Indian Management Studies Journal 14 (2010) 77-100

Indian Management Studies Journal

# Transportation Management and In-Transit Losses : A Case Study of Maruti Limited

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**Abstract**

Today, the Indian economy is one of the most dynamic in the world due to high degree of industrialisation programmes assisted by foreign investment with manufacturing capabilities, low labour cost and stimulated local demand. An effective transportation system is the life line of an economy as trade and transport are closely linked. In this era of globalisation, more and more countries have started realising that the economic growth is not possible without strengthening their transport infrastructure. The fast economic growth can only be achieved through proper transportation management which is an essential and a major sub-function of logistics that creates time and place utility in goods.

Logistics costs, i.e., transportation, inventory holding, warehousing, packaging, losses and related administration costs have been estimated at 13-14% of Indian GDP which is higher than 8% of USA's and 6-8% of other developed countries. Out of this percentage of logistics cost, transportation contributes more than 40% and in-transit losses 14%, thus, both put together account for more than half the logistics cost and very interestingly all these costs are dependent on transportation. Alarmingly, India appears among the top ten countries which suffer from In-Transit losses. Present empirical study is an attempt to get insight into the problems and critical role of transportation management with special reference to in-transit losses in Maruti Limited.

The findings of the study reveal the need for streamlining the transportation management process by adopting most modern techniques like GPS, RFID and others in road transport, multi-layer containerisation and extension of rail to the companies warehouses

for railways, setting up of ports by private operators, allowing private operators for cargo handling and clearances with on-line/real time tracking processes at ports and by using multimodal transportation to lower the cost of transportation for improving bottom line of the organisations under study. It also reveals that Indian companies need to implement the intelligent transport systems (ITS) solution to streamline their business process. The remedial measures like proper packaging , avoiding delays in clearance of cargo, pilferage, managing check points, special transport vehicles, asset utilizations, placement of experienced manpower at strategic locations, negotiation for better insurance cover, better road infrastructure, and uniform tax regime can help in curtailing the in-transit losses to a great extent.

## INTRODUCTION

In 1993, the Indian government deregulated entry into the auto industry, jettisoned the use of licenses to control output levels, and significantly reduced import tariffs on auto components. These changes led to an influx of globally competitive auto assemblers into the Indian passenger car market. Specifically, 12 world-class auto firms including Ford, General Motors, Hyundai, Daewoo, Honda, Toyota, Fiat, and Mercedes-Benz entered this market segment. Previously, there were only four car assemblers in the country and Maruti-Suzuki (Maruti), India's leading car assembler, held a 62% market share. A result of this influx of assemblers is that planned production capacity now exceeds the estimated demand for cars in the country. Competition among auto assemblers is intense, and firms are restructuring to cut costs, enhance quality, and enhance their responsiveness to demand. To achieve these goals, incumbent firms as well as new entrants are all attempting to improve supply chain management and implement lean production techniques. Indeed, most of the assemblers in India strongly believe that lean production is necessary because it offers a "proven" means by which firms can dramatically cut costs and improve performance. It is JIT delivery and low inventories the components of the famous Japanese kanban system that lie at the heart of lean production.

Reduced inventories are not merely a means for lowering the financial or spatial costs associated with stock. Rather, low inventories are the key drivers of the entire lean system and of the associated gains in quality and competitiveness. Many lean assemblers require their suppliers to deliver several times a day, and the deliveries tend to be tightly scheduled. In the leanest firms, such as Toyota, deliveries may be required to arrive within a narrow, two-hour window. Parts are

delivered directly to the assembly line to be fitted into the vehicle; they are neither tested nor warehoused at the assembly plant. Because there are minimal buyer inventories at the assembly plant, a few hours of delay in delivery can stop the entire assembly line the costs of such a delay are prohibitive. This system is incredibly fragile particularly because in a truly lean system every firm in the chain is lean. The lean paradigm, thus, requires all participants and systems to be synchronized like clockwork and to perform unfailingly. This paper shows how fast and reliable transportation is a key ingredient that is required to make the JIT and lean production system work. While it is both intuitive and logical that JIT delivery systems require good transportation, little if any of the vast literature on the topic shows how and to what extent the transportation system affects the implementation of and gains from JIT and lean production. In fact, many proponents of lean production argue that the only significant difference between lean and non-lean firms is management attitude and suggest that mechanistic issues such as distance to suppliers and transport reliability have little role to play (Lieberman & Demeester, 1995; Womack et al., 1990). They also argue that lean production can be fully implemented anywhere in the world (Womack et al., 1990). This paper challenges both of these notions and provides an insight into the types of adjustments that firms need to devise to implement lean production in the context of a developing country.

Poor transportation systems adversely affect industrial competitiveness. Poor transportation raises the damages incurred in transit, total inventories, and ordering and overhead costs. Further, it creates external diseconomies by introducing inefficiencies and unreliability in the supply chain, making it difficult for assemblers to implement lean production. These external diseconomies rather than excessive freight prices or other direct costs may be the more debilitating impact of poor transportation infrastructure on industrial performance. In India, transportation constraints and the imperatives of lean production are driving assemblers to create auto clusters (Gulyani, 2001).

Industrial firms in developing countries have to contend with highly ineffective freight transportation systems. The physical infrastructure the ports, airports, and road and rail networks is capacity constrained and poorly maintained, and the freight services provided by private and public sector operators tend to be limited in range, poor in quality, and often technologically obsolete. Consequently, industrial firms in these countries operate under a handicap relative to their competitors in advanced industrialized countries. But, neither the extent of this handicap nor the mechanisms through which inadequate infrastructure harms

competitiveness are well understood (Diamond & Spence, 1989; Anas & Lee, 2000). To bridge this gap, this study empirically examines the impact of poor transport infrastructure on industrial performance in a developing country. The illustrative case here is the automobile sector in India. It has been observed that poor transportation systems result in slow movement of goods and in high unit cost of freight (3i Network, 2006). The key problem with badly maintained and inadequate road networks is that they directly raise the cost of freight by

(a) enhancing the cost of operations and maintenance (due to greater wear and tear and higher fuel consumption); and

(b) increasing transit time, which, in turn, means that both labour (driver) and capital (the truck) are deployed for a longer period of time to complete a given delivery.

