to access the impact of infrastructure on growth of the economy. To analyze the fact, the input-output transactions table of Indian economy for the years 1989-90 and 1998-99 prepared by the Central Statistical Organization (CSO) has been used. Twenty
three sectors including agriculture, animal husbandry, forestry, fishing, mining, food processing, beverage, textiles, wood and wood products, paper and paper products, plastic and plastic products, non metallic mineral products, basic metal and alloys, non electrical machinery, electrical machinery, transport equipment, construction, electricity, transport and communication services were considered in the study. Empirical results were based on the concept of multiplier linkages and the input output transaction tables. From the discussion, it has been concluded that the infrastructure sector is undoubtedly a key sector having high forward and backward linkages. The expansion of this sector boosts several other sectors of the economy. The study showed that the direct coefficients and multipliers do not move in unison. Hence for policy formulation both should be considered. The ultimate production and investment plan must consider both direct and indirect needs and a compromise is essential among multiple objectives.

Sen and Pal (2005) aimed at quantifying the relationship between economic development and infrastructure. A macro concept, infrastructure has many components. How and to what extent each component affects development were explicitly examined from the angle of human development. A mathematical digression on the concept and measurement of human development has been made in this study and alternative Human Development Indices (HDI) were analytically discussed. The question of sensitivity of alternative HD indices has also been examined. The quantitative study on the relationship between infrastructure and human development has been made using West Bengal’s district level data for the years 1980-81, 1990-91, 1995-96 and 1999-2000. The study showed significant regional disparities in the level of human development and infrastructural development in West Bengal. The regression analysis confirmed the hypothesis that development of infrastructure (ID) stimulates human development (HD). From the regressions of the components of ID on HD it has been evident that village electrification, irrigation, education, health services and above all urbanization played a significant role in the development of the economy. If social sector (health, education etc) expansion has not been properly monitored and controlled by the Government and is left exclusively to the private initiatives, the resulting fruits of development may not be in a desired direction of decreasing inequality in income
distribution. Government should frame policies in favour of expansion of infrastructure in the regional level hitherto lagging behind.

**Anbalagan (2007)** aimed to ascertain the specific role of the transport infrastructure in the context of economic development in India. The focus was on transport infrastructure development in planning era. The study formulated a hypothesis that transport infrastructure has a significant impact on economic development. Secondary data from various national and international sources has been used. The study has used multiple regression model using the time series data from 1980-81 to 2001-02. The analysis was carried out separately for the pre-reform, post-reform and combined period. The study observed that the performance of transport has significantly improved during the planning era. Even though India has adopted several policy measures to upgrade its transport system, the modernization process is still facing many hurdles. Overall observation was that the Indian transport sub sector has developed in the recent past, still it should be strengthened further with world class infrastructure facilities.

**Benni (2007)** pointed out that in spite of more than five and half decades of planning, which is viewed as an effective instrument to reduce disparities in all over the country, there had been a sharp increase in inequalities, noticeably aggravating rural-urban divide in the country. The main objective was to quantify regional infrastructure disparities among the districts of Karnataka state. The level of infrastructure development was captured using ten indicators: Tele density, number of banks in the districts, percentage of villages electrified, number of post offices, total length of roads, railway lines in districts, number of heavy bridges, motor cycles, cars, good vehicles in the district in the year 2000-01. Among districts of north, Belgaum was on the top in terms of development and in south, Bangalore was on top. The study called for a deliberate policy action and initiatives to reduce regional variations in the state. All the districts of North Karnataka and some of South Karnataka (such as Chamaraja Nagar) need special attention from all the directions.

**Lall (2006)** analyzed the role of infrastructure in economic growth as the considerable research in the fields of public policy, economics and planning. He examined the contribution of publicly supplied infrastructure to sub national regional growth in India. He developed and numerically examined a regionally disaggregated model of economic growth to understand the dynamics of private capital and public
infrastructure. For the empirical analysis, he uses a pooled data set for Indian states to examine if publicly supplied infrastructure is a significant determinant of regional growth and whether there are spatial variations in the productivity effects of infrastructure. The main findings were that transport and communications infrastructure expenditures were significant determinants of regional growth, and the positive externalities from network expenditures made by neighbouring states. Finally, the out of sample simulated regional growth predictions showed divergence in private capital formation between lagging and leading states.

