



Centre for  
Global Logistics and  
Manufacturing Strategies

# Achieving Rural & Global Supply Chain Excellence

*The Indian Way*

Edited by

*N. Viswanadham*

**Indian School of Business**

Gachibowli, Hyderabad 500032



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# Foreword

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The entire world is watching with wonder the emergence of India as a major economic force. For this to happen however, we need to have sustained growth in our agriculture, manufacturing and service sectors. We need to concentrate on all the three sectors of our economy since they are interrelated and mutually reinforcing. We need growth strategies that provide our population with jobs and also create wealth in both our rural and urban communities. Our economy needs to be exported oriented by realizing the growth potential in sectors such as Food, Apparel, Leather, IT, Construction, Consulting, after sales services, BPO. Towards this end we need to develop the agriculture and make our manufacturing service sectors globally competitive. We need to attract multinationals to our country through foreign direct investment. It is in this context, academic research in the areas of increasing the efficiency of food supply chains, design of cold chain management systems, risk management in unorganized meat supply chains, Retailing, Design of special economic zones, construction supply chains and location selection problems for MNCs gain importance.

This volume of collection of white papers on topics of great importance is very timely and is a precursor to more in-depth studies to follow by the researchers of the GLAMS. I am sure that this book would be useful for policy makers and supply chain researchers alike. I congratulate the Center for bringing out this volume on its first anniversary.



# 1 Can India be the Food Basket for the World?

N. VISWANADHAM

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## 1.1 Introduction

India can become the food supplier of the world. It has the cultivable land, all the seasons for production of all varieties of fruits and vegetables, an agribusiness system that works although it needs to be vastly improved. The single most important problem facing the Indian agricultural industry is the highly inefficient supply chain. Because of lack of cold chain infrastructure and also a food processing industry about 20 per cent of all foods produced in India (Rs. 500 b) are wasted. By building an efficient and effective supply chain using state of the art techniques it is possible to serve the population with value added food while simultaneously ensuring remunerative prices to the farmers. The surplus of cereals, fruits, vegetables, milk, fish, meat and poultry can be processed as value added food products and marketed aggressively both locally and internationally. Investments in cold chain infrastructure, applied research in post harvest technologies, installation of food processing plants in various sectors and development of food retailing sector are mandatory for achieving gains in this sector. Strategic growth plans for achieving both national and international competitiveness of the food industry are essential.

In this paper we identify emerging opportunities in the food and cold chain sector in India and present ways in which existing market challenges in India can be overcome using technology and experience. In particular, we identify opportunities for improvement in real estate and cold chain infrastructure, establishing food processing plants, wholesale, retail, third party logistics and technology. In Section 1.2, we discuss the current state of the agricultural industry in India. In Section 1.3 we present the state of food processing industry in India. In sections 1.4 and 1.5, we present the cosmic view of the food supply chain and its various constituents. We outline the current initiatives promoted by the Government and the Private sector in Sections 1.6 and 1.7. In Section 1.8, we bring to focus the areas that need attention. A sample list of research areas for OR specialists is discussed in Section 1.9. We wrap up our analysis with conclusions presented in Section 1.10.

## 1.2 Current State of Indian Agricultural Industry

In India, 52% of total land is cultivable as against 11% in the world. All 15 major climates of the world, snow bound Himalayas to hot humid southern peninsula; Thar Desert to heavy rain areas all exist in India. There are 20 agro-climatic regions and nearly 46 out of 60 soil types in the country. Sunshine hours and day length are ideally suited for round the year cultivation of crops. India is the centre for biodiversity in plants, animals, insects, micro-organism and accounts for 17% animal, 12% plants and 10% fish genetic resources of the globe. In the live stock sector, India has 16% of cattle, 57% of buffalo, 17% of goats and 5% of sheep population of the world. Agriculture contributes 24.2% to GDP, 15.2% of total exports and provides employment to 58.4% of countrys work force. As mentioned in the FICCI report of October 2004 India is the