The present study analyzes the transport solutions devised by Maruti Limited. It shows that the analytic approach discussed above is inadequate for understanding how transport infrastructure affects competitiveness and suggests a broader analytical framework within which to consider the issue. It has been observed that freight costs are neither the only nor the most significant cost that poor transportation systems create. An inadequate transportation system also increases the damages incurred in transit, the total inventories that firms have to maintain, and the ordering and overhead costs associated with managing material flows. Taken together, these variables constitute the "total logistics cost" borne by a firm.

Not only the direct logistics costs borne by a particular firm but also the transportation costs over its supply chain have been examined. The quantitative supply chain analysis is supported by semi-structured interviews with firm managers and an inductive analysis of the coping strategies firms have devised to limit the adverse impacts of poor transportation. It is revealed that auto assemblers are highly concerned about the inefficiency and unreliability that poor transportation systems introduce into their supply chains.

## REVIEW OF LITERATURE

Gulyani (2001) studied the effects of poor transportation on lean production and industrial clustering as to the Indian auto industry. Poor transportation systems adversely affect industrial competitiveness by raising the unit cost of freight. The study finds that freight is neither the only nor the most significant cost that poor transportation creates for auto firms in India. Poor transportation also raises the damages incurred in transit, total inventories, and ordering and overhead costs.

Worse, it creates external diseconomies by introducing inefficiencies and unreliability in the supply chain, making it difficult for assemblers to implement lean production. These external diseconomies-rather than excessive freight prices or other direct costs-may be the more debilitating impact of poor transportation infrastructure on industrial performance.

Raghavendra (2003), in his article, revealed that excessive inventories have resulted in higher logistics costs to companies worldwide. Even though this is good news for the logistics industry, the Council for Logistics Management (CLM) feels that even a 1 per cent reduction in overall logistics costs by companies could result in an annual savings of Rs. 25,000 crore. In order to achieve this target, CLM has said that it is important for companies to benefit from third-party logistics (3PL).

Logistics comprises 14 per cent of the total GDP in India. In developed countries it is less than 8 per cent. Realising the potential of the logistics industry, Transport Corporation of India, in collaboration with Management Development Institute (MDI), conducted a research on '3PL Logistics Practices in Indian Industry'. As per the survey, 55 per cent of the Indian companies subscribe to 3PL services compared with 75 per cent globally, indicating a huge potential in the country. Among the companies surveyed, 40 per cent have logistics costs less than 10 per cent of the total cost, 17 per cent have 10-20 per cent, 5 per cent have 20-50 per cent.

Bansal (2005) in his detailed research article studied the various issues relating to freight transport in India. He highlighted that India's freight industry suffers from the features like highly competitive and low cost, low utilization and high transit times, overloading of vehicles, poor infrastructure, and barriers to free movement. He revealed certain reasons for its low utilization. These mainly include : rigid equipment resulting in delays due to loading/unloading; check points-inter-state, octroi, in-transit; excess of fleet; traffic mix on the roads; poor quality of infrastructure; and overloaded trucks. He further explained that the fatality rates in India are 10 times of developed nations. Trucks are involved in over 50% of fatalities. Economic loss due to accidents is 23% of GDP. He also pointed out that erring drivers are not strictly penalized. The study provided that axle-load limit in India is 10.2 tonnes against the optimum axle-load of 11-13 tonnes which adversely affects the Indian economy.

Mishra et al. (2005) studied the problems, challenges and opportunities of logistics with special reference to Indian economy. They believed that the logistics industry in India is evolving rapidly and it is the interplay of infrastructure, technology and new types of service providers that will define whether the

industry is able to help its customers reduce their logistics costs and provide effective services (which are also growing). Changing government policies on taxation and regulation of service providers are going to play an important role in this process.

Gujar (2006) in his thesis titled, "Growth of Containerization and Multimodal Transportation in India" analyzed the multimodal transportation system in India; identified the numerous facets of the system; and studied the role of multimodal transportation in the economic growth of the country. It also highlights the shortcomings and challenges India is facing because of lack of legislation, policy failures, Infrastructure limitation, and operational deficiencies and suggests measures for improving efficiency and operation.

The objective of the article titled, "Impact of Transportation Infrastructure on Logistics in India" by Vijayaraghavan (2007) is to put forth the macro perspectives in Indian transportation logistics, the scenarios in the infrastructure, which constitute Macro Logistics in the country. Transportation has great impact on a country's economy. Studies reveal that in India the total logistics costs constitute nearly 10 per cent of the GNP out of which nearly 40 per cent is because of transportation alone. In the U.S., the estimates show that the cost is around 6 per cent of the GNP.

## OBJECTIVES OF THE STUDY

The present study has been conducted with the following objectives :

- To study the impact of transportation management on Maruti Limited
- To study the reasons for in- transit losses
- To offer suitable suggestions based on the study.

## RESEARCH METHODOLOGY

The available literature on this subject merely describes transportation means and multimodal transport in India. It does neither analyze the role of Transportation Management & In-Transit Losses in the growth of automobile companies and thus improving their bottom line nor does it attempt to establish a relationship between the GDP growth and the Transportation Management. This research paper not only covers the above-mentioned lacunae but also attempts to forecast the growth of Transportation Management and preventing In-Transit Losses in automobile sector in India. Furthermore, an endeavour has also been made to find solutions for the challenges that would appear due to globalization and competitive environment in the country.

This work primarily focuses upon developments taking place in Transportation Management and preventing In-Transit Losses in the automobile industry per se. It further observes the movement of goods and cost of transportation involved and In-Transit Losses incurring. While doing so, it attempts to identify the problems faced in the Transportation Management & In-Transit Losses, and tries to suggest solutions for these problems.

The study also undertakes the macro economic background of India along with special characteristics of different regions where the goods are dispatched to various dealerships. Further, it focuses upon the geographical terrain and the impact of Transportation and In-Transit Losses happening in various regions and zones, and analyzes the reasons for the success and failure of the Transportation Management.

## RESEARCH QUESTIONS

The following research questions have been framed to achieve the said objectives of the study :

1. What is the impact of Transportation Management on the business of the companies?
2. What is the role of Effective Transportation Management in the growth of the companies?