**Francois and Manchin (2007)** examined the influence of infrastructure, institutional quality, colonial and geographical context, and trade preferences on the pattern of bilateral trade from 1988 to 2002. Matching bilateral trade and tariff data and controlling for tariff preferences, level of development and standard distance measures, they found that infrastructure and institutional quality are significant determinants not only of export levels but also of the likelihood exports that would take place at all. Variations in basic transportation are much more important at low income levels in explaining variations in trade performance than at higher income levels. The opposite holds for communications, which grows increasingly important, particularly as a country reaches the middle income range. While at high incomes a larger size of government, with greater regulation, is bad for exports, this is much less so at lower income levels. The results supported the notation that export performance and the propensity to take part in the trading system at all, depends on institutional quality and access to well-developed transport and communication infrastructure. In general, the combination of institutional and infrastructure variation are much more important to the pattern of bilateral trade volumes than is bilateral protection.

**Iimi (2007)** investigated the effect of Public infrastructure and international trade preferences on efficiency in livestock production and trade. The study questioned whether infrastructure really matters and what type of infrastructure is most important in this area. Focus was imposed on the European Union (EU) beef import market where several African countries have been granted preferential treatment under the Cotonou Agreement. The system of supply and demand equations has been estimated jointly by the three-stage least squares estimator. The traditional endogeneity problem between (export) price and quantity has been taken into account. In addition, the simultaneity of infrastructure stocks and national income representing the reservation
price of labor was controlled for. The estimated demand equation showed that the demand elasticity is relatively high and the EU beef import market is competitive in spite of the large degree of distortion caused by trade preferences which means that less competitive beef producers would easily be excluded from the market. The estimated supply function revealed that infrastructure, particularly quality roads and electricity, could significantly reduce beef export prices. The estimated results of this study strongly supported that improved infrastructure could reduce export prices, enhance market shares, and strengthen external competitiveness in a sustainable way.

Pradhan (2007) in his paper focused on the role played by infrastructure in determining the level of urbanization in India and across its states. The analysis was based on construction of Composite Infrastructure Development Index by applying principal component analysis and then integrated the same with degree of urbanization. Cross section data of Indian economy was used and it pertained to past quarter decades. The findings confirmed that infrastructure has a significant role in determining the level of urbanization in India. It has been observed that both are very consistent in the Indian economy over the last four decades. It has also been assumed that without increase of infrastructure, urbanization in India would be much lower today. But the critics said that at what level of urbanization India has achieved so far, it is comparatively low as per the country's need and in contrast to other emerging countries in the world, which requires urgent need to enhance the country's level of urbanization. This requires substantial improvement in infrastructure along with more industrialization in the economy. Therefore, it has been finally concluded with suggestion that India needs a broad based policy to increase urbanization in particular and overall balanced development in general.

Chakraborty (2008) presented new evidence on the links between public infrastructure provisions and time allocation related to the water sector in India. Using time-use data, the analysis revealed that worsening public infrastructure affects market work with evident gender differentials. The estimates suggested that there can be a link between deterioration in infrastructure and rural poverty, as worsening water infrastructure could lock-in the time of women in unpaid work that would otherwise be available for income-generating SNA activity. Time poverty affects income poverty, however, the aspects of time poverty are often surpassed when framing macro policies. It has been noticed here that with the unit-record data, the analysis of
the poverty-related aspects of time allocation and its implications for public investment had been severely restricted, as time-use data across income quintiles or monthly per captia consumer expenditure (mpce) quintiles were not available for India. The results also suggested that the access to public infrastructure can lead to substitution effects in time allocation between unpaid work and market work. The broad conclusion is that public investment policy can redress intra-household inequalities in terms of labour supply decisions by supporting initiatives that reduce the allocation of time in non-market work.

**Straub (2008)** surveyed the theoretical and empirical research on infrastructure sector in developing countries to highlight what works and what doesn’t; when tried to understand the causal pathways between infrastructure investment and development outcomes. On the empirical side,Straub surveyed sixty four recent papers, analyzed some hundred and forty specifications in detail. Two thirds of these specifications supposed a positive and significant link between infrastructure and investment and growth. Study suggested that restructuring should be undertaken before privatization and that a regulatory framework should be put into place. Straub urged to move away from estimating the link between output and aggregate indicators of infrastructure. Data should concentrate on microeconomic household- and firm level survey data.

