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## **Supply Chain Management and Poor Infrastructure: A Tale of Toothless Lion**

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### **Abstract**

*Supply chains are meant for safe, rapid and smooth transfer of goods from point of origin to point of consumption through multiple handling of goods, consolidation, deconsolidation, reconsolidation, transportation, storage and final distribution in right quantity. Logistical flexibility of organization is its potential to rapidly move material/products, cost effectively to/from customers/suppliers. It entirely depends upon the availability of robust and strong infrastructure like express highway networks, fast rail road network, shipping facilities with modernized docks and ports, network of airports and large fleet of cargo aircrafts. Infrastructure in India is in developing state and needs very huge investments. In past decade, Government of India has initiated large infrastructural development projects to boost this otherwise neglected and rudimentary sector. India has been amongst countries where logistic costs are almost 14 % as compare to the USA and other developed nations where it has been brought down to 8 – 9 %. This gap can not be bridged only through adoption of other supply chain management (SCM) practices and enabling technologies. In this paper, a comparative study of transportation energy and communication infrastructure in India and select developed and developing countries is presented to understand the existing large gap. Major challenges for supply chain management in the wake of lack of infrastructure are identified. Infrastructural development is on one hand extremely capital intensive and time consuming and has environmental and social impacts as well on other hand. A need for assessing these impacts is proposed and why they should be attributed to supply chain and logistical flexibility costs is explored. The paper is significant in the wake of wide spread concerns about sustainability and climate change. It can be useful for policy and decision makers also in prioritizing the efforts and resource directed towards new practices and technology adoption.*

**Key Words: Supply chain management, logistical flexibility, infrastructure, environmental costs**

## **1. Introduction**

Supply Chain Management (SCM) is meant for safe, timely, accurate, exact and smooth transfer of goods from point of origin to point of consumption. Activities like multiple handling of goods, consolidation, deconsolidation, reconsolidation, transportation, and storage are carried out at many echelons of the chain. These amalgamated activities are resource and time consuming and needs robust infrastructure like express highway networks, fast railroad network, shipping facilities with modernized docks and ports, wide spread network of airports and large fleet of cargo aircrafts. Adding to this, strong communication and information sharing infrastructures in terms of IT platforms and both mobile and landline communication network are essential to support the supply chain activities which are dominated by the informational flow from and to both upstream and down stream of the supply chains (Thomas, 1999).

Infrastructure in India is in developing state and needs very huge investments. In past decade, Government of India has initiated large infrastructural development projects to boost this otherwise neglected and rudimentary sector. India has been amongst countries where logistic costs are almost 14 % as compare to the USA and other developed nations where it has been brought down to 8 – 9 %. This gap can not be bridged only through adoption of other supply chain management (SCM) practices and enabling technologies of information and communication Technology (ICT), collaborative planning, forecasting and replenishment, quick response, identification and tracking of goods using bar coding or radio frequency identification device (RFID), and many more. An underlying assumption is that SCM practices are supported all through by massive infrastructure of transportation, communication, warehousing and cold storage etc. Successful supply chain management at the enterprise level depends heavily on the state of the infrastructure scenario in the country (Sahay and Mohan, 2003). For example, Wal-Mart could not initially replicate the successful model of USA, when they tried to implement it in developing country like Mexico. Poor infrastructure turned out to be the biggest hurdle.

This paper investigate the current state of infrastructure in India and comparisons have been drawn with the infrastructural facilities of developed countries like Germany, USA, UK, Japan, France, as well as countries which, along with India are considered the growth engines of world economy like China and Brazil. Republic of Korea (South Korea) and Malaysia are also included in comparison because they are proven tigers of the Asia and a comparison is logical to investigate the standing of India in this region as well. Important questions are raised about the accounting of the enormous costs of infrastructure development and cost of environmental damage and should not these costs be attributed to cost of supply chains while one quantitatively demonstrate the benefits organizations derived by successful implementation of the SCM.