- Second highest fruit and vegetable producer in the world (134.5 million tones) with cold storage facilities available only for 10% of the produce.
- Second highest producer of milk with a cold storage capacity of 70,000 tonne.
- Fifth largest producer of eggs. Investments in cold chain required to store 20% of surplus of meat and poultry products during 10th plan requires Rs 500 Crore (US\$ 100M)
- Sixth largest producer of fish with harvesting volumes of 5.2 million tones. Investment required is estimated to be Rs 350 Crore (US\$ 70M)

In spite of the vast natural resources and abundant agricultural produce India ranks below 10<sup>th</sup> in the export of food products. Conservative estimates put processing levels in the fruits and vegetables sector at 2%, meat and poultry at 2%, milk by way of modern dairies at 14%, fish at 4%, bulk meat de-boning is to the tune of 21%. Currently, the food processing sector, though in the nascent stage, constitutes 14% of manufacturing GDP amounting to products value of Rs.2, 80,000 Crores. It employs 130 lakh persons and is supposed to increase at an annual rate of 7%.

## 1.3 The Indian Food Processing Industry

The Food processing industry has an important role to play in linking the farmers to the final consumers in the domestic as well as the international markets. Food processing combined with marketing has the potential of solving the basic problems of agricultural surpluses, wastages, rural jobs, and better remuneration to the growers. In the next ten years, food production is expected to double. These produces, if processed and marketed smartly, can make India a leading food supplier of the world.

India with a population of 1.08 billion (growing at about 1.7 % per annum) provides a large and growing market for food products. Food products are the single largest component of private consumption expenditure, accounting for as much as 49% of the total spending. Furthermore, the upward mobility of income classes and increasing need for convenience and hygiene is driving demand for (a) perishables and non food staples and (b) processed foods. Also, eating out is a booming practice in urban India and processed foods are accepted as alternative to the home cooked food because of the convenience it offers. Also, with the globalization of trade and availability of high speed logistics, food retailers in developed countries are sourcing a year-round supply of fruits and vegetables from developing countries. Thus, both for local consumption as

well for export there is a year round opportunity for fruits and vegetables, meat and poultry products and ready to eat processed foods.

The processed food industry should introduce innovative new products of high quality at low cost in small package sizes in ready to eat format to cash on this booming opportunity. HLL, ITC, MTR and others have introduced some innovative heat and eat dishes with reasonably good packaging. But there is lots of manual handling and hence food hygiene and quality are suspect. Multinational companies have entered the food value chain in India, Cargill and Conagra in agri-inputs, Tropicana in food processing and Metro in wholesaling. Local companies like Dabur, MTR, ITC, Godrej, and Amul are aggressive across the value chain. Multiple restaurant chains such as McDonalds, Pizza Hut, Dominos, Coffee day, Qwikys and Saravana Bhavan, and Sagar Chains are growing rapidly. However, the pace is slow in the food sector compared to the other sectors such as IT and Pharma. There are no billion dollar players in India in the food industry where as China and Philippines have several large players with sales exceeding US\$ 1 billion.

## 1.4 The Food Supply Chain

India has a huge opportunity to become a leading global food supplier if only it has the right marketing strategies and of course agile, adaptive and efficient supply chain. India has diversity in terms of its population with several religious groups with different food habits and culture. This diversity should be used to advantage to become the *Halal Food Hub*, the *Organic food hub*, the *Vegetarian food hub*, and the *Sea food hub* among others.

The food supply chain is complex with perishable goods and numerous small stake holders. In India, the infrastructure connecting these partners is very weak. Each stake holder: farmers, wholesalers, food manufacturers, retailers all work in silos. Also, demand forecasting is totally absent and the farmers try to push what they produce in to the market. Data integration, financial flow management, supply-demand matching, collaborative forecasting, information sharing, goods movement synchronization through efficient transport scheduling, are very well practiced in high technology industries with immense benefits. These best practices should find their way in to the food supply chains.