## DATA COLLECTION

The study is based on both the primary and secondary data. The primary information on Transportation Management was directly collected from the points of origin, i.e., through semi-structured interviews with executives of the respective companies and dealers of various companies.

However, the secondary data was collected from balance-sheets of various companies, and various reports made public by the Commerce and Finance Ministries of the Government of India.

The data on Transportation, In-Transit Losses, and economic growth was also obtained from forecasts and studies published by the Ministry of Surface Transport, Govt. of India/Planning Commission of India/State Governments/ Department of Police in various states, World Bank, International Monetary Fund, United Nations Economic and Social Committee on Asia and Pacific (UNESCAP), and Reserve Bank of India.

## SUPPLY & DISTRIBUTION SYSTEMS AT MARUTI

Maruti's supply and distribution chains and its transportation demand Purchase of raw materials and components is the single largest expense incurred by auto assemblers and their component suppliers in India (Tables 1, 2 and Figures 1 and 2). At Maruti one of the least vertically integrated auto firms in India components and raw materials (C&RM) account for 78% of total expenditure or about 71% of annual sales revenue. In 2007-08, 61.5% value of these purchases was procured domestically, while the rest was imported. The majority of this firm's imported purchases largely steel and components originate in Japan. Almost all of the imported components are supplied in the form of completely knocked-down or semi-knocked-down kits by the Suzuki Motor Company, which has a 50% equity

**Table 1**

**Assemblers Income Statement : 2008-09**

*(in Rs. crore)*

| | Maruti | Hindustan Motors | Hyundai | Tata Motors | Hero Honda |
|---|---|---|---|---|---|
| | 2008 | 2008 | 2008 | 2008 | 2008 |
| Net Revenue | | | | | |
| (a) Net Sales | 17891 | 5961 | 10514 | 35,651 | 10331 |
| (b) Other Income | 341 | 563 | 0 | 267.48 | 185.42 |
| | 18233 | 6524 | 10514 | 35,918 | 10516.42 |
| Total Expenditure | 16502 | 7226.744 | 10175 | 33684 | 9444.42 |
| (a) Power & Fuel | 115 | 46 | 181 | 718 | 189 |
| (b) Wages, salaries, benefits | 396 | 760 | 387 | 2745 | 472 |
| (c) Materials & Components | 12707 | 5023 | 7733 | 22057 | 7272 |
| (d) Stores & spares | 816 | 391 | 419 | 1437 | 283.3326 |
| (e) Freight & packaging | 544 | 326 | 407 | 1042 | 236.1105 |
| (f) Financial expenses | 310 | 124 | 132 | 647 | 141.6663 |
| (g) Depreciation | 572 | 206 | 356 | 782 | 160 |
| (h) Other Expenses | 1039 | 350 | 560 | 4258 | 690 |
| Total Expenditure | 16502 | 7227 | 10175 | 33685 | 9444 |
| Net Profit Before Tax | 1730 | -703 | 514 | 2,234 | 1072 |

**Source :** Compiled from company's annual report and income statements: 2008-09.

stake in Maruti. Suzuki ships most of the components from a port near its major plant in Hammatsu, which are typically carried by a reputed Japanese shipping company. For its domestic purchases, Maruti relies on 400 major suppliers located in the northern, western, and southern regions of the country; the more distant suppliers are located almost 2,500 km away. Maruti relies almost entirely on private truckers for inland transportation of its purchases (inbound freight) from domestic

**Table 2**

**Supplier's Income Statement : 2007-08**

***(in Rs. crore)***

| | **Munjal Showa** | **Bharat Seats** | **Sona Steering** | **Lumax** | **Clutch Auto** | **Rane-M** | **Rana Brake Ln** | **Sundram Brake Ln** |
|---|---|---|---|---|---|---|---|---|
| Net Sales | 842.49 | 219.6 | 693.16 | 523.33 | 196.12 | 352.46 | 191.35 | 171.79 |
| (a) Sales | 953 | 219.6 | 693.16 | 523.33 | 196.12 | 352.46 | 191.35 | 171. 79 |
| (b) Less : Excise Duty | 110.51 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Net Revenue | 843.26 | 219.99 | 696.94 | 529.51 | 199.16 | 353.16 | 193.15 | 171. 79 |
| (a) Net Sales | 842.49 | 219.6 | 693.16 | 523.33 | 196.12 | 352.46 | 191.35 | 171.79 |
| (b) Other Income | 0.77 | 0.39 | 3.78 | 6.18 | 3.04 | 0.7 | 1.8 | 0 |
| Total Expenditure | 865.52 | 233.19 | 793.55 | 551.8 | 204.71 | 385.87 | 204.69 | 175.3 |
| (a) Power & Fuel | | | 0 | | | | | 17.02 |
| (b) Wages, Salaries, Benefits | 32.83 | 5.36 | 53.84 | 48.35 | 21.27 | 36.72 | 29.47 | 21.67 |
| (c) Material & Components | 630.83 | 190 | 560.25 | 328.1 | 117.59 | 228.7 | 87.57 | 82.68 |
| (d) Stores & Spares | 40 | 4 | 30 | 23 | 13 | 19 | 12 | 8 |
| (e) Freight & Packaging | 16 | 4 | 21 | 14 | .., | 15 | 4 | 6 |
| (f) Financial Expenses | 2.27 | 0.91 | 31.68 | 6.51 | 12.58 | 8.19 | 6.14 | 2.81 |
| (g) Depreciation | 16.86 | 2.13 | 24.93 | 19.16 | 5.86 | 9.86 | 10.79 | 5.77 |
| (h) Other Expenses | 126.73 | 16.79 | 71.85 | 112.68 | 31.41 | 68.4 | 54.72 | 31.35 |
| Net Profit Before Tax | -22.26 | -13.2 | -96.61 | -22.29 | -5.55 | -32.71 | -11.54 | -3.51 |