## **2. Literature Review**

The supply chain management is defined in terms of the various flows which occur with in the networked organizations. Mohanty and Deshmukh (2005) gave a comprehensive definition covering flows and processes related to SCM and defined it as a loop that starts

with customer and ends with customer through which flow all materials, finished goods, information, and transactions. It requires looking at business as one continuous, seamless process. This process absorbs distinct functions such as forecasting, purchasing, manufacturing, distribution, sales, and marketing into a continuous business transaction.” These flows require means and carriers that are transformational and communicational facilities available to the supply chain network.

Complex chains need lot of flexibility in operations to face challenges of uncertainty in demand, uncertain lead-times and uncertainty in delivery and distribution. Logistical flexibility is an important flexibility among various flexibilities defined in literature in the context of supply chains. Concept of logistics flexibility and its separation in to flexible logistics competence (physical supply and purchasing flexibilities) from capability (physical distribution and demand management flexibilities) along with definition of range that is the firm’s ability to design, make, and distribute different products is suggested in the literature (Zhang et al.,2005; Naim et al. 2006).

Infrastructural requirements and environmental concerns are not taken into account while advocating the benefits of the flexibility. Supply chain flexibility depends largely on availability of the sound infrastructure. Well-developed infrastructure reduces the effect of distance between regions, with the result of truly integrating the national market and connecting it to markets in other countries and regions (Schwab and Porter, 2008). The word Infrastructure is a combination of the Latin prefix "infra", meaning "below" and "structure" and as per Oxford dictionary, defined as the basic physical and organizational structures needed for the operation of a society or enterprise. The term typically refers to the technical structures that support a society, and industries such as roads, water supply, sewers, power grids, telecommunications, and so forth. While Infrastructure is recognized as a crucial input for economic development, there is no clear definition of infrastructure according to the current usage of the term in India. D Rangarajan Commission indicated six characteristics of infrastructure sectors, (a) Natural monopoly, (b) High-sunk costs, (c) Non-tradability of output (d) Non- rivalness (up to congestion limits) in consumption, (e) Possibility of price exclusion, and (f) Bestowing externalities on society and recommended inclusion of following in infrastructure:

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

(Website: <http://infrastructure.gov.in/>)

In terms of supply chain management it includes capital assets that serve the function of conveyance or channeling of people, vehicles, fluids, energy or information, and which take the form either of a network or of a critical node used by vehicles, or used for the transmission of electro-magnetic waves. Infrastructure systems include both the fixed assets and the control systems and software required to operate, manage and monitor the systems, as well as any accessory buildings, plants or vehicles that are an essential part of the system (Huber and Sweeney, 2007)

Most products in global supply chains needs large degree of consolidation before shipment to achieve economies of scale and then are transported via the slow ocean mode resulting in inadvertent delays during transit and long lead times (Bhatnagar and Teo,

2009). Infrastructural inadequacies compound this effect and for developing countries it is emerging as most critical shortcomings in handling huge transportation load (Ogunsanya, 2002) Transport infrastructure has been identified by 45 per cent of companies as an overriding constraint of the continuing development of business in Ireland. The problems reported mainly relate to costs and ensuring deliveries on time (Huber and Sweeney, 2007). India is one of the world's fastest-growing economies with diverse markets. Managing supply chain in such a vast country is most challenging for any organization because of business practices, government regulations, technology capability, transportation infrastructure, etc. A CRISIL Research study of the logistics expenditure in India reveals that the efficiency of logistics network in the country lags behind that of many developed nations (Crisil report, 2009).

In India 65% of the freight movement is handled by trucks The Indian industry spends an exceptionally high amount of 12 to 15 per cent of its revenue on logistics (Sahay et al., 2006). The higher spend is largely due to inefficient logistics operations, multiple tax structures, inadequate logistics infrastructure and unorganized nature of the industry. (Crisil report, 2009) Road network and other transportation means are grossly inadequate and incapable to handle the present load. Infrastructure may be owned and managed by governments or by private companies, such as public utility or railway companies. Generally, most roads, major ports and airports, water distribution systems and sewage networks are publicly owned in India, whereas private participation has been promoted recently in energy and telecommunications. Some efforts of private participation in roads construction (Built, Operate and Transfer), Railways and airport development have been initiated but they are not yet to take measurable shape.

