1 INTRODUCTION

INFRASTRUCTURE AND ECONOMIC DEVELOPMENT

Infrastructure is important for the services it provides. It is an important input to the production process and raises the productivity of other sectors. Infrastructure connects goods to the markets, workers to industry, people to services and the poor in rural areas to urban growth centers. Infrastructure lowers costs, enlarges markets and facilitates trade. Thus, infrastructure provides services that support economic growth by increasing the productivity of labor and capital thereby reducing the costs of production and raising profitability, production, income and employment.

Role of infrastructure in fostering economic growth has been supported by the empirical literature. A number of studies have highlighted the importance of physical infrastructure as a determinant of economic growth. A country's development is strongly linked to its infrastructure strength and its ability to expand trade, cope with population growth, reduce poverty and produce inclusive growth. Although role of infrastructure in economic growth was recognized in the 1970s and 1980s, its linkage with poverty alleviation was examined in 1990s only. The World Bank in its "World Development Report 1994" pointed out that productivity growth is higher in countries with an adequate and efficient supply of infrastructure services. Provision of infrastructure services to meet the demands of business, households and other users is one of the major challenges of economic development. In many surveys conducted by World Bank Group, private investors have cited

reliable infrastructure services as an important consideration in their investment decisions. The report also points out that "infrastructure capacity grows step by step with economic output – a one percent increase in the stock of infrastructure is associated with a one percent increase in gross domestic product (GDP) across all countries". In an increasingly globalising world, availability of good quality infrastructure is a crucial factor in attracting foreign investments. Availability and accessibility of adequate infrastructure in a country on par with international community is an indicator of the presence of high quality of life. The WBG explored new ways to design and manage projects that relied more on community participation to ensure that the infrastructure investments it supported would reach the poor. The "voices of the poor" survey published in 2000 validated the finding that the linkage was strong. Poor people pointed to the dramatic impacts that access to potable water, sanitation or to a road made to the quality of their life.

In Millennium Development Goals also the role of infrastructure in reducing poverty has been recognised. It has set increasing access to water supply and sanitation service as targets to be achieved by 2015. Infrastructure services contribute to poverty reduction and improvements in living standards in several ways. Demonstrating this empirically is not straightforward because of the complex interrelationship between these variables. Poverty reduction requires economic growth which, when accompanied by sound macroeconomic management and good governance, results in sustainable and socially inclusive development (ADB 1999). Greater access of the poor to education and health services, water and sanitation, employment, credit and markets for produce is needed. Lack of access to product and factor markets, prevents the rural poor to be a part of growth process. Making markets work for poor is the key element in reducing poverty. Infrastructure development enables the markets to expand and fall within the reach of the poor, thus making them part of the growth process.

Therefore, to create and manage good quality infrastructure, we need to measure its performance from time to time. To collect meaningful statistics for measuring infrastructure it is desirable to know why we need them. In case of infrastructure the statistics are required for following purposes:

- Assess the condition of the existing assets.

- Evaluate the extent to which the infrastructure meets current demand.
- Assess whether infrastructure is likely to be able to meet demand in the future.
- Benchmarking; to compare our infrastructure availability with others.

FRAMEWORK FOR INFRASTRUCTURE STATISTICS

Although infrastructure and the services provided by it have always been with us, the word itself is relatively new. The American Heritage Dictionary of the English Language writes that "the term infrastructure has been used since 1927 to refer collectively to […] roads, bridges, rail lines, and similar public works". However, in The English dictionary the term did not find any mention until 1950s. In late 80s and 90s the word became very prominent and was discussed in almost every forum. However, in spite of being extensively discussed, there is no standard definition of infrastructure. Although it is now well recognised that infrastructure impacts the economic growth of a country, there is no unique concept in scientific literature for defining infrastructure and determining its components. It is usually considered as basic public infrastructure that facilitates the economy and society to operate. World Bank report (2004) mentions infrastructure as an umbrella term for many activities. Due to various descriptions it becomes difficult to analyse infrastructure in a comparable way and draw meaningful conclusions. Economists and urban planners distinguish two types of infrastructure: economic infrastructure and social infrastructure. Economic infrastructure is defined as the infrastructure that promotes economic activity, such as roads, highways, railroads, airports, sea ports, electricity, telecommunications, water supply and sanitation. Social infrastructure (such as schools, libraries, universities, clinics, hospitals, courts, museums, theatres, playgrounds, parks, fountains and statues) is defined as the infrastructure that promotes the health, education and cultural standards of the population – activities that have both direct and indirect impact on the welfare.