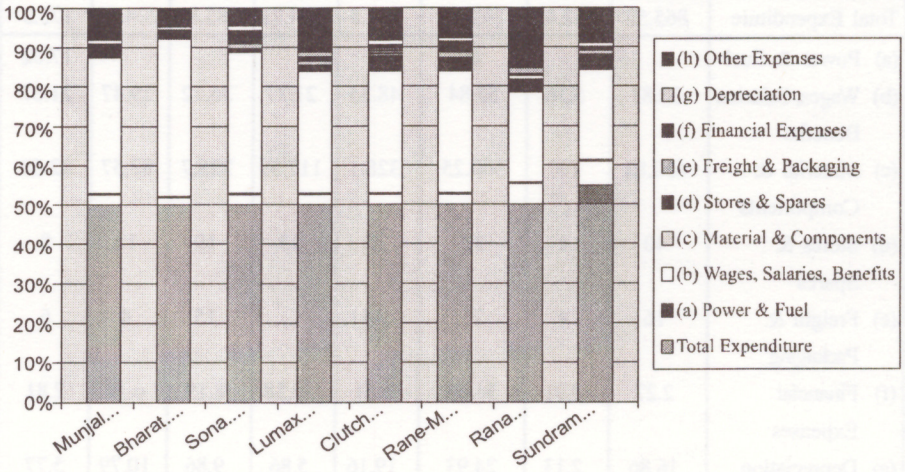
**Source :** Compiled from companies annual report and income statements-2007-08.

suppliers and ports.

Organizing the transportation and distribution of finished vehicles (outbound freight) is also an extensive, albeit less complex, exercise. In 2008-09, Maruti shipped almost 792803 finished vehicles, of which 70023 units in 2008-09 (8.83%) were exported. On average, the assembler dispatched 2642 vehicles, worth an estimated Rs. 71.54 crore, per working day. Maruti's export vehicles are transported by train from a railway station near its assembly plant to a station near the Nhava Sheva Port in Maharashtra, a total distance of about 1,500 km.

For its domestic sales, which account for 90% of total vehicle sales and sales revenue, Maruti relies on private trucking companies. In a nutshell, Maruti has complicated supply and distribution chains which involve the movement of inputs and finished goods of significant value as well as volume. The efficiency of the supply chain is of particular importance because it represents the majority of this assembler's expenditure (i.e., 71% of annual sales revenue). For the inputs that it imports, Maruti relies on ocean freight, which is a relatively slow mode of transportation. For almost all of its freight needs within India, the assembler relies on private trucking operations, and thus on the country's inadequate road network.

**Figure 1 : Assemblers Srtucture of Cost & Salience of Supply Chain : 2007-08**




**Source :** Company's annual statements / balance-sheets / income

The literature on transportation in developing countries suggests that the major problem associated poor transportation systems, in general, is that they raise transportation costs and thereby hurt competitiveness. Analysis of Maruti's

expenditures summarized in Table 3 show that the assembler does indeed incur significant freight costs.

**Table 3**

**Maruti's Logistics Costs as a Per Cent of Sales Revenue : 2007-08**

| | Freight Cost | Cost of Damages | Carry Cost of Inventory | Days of Inventory |
|---|---|---|---|---|
| Total Logistics Cost (Maruti) | 4.00% | 0.35 | 10%* | Total inventory of 30 days |
| (a) Outbound-finished Goods | 2.50% | 0.35 | 5%* | Finished goods inventory of 2 days |
| (b) Inbound-Components Materials | 1.50% | .25% | 3%* | "In-transit" inventory of 9 days and Buffer inventory of 13 days |

Assumption — Cost of capital is 18%

*Estimated carry cost of inventory.

In 2007-08, Maruti's freight bill including damages accounted for 4.35% of total sales revenue. These freight costs represent a highly significant expense, given that the assembler's entire wage bill accounted for only 2.0% of total sales revenues in the year. But, as the table indicates, freight is not the largest cost variable in the total logistics cost equation : the estimated inventory carrying costs were more than double the total freight costs. The carrying cost of supply-chain inventories was 8.0% of which buffer stock accounted for 5.0% and inbound in-transit inventories for 3.0%; the latter alone exceeded the expenditures on inbound freight (1.5%) and those on outbound freight (2.5%).

As compared to the traditional approach of examining freight expenditures and vehicle operating costs, the total logistics cost equation offers a more comprehensive insight into the direct costs especially the financial costs imposed by poor transport systems on firms. It also suggests reasons why distance between firms tends to affect competitiveness with increasing distance, not only do freight costs increase, but so do in-transit inventories, buffer stock, and damages. As an analytical framework, however, the equation offers only a limited understanding of the transportation problem. It appears to suggest that the key problem with poor transportation is that it raises freight costs and increases the financial cost of holding inventories, that is, the problem is that assemblers have to spend more.

From the assemblers' perspective, however, the more difficult problem is that poor transport systems introduce or aggravate unreliability and inefficiency in the non-local supply chain. They find, for example, that distant suppliers deliver far less frequently as compared to local suppliers, that only local suppliers are able to deliver just-in-time, and that the feedback and response loops tend to be slower among firms located a significant distance apart. Taken individually, just-in-time delivery, low inventories, and quick response feedback loops are important competitive strategies; taken together, they are key drivers of the lean production system and can create dynamic gains in quality and competitiveness. Thus, poor transportation systems serve as a major obstacle in firms' efforts at implementing and realizing dynamic gains from competitive strategies such as lean production and supply chain management.

This finding stands in contrast to much of the literature on lean production in the auto industry. These studies have found that distance from or, conversely, proximity to suppliers does not help explain differences in inventory levels and "leanness" at different assembly plants (Lieberman & Demeester, 1995; Womack et al., 1990).

The difference between the above findings based largely on research in advanced industrialized economies and my observations can be explained as follows :

Within India, the poor road infrastructure means that the transit time for road freight is both longer and more unpredictable as compared to, say, the United States and Europe. The excellent road and rail infrastructure for freight in the United States and Europe reduce the importance of proximity in their auto industries, while the terrible infrastructure in India makes proximity crucial to implementing just-in-time production in the Indian auto industry. This is also the reason why assemblers in India, unlike those in the United States, are selecting locations with a significant existing supplier base, clustering with other assemblers, and pushing suppliers to relocate in close proximity to their own assembly plants. Poor transportation, combined with the logic of lean production, is determining the geography of production in the Indian auto industry. What are the wider implications of this analysis of automobiles industry in a developing country like India?