### **3. Methodology**

Infrastructural strength of the nation, being an important enabler for effective and efficient supply chains operations has been compared and contrasted to get the current standing of India. Supply chains are instrumental in trade activities and we have thus identified top five exporting and importing countries of the world. Apart from this Brazil, India and China (BIC) are being projected as the new carriers of world economy based on high growth potential shown by these developing countries are also taken for comparison. In Asian countries South Korea and Malaysia have ranked amongst top exporter and importer apart from China, Japan and India so they have also been included. In all 10 countries including India are selected which covers global, Asian and fast developing economies scenario for the purpose of comparison of infrastructural facilities to get an insight the Indian infrastructural robustness. To show the comparison of the scale of supply chain activities in these countries export and import statistics along with respective ranks in world trade are presented in Table 1.

**Table 1: Export and Import statistics of select countries**

S. No.	Rank	Exporters	Value in billion \$	Percentage Share	Rank	Importers	Value in billion \$	Percentage Share
1	1	Germany	1326.4	9.5	1	USA	2020.4	14.2
2	2	China	1217.8	8.7	2	Germany	1058.6	7.4
3	3	USA	1162.5	8.3	3	China	956.0	6.7
4	4	Japan	712.8	5.1	4	Japan	621.1	4.4
5	5	France	553.4	4.0	5	UK	619.6	4.4
6	8	UK	437.8	3.1	6	France	615.2	4.3
7	11	Rep of Korea	371.5	2.7	13	Rep of Korea	356.8	2.5
8	19	Malaysia	176.2	1.3	18	India	216.6	1.5
9	24	Brazil	160.6	1.2	25	Malaysia	147.0	1.0
10	26	India	145.3	1.0	28	Brazil	126.6	0.9

(Source: International Trade statistics 2008, World Trade organization report)

Supply chain activities are linked directly with the trade in the country and Indian trade scenario in comparison to world scenario must be understood to get an assessment of the current status of the supply chains operations. Brazil, India and China are illustrative of a clear trend of vigorous growth among a number of emerging economies. While this growth implies a growing share of world trade, the share in world exports remains relatively small for most of the emerging economies individually. The share of Brazil and India, for example, is still just over 1 per cent, while China's share is approaching 10 per cent. In 2007, Brazil exported merchandise worth \$161 billion. With imports accounting for \$127 billion, it recorded a positive trade balance of \$34 billion. India's merchandise exports reached \$145 billion in 2007, growing at an annual average of 19 per cent since 2000. More than 30 per cent of its exports go to Asia, with Europe being the second-largest trading region (23 per cent). The Middle East absorbs 17 per cent of India's merchandise exports while North America receives 15 per cent. In 2007, India's imports reached \$217 billion, resulting in a negative trade balance of \$72 billion. Since China joined the WTO in 2001, it has almost quadrupled its exports while imports have more than tripled. In 2007, its trade surplus reached \$262 billion. Clearly, in comparison to these emerging economies also, India is lagging mainly due to late initiatives of economic liberalization. The trade deficit is mainly caused due to heavy import of petroleum crude. To make comparison more illustrative various reports of the organizations like world trade organization and world economic forum (International trade statistics 2008 and global competitiveness report 2008-09) along with other secondary sources are used for data collection.

#### **4. Comparison of Infrastructure**

A detailed comparison is presented in this section for selected 10 countries and based on the available statistics current ranking on the basis of availability of different categories of infrastructure are given. Since this type of comparison may become highly skewed and meaningless if the area and population of the country is not been accounted. For e.g. road network in India is playing extremely vital role in domestic as well as international supply chains. The vast area and geographically difficult terrains in subcontinent are major problems in developing road network. Rural road network though constitute almost 80 % of the total roads available it is highly neglected and is in poor condition. Table 2 gives the typology of infrastructure which supports the supply chain activities.