Cold chain logistics supply chains should take advantage of technology improvements in data capture and processing, product tracking and tracing, synchronized freight transport transit times for time compression along the supply chain and supply demand matching. Also, the supply chain need to be designed and built as a whole in an integrated manner with the processes of new product development, procurement and order to delivery processes well designed and well supported using IT tools and software.

The food supply chain can be subdivided into a number of sectors. Agriculture, horticulture, fisheries and aquaculture are the primary producers, the manufacturers who process the food for ready to eat or cook format together with the packaging companies are in the intermediate stage, and the retailers, wholesalers and caterers are in the last stage of the supply chain. At each stage value is added by the new ownership such as processors, distributors, packers, etc. and the cost and profits are part of the business. The food items can go to the final consumer from any of the three stages: from farmers in the form of fresh produce, to the caterers directly from the manufacturer, and finally from the retailer (small or big) to the consumer. The movement of goods from one stake holder to another is facilitated by the in house or third party logistics service provider. The information management is done by the all the stake holders and their information

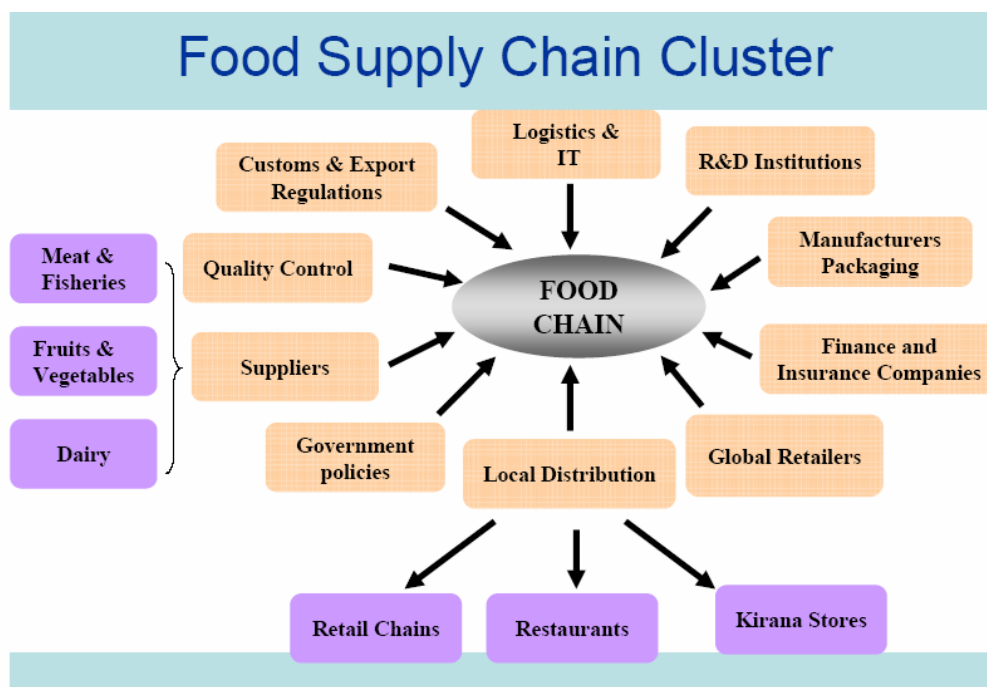


Fig. 1.1 Food supply chain cluster

systems are all interconnected seamlessly. What we described above is the state of food chain in the advanced countries. In India and other developing countries, the state of food chain is more fragmented and primitive we have dealt with it in the earlier sections.

## 1.5 Food Supply Chain Cluster

Food chain clusters (See Figure 1.1) are formed with the participation of all stake holders such as farmers, seed growers, merchants, transporters, wholesalers, retailers, financial institutions, and insurance companies. Information sharing is essential for generating the efficiencies. The Internet and mobile communications are used to enable information and financial transfer between the stake holders. Also, recent advances in RFID technology will have tremendous impact in the management of the food chain particularly for source identification and tracking and also in providing supply chain visibility.