First, it argues for the reintroduction of the infrastructure variable into the debates on economic geography, industrial districts, globalization, and industrial competitiveness. It highlights how physical infrastructure can influence firm level competitive strategies, the nature of inter-firm networks, and the geography of

production. These effects combined with its more intuitively obvious impacts on production costs and efficiency make infrastructure a critical variable influencing industrial performance.

Second, there is a need to resurrect the old concept of external economies in transport and infrastructure analysis, and to broaden the set of direct cost variables with which we work. Recent literature and practice takes far too narrow a view of the benefits and costs that infrastructure creates. By relying on easily quantifiable and narrowly defined proxy indicators such as freight costs and vehicle operating costs we may be making significant errors in identifying and selecting transportation investments and projects. Indeed, we may be under investing in precisely those types of infrastructure projects that are worthy of public investment those that create large external economies and contribute more significantly toward enhancing industrial development and performance.

**(a) Effect of the Transportation System on Logistics Costs**

Logistics is defined as the process of strategically managing the movement and storage of materials, parts, and finished inventory from suppliers, between enterprise facilities and to customers. Maruti and industrial firms in general bear five kinds of logistics costs that are directly related to transportation systems and their efficiency : freight expenditures, that is, direct cost or price of transporting a shipment by a given transportation mode (road, rail, sea, air); damages and losses incurred during shipment; cost of carrying inventories at origin, in-transit, at destination as well as the costs incurred due to a "stock out" which may occur if a shipment is late; ordering and overhead costs associated with managing material flows; and packaging costs. Taken together, these costs comprise the total logistics cost equation set forth earlier; their relative magnitudes at Maruti are discussed below. However, for simplicity, "ordering and overhead costs" and "packaging costs" are not discussed here. Further, only basic inventory carrying costs, as opposed to such related costs as warehousing and the use of extra land or space, are addressed.

**(i) Freight Expenditures**

Maruti's freight bill accounts for a significant proportion of its sales revenues.

For fiscal year 2007-08, Maruti spent Rs. 440 crore on outbound freight, that is, on the transportation and distribution of finished vehicles to domestic

dealers and overseas.

The cost of inbound freight the transport of C&RM purchased in India and abroad is harder to calculate because it is included in the delivered price of these items; disaggregated data on freight as a proportion of these prices or total purchases are not available. Maruti's purchase managers conservatively estimated the total cost of inbound freight at about Rs. 240 crore for 2007-08. Thus, in 2007-08, outbound freight accounted for 2.7% of total sales revenue, and inbound freight accounted for at least an additional 1.5% of sales revenue. By comparison, Maruti's entire wage bill for the year, including benefits, accounted for 2.0% of total sales revenue.

**(ii) Cost of Goods Damaged in Transit**

Although data for total damages incurred during transit (inbound plus outbound) is not available, there is data on outbound freight finished vehicles that indicates the type and magnitude of losses. For fiscal year 2007-08, a total of 3724 vehicles were damaged to the extent that they were not fit for sale. Of these, 2960 finished vehicles were damaged beyond repair during transit and had to be dismantled. The other 764 vehicles had to be returned to the factory for repairs; these vehicles were subsequently not considered fit for sale and were assigned to alternative uses within the plant (e.g., for testing purposes or for in-plant transportation). To fix damages incurred during transit, an additional 518 vehicles needed to be repaired prior to sale. A relatively conservative estimate of the aggregate losses incurred in 2007-08 on finished vehicles' in- transit, would be Rs. 33 crore. This figure represents the net costs to Maruti, after the salvage value of the usable components is deducted. An alternative way to estimate the loss is to calculate the foregone sales revenue : the number of vehicles rendered unit for sale due to in-transit damages represents 0.50% of the total number of vehicles sold in that year; the value of these foregone sales amounts to an estimated Rs. 100 crore.

**(iii) How the Transportation System Affects Inventory Levels**

The available literature on logistics provides that both the length and predictability of travel or transit time affect inventory levels. Transit time, in turn, depends on distance, the speed of a chosen mode (air versus ocean versus road freight), the quantity and quality of transport infrastructure, and the level of service provided by the shipping or freight company.

Analysis of qualitative and quantitative data from Maruti suggests that

**Table 4**

**Maruti's Distribution of Finished Vehicles : Cost of Freight & Travel Time**

| Destination | Dist-ance | Freight Cost US $/Car | | Transit Time–Days | | Turnaround Time–Days | |
|---|---|---|---|---|---|---|---|
| | | Trailer | Truck | Trailer | Truck | Trailer | Truck |
| Nava Sheva Port | 1466 | 151 | 140 | 6 | 5 | 14 | 12 |
| Mumbai | 1436 | 149 | 139 | 6 | 5 | 14 | 12 |
| Chennai | 2502 | 260 | 242 | 9 | 7 | 21 | 17 |
| Banglaru | 2168 | 225 | 209 | 8 | 6 | 19 | 14 |
| Kolkata | 1515 | 180 | 167 | 8 | 7 | 19 | 17 |
| Delhi | 30 | 10 | 9 | 1 | 1 | 1 | 1 |
| Jaipur | 280 | 33 | 31 | 1 | 1 | 3 | 3 |
| Ludhiana | 392 | 44 | 41 | 1 | 1 | 3 | 3 |

**Source :** Company Data, Year 2008

there are two mechanisms by which infrastructure and transit time directly affect its supply chain (C&RM) inventory. First, poor infrastructure raises the total transit time, which translates into higher "in-transit" or "'pipeline" inventories. That is, goods that have been dispatched by the supplier take longer to reach the assembly plant, and capital is tied up for more time.

To estimate the inventory penalty that inadequate road network imposes, it is necessary to ascertain how much longer the transit time for road freight is in India compared to transit time in countries with adequate highway in structure.