S. No.	Type of Infrastructure		Main Systems
	Main Category	Sub Categories	
1	Transport	Road Transport	Road network, Highways, Expressways, Bridges, Flyovers, Street lights Traffic Signaling
		Railways	Train Stations, Total rail reach, Rail yards Number of Trains (goods and passenger), Dedicated freight corridors, Signaling Communication facilities
		Seaports	Docks, No. of ships
		Airports	International Airports, Domestic air ports, Navigational facilities, Cargo facilities, Aircrafts
2	Energy	Electrical Power	Generation Plants, Total generation, Grids and substation, Distribution network
		Oil and Natural Gas	Natural gas pipeline, Petroleum Pipeline. Refineries, Depots, Filling Stations
3	Water	Drinking Water supply	Filtration Plants, Supply networks, Overhead tanks and pumping houses
		Irrigation	Number of Dams and reservoirs, Canals, Flood Control systems
		Waste Water Mgmt.	Drainage, Sewage
4	Communication	Phone	Landline, Mobile
		Internet	Internet Broadband connections, Servers and Router
		Others	Satellite communication, Global Positioning Systems (GPS)
5	Waste Management		Solid waste landfills, Solid waste incinerators, Hazardous waste disposal facilities

**Table 2: Types of infrastructure supporting supply chain management**

For keeping the size of paper within bounds, broad indicators of transport, energy and communication infrastructures are discussed in detail in next section.

In Indian context the condition of most of the infrastructure is not sound due to poor maintenance and inadequacy of fund for repair. Indian rail has many bridges over rivers that are close to 100 year old. Condition of roads is extremely poor in some part of the country and restricts the traffic speed to less than 30 kmph (Shah, 2009). It is, thus, found necessary to investigate above infrastructure on qualitative scale. Since it was difficult to get opinion on such vast parameters from large no. of people, it is felt suitable to reproduce the data of the Global Competitiveness Report 2008–2009 where majority of the parameters are ranked on quality aspects. All 10 countries selected here for this study are part of the total 134 countries that are included in the survey.

A seven point scale (1 = underdeveloped, 7 = extensive and efficient by international standards) is used to get the score of various parameters of infrastructure and ICT facilities. Based on these scores countries are ranked. The details of these are presented in tables 12 and 13 (Schwab and Porter, 2008). Also in this survey, from a list of 15 factors, respondents were asked to select the five most problematic factor for doing business in their country and to rank them between 1 (most problematic) and 5. In Case of India 25.5 % respondent, who are managers of different firms, chose inadequate supply of infrastructure is the top most problematic factor for doing business. The data shows that India ranked 90<sup>th</sup> among 134 countries for overall quality of Infrastructure.