In advanced countries, the retailers (Walmart, Tesco, etc) have become the Channel Masters of food supply chain taking over from the food manufacturers. In India, with no superstores, no economies of scale, too many intermediaries, there is a vacuum, meaning there is no real channel master managing the supply demand situation and coordinating the supply chain and managing the logistical activities. This provides a tremendous opportunity for smart players to enter a growing market with a high potential of retail FDI. But one needs to remember that the infrastructure capital outlays are high and the returns are long term. Also there are various risks associated



with owning a cold chain. some of these include country risk, monsoon risk, crop or raw material supply failures due to pests, diseases, etc., partner risk, and numerous others.

In India, there are very few large food manufacturers. Amul, Ruchi Soya, Nestle, MTR, ITC, Dabur, Britannia, HLLs food and beverages section, beverage companies such as Coke and Pepsi are some of the big names. In poultry Godrej Agrovet, Suguna, Pioneer and Venkateswara hatcheries are some of the companies integrating operations end to end from breeding to ready to eat chicken foods. High taxes on processed food, high import duties, nascent contract farming, make the profitability a big issue in India. There are several regulatory changes that need to be made all along the supply chain so that they are consistent and mutually reinforcing

### 1.5.1 Cold Chain

Cold chain is a logistic system that provides a series of facilities for maintaining ideal storage conditions for perishables from the point of origin to the point of consumption in the food supply chain. The chain needs to start at the farm level (e.g. harvest methods, pre-cooling) and cover up to the consumer level or at least to the retail level. A well-organized cold chain reduces spoilage, retains the quality of the harvested products and guarantees a cost efficient delivery to the consumer given adequate attention for customer service. The main feature of the chain is that if any of the links is missing or is weak, the whole system fails.

The Cold chain logistics infrastructure generally consists of

- Pre-cooling facilities
- Cold Storages
- Refrigerated Carriers
- Packaging
- Warehouse and Information Management systems
- Traceability
- Financial and Insurance Institutions

The temperature controlled supply chains or cold chains are a significant proportion of the retail food market. Fast foods, ready meals and frozen products have increased market share in recent years. There are several food temperature levels to suit different types of products. Frozen, cold chill, medium chill, and exotic chill are some of the frequently nomenclatures with identified temperature ranges. The range of temperatures is dependent on the products whether it is meat or ice cream or potatoes or bananas. Failure to maintain appropriate temperature regimes through out the product life cycle may shorten the product life or adversely affect its fitness for consumption. Cold chain management involves maintaining appropriate temperature regime when the product travels from the farm in Himachal Pradesh to the consumer in London or New York City. That is why the logistics challenge is formidable in food chains, which is cost conscious industry. There are several governmental regulations in all countries and the responsibility to maintain hygiene and standards falls on the food retailer or manufacturer. The recent developments in electronic tagging could be useful for monitoring the temperatures and also the shelf life of the product.

### 1.5.2 Supply chain expertise

There is a need to embrace the concept of Efficient Consumer Response (ECR) which was introduced in the United States in the 1990s and is now followed world wide in grocery supply chains. ECR refers to a set of strategies that aims to get companies across a supply chain to work closely to serve their customers better and at lower cost. Consumers benefit from improved product availability and choice, while distributors and suppliers derive better efficiency and cost savings. Also collaborative planning forecasting and replenishment is another area that has yielded substantial savings for retailers. Relationship between the stake holders in the supply chain is of paramount importance for ECR, CPFR and other relationship paradigms to work.