**Pradhan and Tapan (2012)** have examined the presence of any nexus between transport infrastructure and economic growth in India using the data for the 1970-2010 periods by using cointegration and Granger causality test. The study found that the bidirectional causality exists between road transport infrastructure and economic growth. That means that road transport causes economic growth and vice versa. The causality exists because of the reason road transport is one of the basic inputs in the production process; hence, an increase in road transport would be expected to have a positive effect on economic growth. Similarly, there are two reasons why economic growth has boosted road transport development in India. **First**, economic growth has resulted in an expansion in the commercial and industrial sectors, and in particular in the manufacturing sector, to facilitate which road transport would be a basic input. **Second**, higher disposable income has increased demand for better road infrastructure for household entertainment. Further, the bidirectional causality exists between road transport infrastructure and gross domestic capital formation. This implies that when road transport steps up, both in quantity and quality, government can charge toll tax
and that can contribute to government’s revenue, a part of which can contribute to increased gross domestic capital formation. On the contrary, when there is higher gross domestic capital formation, it may be used for expanding economic investment including that in road transport; hence, building roads contributes to economic growth. However, the relationship between economic growth and gross domestic capital formation reveals that when the economy grows, people’s individual income also increases and a part of the increased income can contribute to gross domestic capital formation. Similarly, when gross domestic capital formation increases, it can be used to raise socio-economic investment and hence to contribute to economic growth. The study concludes that in India, transport infrastructure not only influences economic growth but also gross capital formation. It is therefore suggested that increasing transport facility along with gross capital formation will lead to more pervasive economic growth in India.

Section 2.4
Impact of Infrastructure on Pollution

Conrad (2001) stated that in Europe traffic congestions made it impossible to estimate travel time. The increasing number of cars calls for a transportation policy towards an improved efficiency of the transportation system. However extending road infrastructure to reduce the congestion externality implies another type of externality i.e. air pollution. Designing a transportation policy in industrialized countries one has to consider this trade-off. The objective was to investigate the role of transportation services and their prices within an inter-industry framework. The authority wished to minimize the total cost of production with respect to the provision of infrastructure subject to an emission standard. By omitting a financial constraint to finance infrastructure he determines the size of infrastructure where no congestion occurs. The productivity effect of infrastructure and the cost savings from a dissolved congestion determines the optimal stock of infrastructure. In view of the trade-off between the benefit of a productivity gain from a dissolved congestion and the deadweight loss from taxation the lower level of infrastructure will result in an index of congestion higher than unity implying a negative externality to the economy.

Their results also revealed that the sample selection affects the point estimates of specifications in levels, while models in first differences behave more robustly. This may be an indication that specifications in log-levels may constitute spurious regressions caused by the differing order of integration or non-cointegration of the variables, although these issues were not formally addressed in their analysis. 

**Quaas (2007)** analyzed the introduction of pollution-reducing infrastructure in a general spatial equilibrium model of a monocentric city as a public good, which serves to abate polluting emissions from households’ consumption. This was an innovative extension to an urban economics model and motivated by stylized facts observed for the case of Bombay. It allows them to develop and analyse improved policy instruments to solve urban environmental problems. They showed the efficient supply of pollution-reducing infrastructure and the efficient allocation of (polluting) consumption goods are interrelated. Increased infrastructural supply lessens the environmental costs of consumption, and, the other way round, increased consumption increases the marginal benefit of pollution-reducing infrastructure. Because consumption of goods and of living space were interrelated, too, the introduction of pollution-reducing infrastructure affects the spatial distribution of households across the city. The public-good character of infrastructure also showed a favourable increase in infrastructural density all over the city in response to increased population size. In two settings of public and private infrastructural supply, they derive three interrelated and spatially differentiated policy instruments, by which the optimal allocation was implemented as spatial market equilibrium.

The above studies reviewed showed that though much work has been done on the infrastructure growth, its disparities, and its relationship with economic growth at all India level and at different state levels, however, a little work has been done on measuring externalities of infrastructure. The present study is an attempt in this direction to fill this gap as per the main objectives specified in the previous chapter (i.e. chapter 1).