**Table 3: Comparison of quality of important infrastructure based on scores and ranks**

S. No.	Country	Infrastructure		Over all Quality		Quality of roads		Quality of railroads		Quality of Ports		Quality of air transport		Available seat kilometers		Quality of electricity supply		Telephone lines	
		R	S	R	S	R	S	R	S	R	S	R	S	R	S	R	S	R	S
1	USA	7	6.1	9	6.1	8	6.2	16	5.2	11	5.9	12	6.3	1	33454.2	16	6.5	10	55.6
2	Germany	1	6.65	3	6.5	4	6.5	4	6.4	4	6.4	3	6.7	5	4451.2	8	6.7	2	65.9
3	China	47	4.22	58	3.9	51	4.1	28	4.1	54	4.3	74	4.4	2	7215.1	68	4.7	47	27.8
4	Japan	11	5.8	16	5.7	19	5.6	3	6.5	25	5.2	49	5.1	4	5116.5	6	6.7	28	43.6
5	UK	18	5.52	24	5.3	24	5.3	20	4.6	30	5.1	27	5.8	3	6546.7	18	6.4	8	56.1
6	France	2	6.54	4	6.6	1	6.7	2	6.6	10	5.9	5	6.5	6	3524.9	4	6.8	9	55.8
7	S. Korea	15	5.63	18	5.6	13	5.8	7	5.8	29	5.2	26	5.9	19	1701.3	21	6.1	17	49.8
8	India	72	3.38	90	2.9	87	2.9	21	4.4	93	3.3	66	4.7	10	2724.9	108	3.2	107	3.6
9	Malaysia	23	5.25	19	5.6	17	5.7	17	5	16	5.7	20	6	22	1063.4	31	5.8	71	16.8
10	Brazil	78	3.15	98	2.7	110	2.5	86	1.8	123	2.5	101	3.7	12	2353.9	58	5	62	20.5

Source: Schwab, K. and Porter, M.E. (2008)

R = Rank: All ranks are out of 134 (Number of countries)

S = Score: All scores except available seat Kilometers and telephone lines are out of 7 (1 = underdeveloped, 7 = extensive and efficient by international standards)

Available seat kilometers: Scheduled available seat kilometers per week originating in country (in millions)

Telephone Lines: Main telephone lines per 100 population.

**Table 4: Comparison of ICT related capabilities based on score and ranks**

S. No.	Country	Technological Enhancer		Mobile Telephone subscribers/100		Internet users / 100		Personal Computers/100		Broadband internet subscriber / 100		Laws related to ICT	
		R	S	R	S	R	S	R	S	R	S	R	S
1	USA	11	5.57	51	80.3	9	69.8	6	79.9	18	20.1	9	5.6
2	Germany	18	5.22	26	103.5	30	46.7	12	65.3	23	18.1	13	5.5
3	China	77	3.19	90	34.8	85	10.4	81	5.6	49	3.8	47	4.2
4	Japan	21	5.11	52	79.3	10	68.3	26	40.8	16	20.6	32	4.8
5	UK	8	5.62	10	116.6	14	63.2	5	81.2	12	21.7	17	5.4
6	France	20	5.16	45	85.1	26	49.6	11	65.9	14	20.9	16	5.4
7	S. Korea	13	5.51	47	83.8	8	71.1	20	53.2	4	29.3	2	6.0
8	India	69	3.27	115	14.8	84	10.7	96	2.8	92	0.2	38	4.6
9	Malaysia	34	4.41	56	75.5	26	54.2	38	23.4	51	3.5	19	5.3
10	Brazil	56	3.59	78	52.9	57	22.6	50	16.1	52	3.1	49	4.2

Data Source: Schwab, K. and Porter, M.E. (2008)

R = Rank

All ranks are out of 134 (Number of countries)

S = Score

Scores for Technological Enhancer and Laws related to ICT are out of 7

For all other hard data on per 100 population

## **5. Sustainable aspects of Infrastructural development**

Huge infrastructures like expressways, flyovers, elevated roads, bridges, railway tracks, tunnels and sky rails are not only consuming excessive material resources like steel, aluminum, cement, concrete, lime, pebbles, stones, sand, other metals, wood which predominantly come from natural sources. Depletion of such sources in recent past is at alarming rate is a matter of great concern. Example of Aravalli range in west north India is an eye opener. Supreme Court of India has to intervene to stop the mining in Aravalli. According to environmentalist and expert in desert sciences Anupam Mishra “These hills are nine times the geological age of the Himalayas - and unlike the Himalayas they are very stable and strong. The Aravallis control everything, rain, drought and flood, on both sides, the desert and the fertile plains,” Crucially, they block the sands of the Thar Desert from blowing into the fertile plains of north India. Since they are not very high, people have exploited them for mining and construction. The range is considered raw material but it is actually a crucial lifeline,” (Website: [http://www.thaindian.com/newsportal/uncategorized/save-aravallis-save-north-india-plead-environmentalists\\_100146443.html](http://www.thaindian.com/newsportal/uncategorized/save-aravallis-save-north-india-plead-environmentalists_100146443.html)). Other issues involved are