### 1.5.3 Food packaging

Dairy products, edible oils, farm products, sugar, fruit juices, concentrates, preserves, hot and cold beverages, breakfast foods, biscuits and confectionery, atta, are some major foods of daily necessities where packaging will have excellent potential and growth areas. Package has become the competitive tool to reach the consumer and the task assumes increasing responsibility with more and more of competitive and substitute products being introduced. This has opened the sector for introduction of modern technology for processing and packaging and entry of host of new organizations from all sectors of the economy both domestic and overseas. Cost of packaging ranges anywhere from 10 to 64% of production costs and efforts should be made to reduce these costs through use of manufacturing automation and economies of scale.

### 1.5.4 Standards

Standardization is a powerful tool for improving supply chain efficiency. There are two kinds of standards in the food supply chain. The first one is the food standard that concerns itself about the content and the manufacturing process and the packaging etc. There are several such standards for dairy, poultry etc. the second standard concerns regarding the logistics and IT systems like standardization of cartons, pallets and IT software so that seamless transfer of goods and information is possible. Standards enable partners across the supply chain to enjoy increased productivity and economies of scale due to better compatibility and interoperability of their systems and processes.

### 1.5.5 Food safety and hygiene

Food safety is a growing concern across the world. There is increasing need to provide greater assurance about the safety and quality of food to consumers. The increase in world food trade and the advent of the Sanitary and Phytosanitary (SPS) Agreement under the World Trade Organization (WTO) have lead to increasing recognition and adoption of food safety measures. The capacity of India to penetrate world markets depends on its ability to meet increasingly stringent food safety standards imposed in developed countries. Food standards are expected to acquire greater importance given increasing concerns on food safety on the back of breakout of diseases such as BSE, Avian Influenza, Bird Flu etc on the one hand, and growing consumer demand for products which are healthy on the other. Compliance with international food standards is a prerequisite to gain a higher share of world trade.

### 1.5.6 Training

The food supply chain is going through a period of great change and needs to be supported through new organizational forms manned by specialists. Training, coaching, counseling and mentoring have to be extended to all the parties in the supply chain. For example, it is important to conduct courses and training sessions on cold chain management to raise the knowledge and awareness on the importance of implementing the cold chain management to ensure that there is no breakdown in maintaining the required temperature throughout the supply chain. In this way a pool of skilled workforce with good knowledge of cold chain management to meet the needs of the industry to be a cold chain will be generated. The same applies to other areas in the food supply chain such as procurement, retailing etc.

### 1.5.7 Business model: Retail, e-retail, local use, export

The food processing industry supply chain starts at the farm and ends with the consumer. The local consumer could be served through home delivery or through a retailer or a neighborhood kirana store. An international consumer could be served through food malls. Thus the products need to be manufactured for local as well for export. It is important to forecast the demand for each of the channels and serve the customer within the expected lead time. The service levels and the pricing will determine if the customer returns for his or her next purchase.

### 1.5.8 Government policies

Food and Agriculture are important national activities and affect the well being of its population of every country. In formulating the policies of farming, production, processing, distribution and retailing and also in financing these activities the Governments play leading role. This becomes all the more important in view of the globalization of the food industry. Allowing foreign operators for food production, distribution and retailing is a decision of national importance. The decisions need to be consistent all along the supply chain and mutually reinforcing and not contradictory. There are several regulatory measures handled by multitude of departments divided between State and Central governments. While some of this is inevitable but streamlining by looking at the supply chain would be extremely productive. Further, research should be initiated to develop indigenous packaging materials, machines, laboratories for developing new food products and more importantly protocols for storage and processing food raw materials.

## 1.6 Government Initiatives to Promote Food Exports

The Government of India (GOI) has accorded high priority to the establishment of cold chains and encourages major initiatives in this sector.

- Foreign equity participation of 51% is permitted for cold chain projects.
- There is no restriction on import of cold storage equipment or establishing cold storages in India.
- National Horticulture Board (NHB) operates a capital investment subsidy scheme (CISS) which provides 25% (maximum Rs.50 lakhs) subsidies to the promoter.