In India the notion of infrastructure was discussed extensively by the Rangarajan Commission while examining the statistical system of India. The Commission stated that the Infrastructure is important in determining the availability of inputs that are crucial to a wide variety of productive activities. Its non-availability will act as a severe constraint on the productive capacities of the economy. The Commission in its report submitted in 2001 stated that infrastructure is an important input for industrial and overall economic development of a country. However, there is no clear cut definition of infrastructure nor its

characteristics defined which can differentiate infrastructure sector from other sectors. Based on the necessity of infrastructure activities like power, transport, telecommunication, water, sanitation, disposal of waste etc. which are central to the activities of household and economic production, one could view these activities as essential inputs to the economic system.

Infrastructure, according to Rangarajan Commission, tends not to be user or user specific and typically have long-lived engineering structures. It indicated six pertinent characteristics for identification of infrastructure sub-sectors, viz. natural monopoly; non-tradability of output; bestowing externalities on society; high-sunk costs or asset specificity; non-rivalness (up to congestion limits) in consumption; and, possibility of price exclusion.

Natural Monopoly

Natural monopoly refers to a situation where one firm can supply a market's entire demand for a goods or service at a price lower than two or more firms can. Many infrastructure facilities have a significant component characterized by declining cost associated with increasing output throughout the range of the possible demand. This leads to the situation of natural monopoly. In general road and rail networks and gas and electricity reticulation systems are examples of sectors with strong monopoly characteristics. However, this situation can change due to technical or structural developments. Telecom sector is the classic example of a sector which has swung from a monopoly situation, when it was necessary to have a wire line network to a state of competition mainly due to technology advancements in the field of wireless telephony.

High sunk costs or asset specificity

Sunk costs are investment costs which cannot be immediately recovered by the possible sale of the assets that were invested in. Sunk costs represent both barriers to exit from the sector and barriers to entry into the sector. High sunk cost makes an investment irreversible which impacts the level of investment by industry. Longer periods of gestation and very large investment in activity specific assets that cannot be deployed elsewhere, such as road-typical of infrastructure projects, result into higher sunk cost. Many infrastructure services are designed to be delivered through a dedicated network. Common examples are piped water, electric power, telecommunication towers, sewerage and rail services. All of these industries involve networks which distribute products or services over geographic space,

and in most cases the networks are capital intensive and the investments are durable and immobile. High sunk costs imply that the service is prone to be a natural monopoly. If investments are durable and immobile a firm cannot exit market without losing its investments.

Non tradability

A tradable good or service can be sold in another location distant from where it was produced. Different goods have different levels of tradability; the higher the cost of and time taken for transportation and the shorter the shelf life, the less tradable good is. Most infrastructure services are non-tradable in nature. In some cases carriage may not be tradable but the content may. A common example is power transmission system which is non-tradable even though electric power itself may be tradable. Non-tradability implies that the stock of infrastructure services cannot be readily augmented through imports.

Non- rivalness in consumption

Public good is normally characterized by two factors – non-rivalness and non- excludable. This means that consumption of the good by an individual does not reduce availability of the good for consumption by others and that no one can be effectively excluded from using the good. The characteristic of non-rivalness implies zero marginal cost of providing benefit of a public good (infrastructure service in this case) to an additional consumer, usually up to a certain capacity or congestion limit.

Possibility of price exclusion

Price exclusion is a characteristic of 'private goods'. Efficiency requires that the price be set at marginal cost. However, in this case, it will not be possible to recover the cost of provision (except through taxes). Besides as capacity limits are reached there are positive marginal costs of providing additional capacity. The pricing of infrastructure is thus not easily amenable to market principles.

Presence of Externalities

Many infrastructure services are also characterized by the presence of externalities. The canonical example is that of improvement in public health from better water and sewerage

infrastructure. An absence of public hygiene will hurt even those who are individually hygienic. Similarly a road could lead to an increase in the value of adjoining land. In this sense, infrastructure creates external benefits or positive externalities.