Table 4 presents the average travel time index developed by Maruti for its shipments, based on actual truck arrival and departure data. For example, it takes an average of seven days to transport material by truck 2,500 km from Maruti's plant near Delhi to Chennai; the round trip takes an average of 17 days. Given that the one-way trip is roughly equal to the distance between Boston and Miami, it is evident that the transit and "'cycle" (turnaround or round trip) times are relatively long in India. As a further comparison, note that it takes about 1.5 days (37 hours) for shipments to travel a 2,000 km distance between Valencia, Spain, and Ford's assembly plant in Dagen-ham, United Kingdom. Second, with poor transportation infrastructure not only does freight stay in-transit significantly longer than it does in countries such as the United States, transit time is also relatively unpredictable. In fact, the literature indicates that unpredictability may have a greater adverse impact on costs than transit time itself. This is because unpredictability tends to raise the buffer or safety stocks that need to be held

both at origin and destination.

Further, it may also cause the receiving firm to bear "stock out" costs, costs that arise if the safety stock has already been used up and the shipment carrying the replacement stock is late; in the case of auto assemblers, the stock out cost is the cost of stopping the assembly line, reducing production, or altering the product mix scheduled for production.

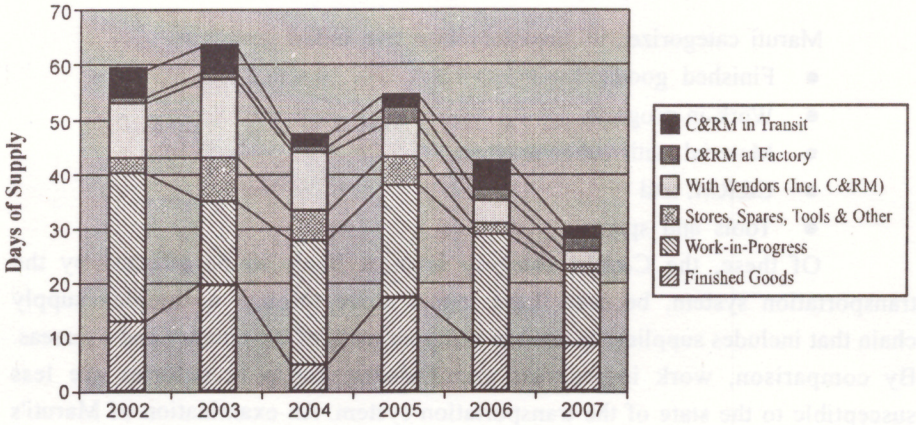
Interviews at Maruti indicate that the firm explicitly factors in unpredictability in transit time in determining the level of buffer inventories or safety stock that it holds. For example, although the estimated average transit time from Chennai to Maruti is seven days, a particular truck may take anywhere between about six to nine days to arrive, depending on road condition and weather. According to a manager in production planning, a three-day variation in travel time requires a minimum of three days of buffer inventory for most components procured from Chennai, in addition to an average in-transit inventory of seven days. Similarly, if goods ordered from Japan take between 35 and 45 days in transit, the firm will hold a minimum of 10 days of buffer inventory for these goods, plus an average of about 40 days of in-transit inventory. Thus, even if Maruti and its suppliers could fully control all other problems associated with procuring raw materials and components for example, ensure zero defect shipments, and fully optimize its ordering systems the long and unpredictable transit time would prevent them from achieving zero (or very low levels of) inventory.

Overall, long and unpredictable transit times raise both in-transit inventory and the buffer or safety stock held by Maruti. But how high are the inventory levels? How much of the total inventory can be associated with the supply chain, and what proportion of these can be ascribed to the inadequate transport system? To answer these questions, Maruti's inventories have been examined in detail.

**(b) Struggling to Get Lean : Maruti's Inventory Problem**

To enhance its competitiveness, Maruti has been trying to cut inventories and implement JIT/lean production systems. Figure 2 shows that its inventory levels have indeed fallen substantially over 2002 to 2007. The total value of inventories as a percentage of sales revenue improved from a high of 20% in 2002 to 10% in 2007. Maruti, thus, was able to halve the value of its inventories as a percentage of sales revenue over a six-year period. Although inventory levels are falling, they continue to represent a significant problem for Maruti, whether they are analyzed in terms of their capital value and associated carrying cost, or in days of inventory. On average, the capital value of inventories amounted to 15% of the

**Figure 2 : Inventory Levels of Maruti : 2002-07**




**Source :** Company's Annual Data : 2002-07

sales revenue over the six-year period 2002 to 2007. The fact that such a significant amount of capital is tied up is especially problematic given the high opportunity cost of capital in India.

**(c) Days of Inventory by Type- Company Reports**

The minimum interest rate for loans from commercial banks ranged from 14% to 19% over 2002 to 07 (World Bank, 2006). Assuming an opportunity cost of capital of 18% (simple interest, for convenience), the cost of carrying these inventories amounts to $2 \pm 4\%$ of total sales revenue for 2002 to 2007. By comparison, wages accounted for $2 \pm 3\%$ of sales revenue over the same period. Overall, the estimated inventory carrying cost was greater than the labour costs for each financial year during 2002 to 2007; only in the year 2007 did the costs for the two categories converge. Another way to assess Maruti's inventory performance is to examine the days of inventory the assembler holds. Total inventory level at Maruti fell from about 57 days of stock in 2002 to 30 days of stock in 2007. Inventory of C&RM fell from 39 days to 22 days. While it is hard to find strictly comparable data on inventory levels at other assembly plants in the world, the following data are indicative. In 2001, Toyota held just one day of raw material inventory and Nissan held about three days of stock at its plants in Japan (Lieberman & Asaba, 1997). Therefore, Maruti needs to improve its inventory performance significantly and to work with as little as one to three days of stock in order to compare favourably with other lean, world-class assemblers.