Furthermore, to handle the expected higher agricultural production during the Tenth Plan Period, the Inter Ministerial Task force on Agricultural Marketing Reforms constituted by Ministry of Agriculture, Government of India has recommended the creation of additional cold chain facilities at an investment cost of Rs. 2500 crore of which Rs. 625 crore are to be provided as subsidy and the rest has to come as private investment. They have also suggested modernization of existing facilities with an investment cost of Rs. 2100 crore of which Rs. 525 crore are to be subsidy and the balance to come as private investment.

The state governments also have initiatives in the food processing and cold chain sectors. For example the Gujarat government has accorded priority to agro processing and horticulture, in view of the high export potential for fruits like mango, banana and chikoo. The government supports the sector by providing assistance to farmers for agricultural inputs, developing systems like drip irrigation and encouraging development of infrastructure facilities like warehousing, cold chain, etc for better pre-harvest and post-harvest crop management. Gujarat also has good logistical infrastructure such as airport, seaport and extensive road & railway network. Other states such as Maharashtra, Andhra Pradesh, Kerala and Punjab have similar schemes in place.

### 1.6.1 Agri Export Zones (AEZs)

: The concept of the Agri Export Zone attempts to take a comprehensive look at a particular produce/products located in a contiguous area for the purpose of developing and sourcing the raw materials, their processing and packaging, finally exporting them. Thus, the entire effort is centered on a cluster approach of identifying the potential products, the geographical region in which these are grown and adopting an end to end approach of integrating the entire process, right from the stage of production till it reaches the market. The government helps in sourcing for raw materials, the setting up of processing facilities, providing finance at low interest rates and even matching with international buyers. The export zones mooted by the Agricultural and Processed Food Products Export Development Authority (APEDA) to increase international trade in agri-commodities are an attempt to take a holistic approach to encouraging trade in specific commodities located in contiguous areas. For instance, in Tamil Nadu, the AEZs would focus on grapes, mangoes and chikkoo, in Kerala – vegetables, in Punjab and Haryana – kino, wheat and rice, Karnataka – vegetables and flowers, Maharashtra – mangoes, grapes and flower, Gujarat – bananas, mango, castor and garlic, and in Uttaranchal – litchi and medicinal plants.

## 1.7 Private Sector Initiatives

There are several private sector initiatives in the food processing and service sector. A number of companies are actively working on integrating the agriculture supply chain. Here we mention a few of them. These show the feasibility of operating efficient cold chains in the India scenario. They could be treated as pilots and other projects can be built emulating them. Here we consider the following cases:

- Mcdonalds-India, a fast food service operator growing its own ingredients such as lettuce, potatoes, etc;
- Amul which is a highly successful cooperative dairy in Gujarat.

- E-choupals which is an ITC success story of procurement of produce from small farmers is an example of supply chain management Indian style.

There are other examples such as Bombay dabba walah which is an excellent example of six-sigma forward and reverse logistics delivery. Also, ITC, Mahindra and Rallis together are creating a network of service providers who offer information on weather and prices, credit, transport and assured demand.

## 1.8 Opportunities for Improving Food Supply Chain

The following are some of the opportunities:

### 1.8.1 Cold chain infrastructure

Investments in real estate and cold chain infrastructure are capital intensive and will yield slow returns. However, 100% foreign direct investment (FDI) is allowed in this sector. The Infrastructure consists of Coolers, Warehouses, Refrigerated Trucks, Carriers, Shopping malls, etc. One needs to study of the potential risks and the ROI for this activity?

### 1.8.2 Third party logistics

The food supply chain is temperature sensitive and manual handling reduces the product quality and life. Logistics providers with air conditioned trucks, automatic handling equipment and trained manpower will provide end to end support. They can also adapt state of the art techniques such as cross docking that will reduce the transit times and inventory.