IDENTIFICATION OF KEY INFRASTRUCTURE SECTORS

A number of Ministries/ Departments have worked towards the harmonization of definition of Infrastructure and the sectors that can be included under it. Due to different mandates of these Ministries/ Departments they had been using different definitions and varying list of sectors included under it. A decision was, therefore taken to harmonize the definition and finalize the list of sectors so that there is uniformity in its usage. The basic framework adopted for this purpose was the same as prescribed by the Rangarajan Commission, but also considered the requirements of other Ministries / Departments as well. A summary of all these efforts is given below:

Rangarajan Commission

Based on the six characteristics of infrastructure as defined above, Rangarajan Commission suggested that following sub- sectors may be considered as infrastructure:

- Railway tracks, signalling system, stations
- Roads, bridges
- Runaways and other airport facilities
- Transmission and distribution of electricity
- Telephone lines, telecommunications network
- Pipelines for water, crude oil, slurry, etc.
- Waterways, port facilities
- Canal networks for irrigation
- Sanitation or sewerage.

This list of infrastructure sectors was prescribed for the purpose of data collection. It was suggested that initially the data may be collected pertaining to these sectors and thereafter it may be extended to include the following as well:

- Rolling stock on railways

- Vehicles
- Aircrafts
- Power generating plants
- Production of crude oil, purification of water
- Ships and other vessels.

Cabinet Committee on Infrastructure (CCI)

The Cabinet Committee on Infrastructure, under the chairmanship of the Prime Minister, was constituted on July 6, 2009. It substituted the Committee on Infrastructure which was set up on 31st August, 2004. The CCI approves and reviews policies and monitors implementation of programmes and projects across infrastructure sectors. The Secretariat for infrastructure in the Planning Commission is involved in initiating policies that would ensure time bound creation of world class infrastructure delivering services matching international standards, developing structures that maximize the role of public private partnership and monitoring of key infrastructure projects to ensure that established targets are realized. With this objective, the secretariat felt the need to define infrastructure for the purpose of policy formulation, setting of sectoral targets and monitoring projects. It emphasized the need to clearly define 'Infrastructure' and its coverage to ensure consistency and comparability in the data collected and reported by various agencies over time. For this purpose it studied the definition of infrastructure as applied by various organisations like Rangarajan Commission, RBI, Income Tax Department, Dr. Rakesh Mohan Committee Report (1996), Insurance Regulatory and Development Authority (IRDA), Economic Survey, and World Bank. Thus, the Empowered Sub-Committee of the Committee on Infrastructure, headed by Deputy Chairman, Planning Commission identified a list of sectors to be included under infrastructure. These are:

i. electricity (including generation, transmission and distribution) and R&M of Power stations;
ii. non-conventional energy (including wind energy and solar energy);
iii. water supply and sanitation (including solid waste management, drainage and sewerage) and street lighting
iv. telecommunications
v. road and bridges

vi. ports

vii. inland waterways

viii. airports

ix. railways (including rolling stock and mass transit system)

x. irrigation (including watershed development)

xi. storage

xii. oil and gas pipeline networks

Ministry of Finance, Department of Economic Affairs

On the directions of Prime Minister's office, Department of Economic Affairs has prepared a concept paper to resolve the issue of uniform definition of infrastructure. This concept paper has defined "Infrastructure" as an essential input to the economic system. To draw an indicative set of infrastructure sub sectors, the broad framework developed by Rangarajan Commission has been employed. The list of sub sectors identified earlier by Rangarajan Commission has been further extended by including sectors that merit inclusion on account of their importance to the scheme of economic development or their ability to contribute to human capital or the specific circumstances under which these are developed in India. To finalize this list opinion of concerned Ministries/ Departments, Regulatory bodies like RBI, SEBI, IRDA , PFRDA and other stakeholders like Confederation of Indian Industry (CII) and Federation of Indian Chamber of Commerce and Industry (FICCI) was also obtained. The identified infrastructure sub-sectors have been classified, for the sake of convenience, under five broad categories. These are: Transport; Energy; Water and Sanitation; Communication; Social and Commercial Infrastructure.

It is recommended that any sub-sector which may be identified as an infrastructure sub-sector in future will fall under one of these categories. For example, agro-industries will be classified under social/commercial infrastructure category. Similarly, watershed will be classified under water and sanitation category, if included in future. The dynamic nature of the characteristics used for defining infrastructure is also emphasized and is therefore recommended that the list be periodically updated through a formal institutional mechanism.