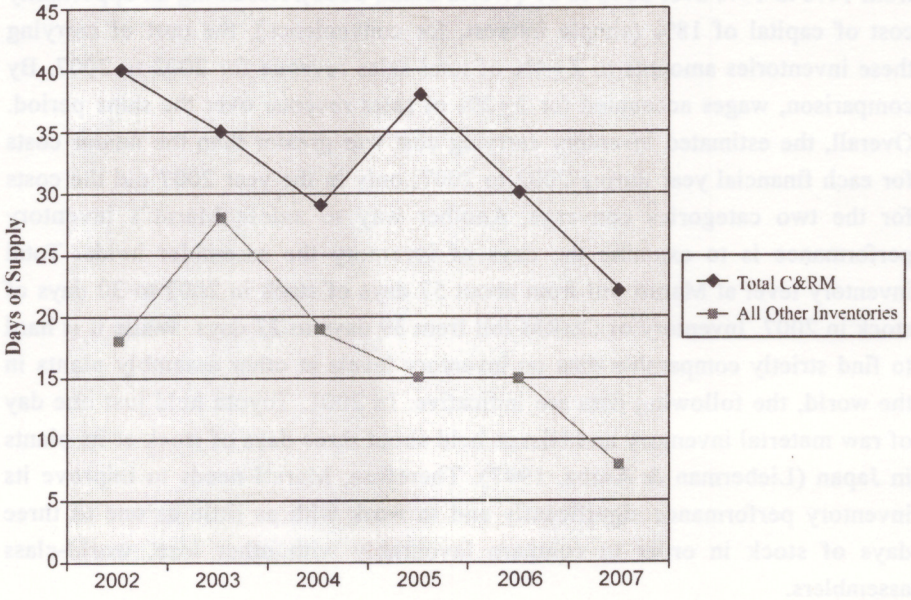
**(i) The "fat" is in the supply chain**

Maruti categorizes its inventory into five broad groups :

- Finished goods
- Work-in-progress
- Material with subcontractors
- C&RM, and
- Tools and spares.

Of these, the C&RM category is most likely to be affected by the transportation system, because these inputs move through a complex supply chain that includes suppliers located in different parts of the country and overseas. By comparison, work in-progress and finished goods inventories are less susceptible to the state of the transportation system. An examination of Maruti's inventory, during 2002 to 2007, shows that the C&RM category or, simply, the supply chain accounts for a majority of the total inventory (Figure 3). Over the past few years, Maruti has been able to squeeze down its inventory in all other categories such as work-in-progress and finished goods to relatively insignificant levels. Thus, in its own factory and for procedures that are directly under its control, Maruti has been able to move towards lean systems. By contrast, it has

**Figure 3 : Maruti's C&RM Versus Other Inventories: 2002-07**




**Source :** Company's Annual Data

been harder to make the supply chain lean. In each of the six years under review, the C&RM inventory was significantly higher than all other categories of inventory combined (Figure 3). The average C&RM inventory over the six-year period was 32 days.

Given that the average total inventory was 49 days, C&RM accounted for 65% of total. During 2002 to 2007, then, as much as 65% of the total "fat" in this system was directly related to the assembler's supply chain for components and raw materials, and the capital value of these C&RM inventories was equivalent to 10% of average sales revenue.

The C&RM inventory can essentially be broken down into two categories: in-transit goods and at-factory goods. Figure 2 presents the relative magnitude of these categories. It shows, for instance, that in 2007 the at-factory stock or buyer inventory at Maruti was 13 days as compared to an in-transit inventory of nine days. During 2002 to 2007, the average buyer inventory was 20 days, and goods in-transit accounted for the remaining 12 days of C&RM inventory. In other words, one-fourth of Maruti's total inventory of 49 days was accounted for by goods that were on the road, or some other part of the transport network dispatched by suppliers but not yet at the assembly plant. The average capital value of in-transit inventory for 2002 to 2007 was equivalent to an extraordinary 4.0% of the average sales revenue.

**(ii) Inventories increase with distance, and only local suppliers can deliver just-in time**

The analysis further reveals that both buffer stock and in-transit inventory increase with distance or, more specifically, with transit time. Farther the supplier is from the assembly plant, the more buyer stock Maruti has to hold and higher its in-transit inventory becomes. The connection between inventory and distance or transit time is most apparent in the case of imports. Imports account for a disproportionate amount of at-factory or buyer inventory at Maruti. In 2002 to 2007, for example, "closing stock" that is, the level of buyer stock recorded on the last day of the financial year for imported components was twice as high as the closing stock for domestically sourced components (Figure 4). Another way to understand the import "penalty" is to examine the inventory for imports and domestic materials in terms of their respective consumption. According to a manager at Maruti, in August 2007, the buyer inventory for imports was 25 days of consumption, whereas the buyer inventory for domestic purchases was only about four days of consumption or about one-sixth as much. This finding suggests, then, that the more a firm relies on imports the higher its buyer inventories. Imports also account for



plant; at this point they become at-factory inventory.

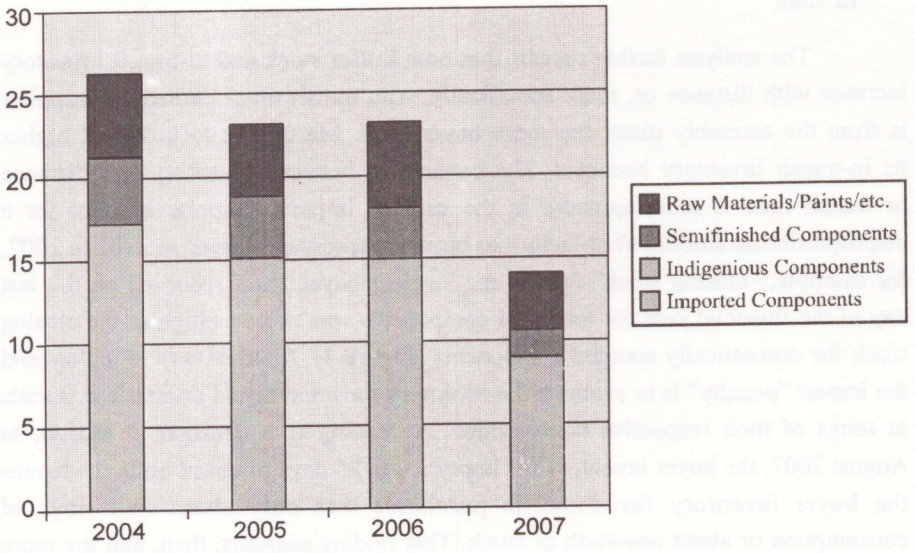
Under its current delivery arrangements, Maruti does not directly bear a

almost all of Maruti's in-transit inventory (Figure 5). Most of Maruti's imports are from Suzuki in Japan. Despite serious efforts to reduce transit time, it still takes about 35 days for an ocean freight shipment dispatched by Suzuki to reach Maruti. In absolute terms, this translates into large in-transit inventory for imports : indeed, it accounts for as much as one-fourth of Maruti's total inventory. Overall, imports carry a high inventory penalty, and the international supply chain is anything but lean. If Maruti were to reduce its reliance on imports, this would directly help lower its inventory levels and carrying costs.