- Diversion of agricultural land
- Huge capital requirement
- Destruction of natural water channels resulting in water logging and fall in water table
- Disruption, dislocation and nuisance during construction and during operation.
- Social issues like shifting of people, houses and shops
- Energy consumption in construction and operations. (Street lights and signals)
- Loss of biodiversity
- Promotes purchase of more vehicles and thus more pollution
- Accidents, loss of life, property and goods
- Spilling of oil in sea, toxic emission during transits and leakage of hazardous gases and liquids

In Indian context, social and environmental issues are very sensitive. Acquisition of land from farmers has been a core reason of disharmony in recent past and now it has become a political issue as well. Direct foreign investment in infrastructural development is a risky proposition mainly due to this reason.

## **6. Discussion**

"The Indian logistics industry, valued at Rs 3.6 trillion, is poised for strong growth in the next five years with a CAGR of around 11 per cent. A well developed and networked logistics industry is imperative for the success and overall growth of the economy. Strong growth in economic fundamentals, favourable regulatory environment and greater thrust on logistics infrastructure development would be the key factors driving logistics growth" (Crisil Report, 2009). These words are indicative of the size and importance of the

logistics industry in India and if India has a play a bigger role in globalised supply chains, there is urgent need to address the infrastructural issues as first priority. Road, Rail, airport and seaport are sector needs major restructuring and huge capital investment is warranted to support such action. Government alone can not undertake these huge projects and active participation from the private sector is essential to develop long term dependable private–public partnership in infrastructural projects. Beginning of such relationships has started and for e.g. decision to allow private operators in container service already taken and 14 firms have qualified. Similarly in airports and seaport private partner ship is increasing. With all these activities, India needs to focus on achieving targets of logistics cost by 3 to 4 % in next five years to remain competitive in world markets. As a major acknowledgement of infrastructural inadequacy and need to provide inordinate impetus to develop it, Cabinet Committee on Infrastructure (CCI) under the chairmanship of Prime Minister, has been constituted recently that will approve and review policies and projects across infrastructure sectors. The ongoing programme of four-laning the 5846 km long Golden Quadrilateral and four-laning of the 7,142 km North-South East-West (NSEW) corridor is an indication of efforts in this direction.

Even if India can not reach any where close to standards of developed countries like Germany, USA, France, UK, and Japan, it has to compete with emerging economies like China and Brazil and should aim at getting close to Asian countries like Malaysia and South Korea. Social and environmental issues discussed above needs to be addressed with careful attention to avoid skewed growth as reported in China. Environmental impact assessment in India is mandatory legally but its effectiveness in poor due to laxity in implementation of constituted laws. Proactive environmental and social impact assessment of all major infrastructural development projects must be carried out seriously to create a good balance between two contrasting objectives.

## **7. Conclusions**

Supply chains are characterized by speedy and smooth flow of material and information. Flow management needs supporting infrastructure. Logistic costs reduction has been main focus of supply chain management and companies like Wal-Mart have made lean logistics as its core competency to cut cost and gain competitive edge. In Indian context, many organizations specially in retail sector are facing logistics problems. It has been demonstrated through data analyses that Indian infrastructure is grossly inadequate to support large scale supply chain operations. The infrastructure has been compared and ranked for select countries and it is made explicitly clear that without robust infrastructure, India can not compete with global supply chains. This macro level analysis is helpful in understanding the widening gap and comparative study may stimulate the thinking in developing necessary environment for supply chains activities to grow and achieve global standards. Capital requirement and environmental impacts of infrastructural development are found to be major concerns. Sustainability of supply chains is highlighted as core concern for future trade because climate change and global warming are becoming guiding and limiting forces for all future business activities.

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