The list of infrastructure sector, thus recommended is given in the table below:

S.No.	Category	Infrastructure sub-sectors
1.	Transport	• Roads and bridges

		• Ports • Inland waterways • Airports • Railway Track, tunnels. viaducts, bridges • Urban Public Transport(except rolling stock in case of urban road transport)
2.	Energy	• Electricity Generation • Electricity Transmission • Electricity Distribution • Oil pipelines • Oil/Gas/Liquefied Natural Gas(LNG) storage facility • Gas pipelines
3.	Water & Sanitation	• Solid Waste Management • Water supply pipelines • Water treatment plants • Sewage collection, treatment and disposal system • Irrigation(dams, channels, embankments etc) • Storm Water Drainage System
4.	Communication	• Telecommunication(Fixed network) • Telecommunication towers
5.	Social and Commercial Infrastructure	• Education Institutions(capital stock) • Hospitals(capital stock) • Three-star or higher category classified hotels located outside cities with population of more than 1 million • Common infrastructure for industrial parks, SEZ, tourism facilities and agriculture markets. • Fertilizer(Capital investment) • Post harvest storage infrastructure for agriculture and horticultural produce including cold storage • Terminal markets • Soil-testing laboratories • Cold chain

Central Statistics Office

To implement the recommendations of Rangarajan Commission, the Central Statistics Office constituted a Standing Committee on Infrastructure Statistics to harmonize the definition of Infrastructure and identify the list of sectors that can be considered under it. The standing Committee finalized the list of infrastructure sub sectors with the objective to generate

statistics following a harmonized and universally comparable concepts, definitions, standards and classifications. Adopting an inclusive approach so that the data is available on a supraset basis to serve the purpose of all users, whether policy makers or researchers, the infrastructure sub sectors included in this publication are somewhat extended as compared to the one proposed by CCI. For example, the list proposed by CCI does not include postal communication and storage whereas they have been included in the list proposed by SCINS. Under each category statistics have been compiled on infrastructure items and other related items which are important for giving a clear idea about the status of the sector. For example, the capacity for power generation does not only depend on number of power plants but also on capacity of coal, petroleum and natural gas production. Since thermal power has 79% share in the power production, separate chapters have been kept on mining and quarrying, petroleum and natural gas sectors. The available data on new and renewable energy systems is covered in the chapter on electricity because unlike mining and quarrying, petroleum and natural gas sectors, output of new and renewable energy systems is directly in the form of heat or electricity. The finalized list of infrastructure sectors and sub- sectors is as given below:

Infrastructure Sector	Sub - sector	Coverage
Transport	Road Transport	Roads and bridges Tunnels, motor vehicles
	Rail Transport	Railways , signaling, communication system, rail yards, stations Rolling stock
	Inland water transport	Inland waterways Inland water vessels
	Sea and coastal transport	Seaports Ships and other vessels
	Air Transport	Airports Air crafts
Energy/power	Electricity (Thermal, Hydro, Nuclear)	Generation plants, wind mills, transmission and distribution

		lines, electric substances.
		Coal reserves, coal fields/mines, coal washeries.
	Petroleum and natural gas	Oil and gas pipeline networks
		Distribution terminals, gas fields/wells, refineries
Drinking water supply , sanitation	Drinking water supply	Water supply pipelines, filteration and treatment plants
	Sanitation	Sewage treatment plants, drainage pipelines, on site sanitation facilities, landfills, incinerators
Irrigation	Irrigation	Major and minor irrigation structures, command areas, irrigation canals, reservoirs, water shed development
Communication	Telecommunication	Telephone network (landlines, mobiles), internet servers, communication satellites, cable television network
	Postal communication	Postal network, courier mail service
Storage	Storage	Food grain storage, cold storages, warehouses

OVERVIEW OF THE PUBLICATION

The data compiled in this publication is limited to the secondary data generated as official by-products and available with the functional ministries/ departments. The infrastructure statistics are compiled under six sub sectors viz: Transport, Energy, Communication, Water

and sanitation, Irrigation and Storage. The data is presented under five indicators: Access indicators, Quality indicators, Fiscal Cost and Revenue indicators, Utilization indicators and Affordability indicators. For each sector, country profile is followed by state profiles, although at state –level there are data gaps, both at indicator level and year level which needs to be filled up for a complete profile. For each state, the data for five years viz 2006-07 to 2010-11 is compiled with appropriate graphs showing trends. For detailed notes on the concepts, definitions and classification of infrastructure statistics on each sector, the manual on infrastructure statistics available at http://mospi.nic.in/mospi_new/upload/Manual_Infrastructure_Statistics_28_mar12.pdf may be consulted.