This does not mean, however, that the domestic supply chain is highly efficient or that the inventory costs associated with it are small. As discussed earlier, the transit time for freight in India is both long and unpredictable and translates into significant in-transit and buyer inventories. In-transit inventory for domestic goods appears to be minimal because of the delivery and accounting systems Maruti uses.

Domestic suppliers are responsible for delivering to the assembly plant, which means that the goods show up as Maruti's inventory only after they reach the plant; thus, most domestic purchases show up only as at-factory inventory and not as goods in-transit. By contrast, imported goods show up as Maruti's in-transit inventory from the time they are dispatched to the time they reach the assembly

**Figure 4 : Closing Stock / Buffer Inventories / Raw Material / Imported / Indigenous Material : 2004-07**



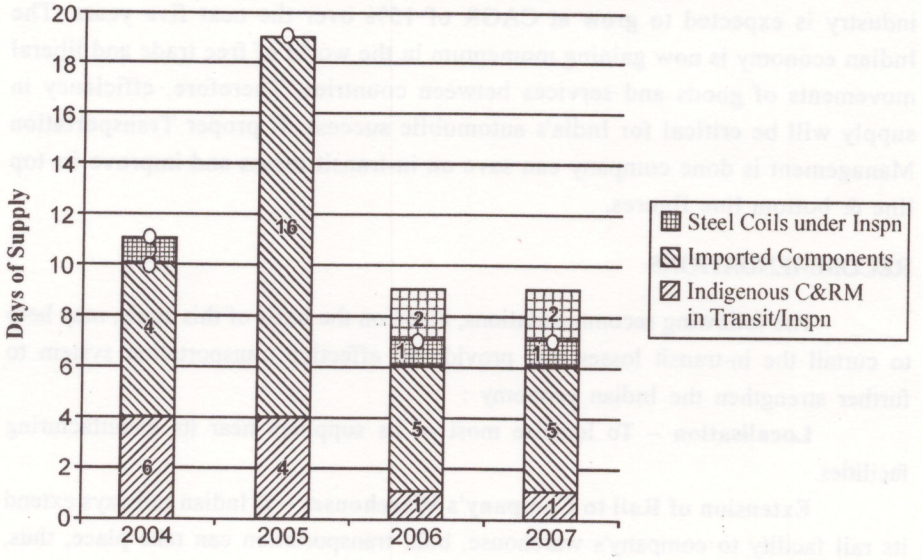

**Source :** Company Data 2004-07

plant; at this point they become at-factory inventory.

Under its current delivery arrangements, Maruti does not directly bear a large proportion of the financial costs associated with inventory levels in its domestic supply chain.

Nevertheless, poor logistics and inefficiencies in its domestic supply chain end up hurting the assembler; Maruti is both aware of and concerned about these external diseconomies. It has found that only "local" suppliers (defined here as those within a radius of 80 km or less from the assembly plant) are able to deliver both frequently and on a just-in-time basis; only with such suppliers can Maruti expect delivery frequencies of one per day or more, and thus operate on minimal buyer inventories ranging from one to three days. This is not to say that all local suppliers are capable of JIT delivery, but rather that distant suppliers, irrespective of their competence, are unable to deliver just-in-time. Maruti has also discovered that, in general, buyer inventories must be increased as distance to a supplier increases. In other words, poor transportation systems appear to make it difficult, if not impossible, for Maruti to implement JIT delivery systems in its non-local domestic supply chain.

**Figure 5 : Transport on Lean Production**




**Source :** Company Data, 2004-07

In sum, many of the inventory costs associated with the domestic supply chain tend to appear as direct costs at the supplier level and only as indirect costs or external diseconomies to Maruti, whereas those associated with the

international supply chain show up as direct costs for the assembler. Maruti considers the indirect costs associated with its domestic supply chain to be highly problematic and is devising elaborate solutions to reduce them. In particular, the assembler is implementing a "localization" solution which helps offset both the direct costs and external diseconomies imposed by poor transportation systems.

## CONCLUSION

Indian automobile and Maruti Limited is on a roll and there is an immense scope for management for enhancing the supply chain of the sector. India has become a favourable destination for foreign companies to establish their facilities and form alliances with domestic companies. Low cost of manufacturing and conducive government support have been the major drivers for foreign companies investing in India. India's large young population, higher GDP growth, and most importantly per capita passenger car penetration is low at 8.5 car per thousand population, which creates great opportunity for industry players to offer an affordable four-wheeler alternative to the two-wheeler customers. According to Planning Commission of India, Indian automobile industry is expected to grow at CAGR of 15% over the next five years. The Indian economy is now gaining momentum in the world of free trade and liberal movements of goods and services between countries. Therefore, efficiency in supply will be critical for India's automobile success. If proper Transportation Management is done company can save on in-transit losses and improve its top line & bottom line figures.

## RECOMMENDATIONS

The following recommendations, made on the basis of this study, may help to curtail the in-transit losses and provide an effective transportation system to further strengthen the Indian economy :

**Localisation** – To localise most of its suppliers near its manufacturing facilities.

**Extension of Rail to Company's Warehouses** – If Indian railways extend its rail facility to company's warehouse, bulk transportation can take place, thus, reducing cost of transportation.

**Use of GPS** – The trucks / trailers carrying the vehicles fitted with GPS systems can help to improve the customer service, thus, top & bottom line figures.

**Use of RFID in Production Facilities** – If RFID is used in the production facilities it can reduce the time in & time out of transportation.

**Advance Cargo Information System (ACIS)** – If ACIS is used in transportation management it can save a lot of money & provide better customer service.

**Better Insurance Cover** – A good negotiated insurance cover with insurance companies can make good of in-transit losses.

**Imported Components** – By reducing dependence on imported components in the manufacturing of cars, cost of transportation, in-transit losses can be reduced.

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