### 1.8.3 Food processing industry

The Government of India allows 100% FDI in this sector. There are incentives for setting up processing plants either in Agri Export Zones or outside of them. Sourcing of raw materials either fruits and vegetables or flowers or meat is easier with an AEZ since there are already participants with knowledge about the industry standards. There are opportunities to create in India:

- Halal hub (Export to South-East Asia, Middle East)
- Vegetarian hub (20% of Indian population + overseas)
- Organic food hub (Europe and USA)
- Sea food hub

### 1.8.4 Retail

Retail, one of the largest sectors in the global economy (USD 7 Trillion), is going through a transition phase in India. One of the prime factors for non-competitiveness of the food processing industry is because of the cost and quality of marketing channels. Globally more than 72% of

food sales occur through super stores. In India there are 12 million outlets selling food and related items including push carts, wet markets and neighborhood kirana stores. The kirana stores are generally located in small space and have no cold storage facilities. They also have restricted capital resulting in lack of shopping variety. The Indian retail sector is estimated to have a market size of about \$180 billion; but the organized sector represents only 2% share of this market. A strong retail front-end can also provide the necessary fillip to agriculture and food processing, and other industries. Currently 100% FDI is not allowed for foreign companies. India presents a huge opportunity and is all set for a big retail revolution. India is the least saturated of global markets with a small organized retail and also the least competitive of all global markets.

## 1.9 Opportunities for Research in Food Supply Chain

There are several significant research issues for an emerging economy like India. Although Agribusiness may look low tech, there are several innovations possible with tremendous consequences. We outline a few of these here:

### 1.9.1 Strategic Level

Given the fact India has surplus fresh food stuffs that are currently wasted away and also has a very large local market, the Government can invite processed food manufacturers to set up mass production shops in the country which may be marketed through the fair price shops (these shops currently sell fresh foods). Design of the country wide production-distribution system for each of the produces taking into account the constraints on power infrastructure and water and identifying the possible MNCs that can play role will be a challenging task. The formats of small packages combined with *buy before you eat* variety will reduce the load on cold chain and will cater to the large section of people without refrigerators at home. Another important area of research is to develop predictive models for concerns such as *What happens if 100% FDI is allowed in retail?* and also *ROI models for establishing cold chain infrastructure, etc.*

### 1.9.2 Operational level

Produce to demand rather cropping as a matter of routine is an absolute necessity. This will probably lead to contract farming with ensured quality of the produce. This is a design of experiments problem of choosing the right kind of inputs, and timing for various tasks for seeding, weeding and harvesting depending on the environmental parameters. Design of E-procurement and just in time delivery systems for estaurants and hotels in big cities will save money on inventory, wastage and bulk purchase.

The above is a sample of research issues of extreme significance to the country. There are several others that can inspire young and mature minds while creating significant opportunities for growth.

## 1.10 Conclusions

India is all set to become the food supplier of the world. It has the cultivable land, all the seasons for production of all varieties of fruits and vegetables, well developed agribusiness system that works in its own way. The business system is tuned to food habits (cooking at home) and convenience (kirana stores) of rural and urban folks of the previous generation. Factors such as rapid growth in the economy, the technological innovations in home appliances such as refrigerators microwave ovens, rise of families with dual incomes and the changing food habits of the population all point to the increasing need for healthy processed food. The supply chain sector is very weak with no process owner and this can spell disaster. The food supply chain needs the attention of the academics, the industry and the Government.

## References

1. *Cold chain in India-A note on the Present Status & Future Prospects*, Federation of Indian Chambers of Commerce & Industry (October 2004).
2. *Vision, Strategy and Action plan for Food Processing Industries, Volume I and Volume II*, Prepared by Rabobank, India for the Ministry of Food Processing Industries, Government of India, (December 2004) (Downloadable from <http://mofpi.nic.in/visdoc/visndoc.htm>)
3. S. Raghunath and D. Ashok, *Delivering Simultaneous Benefits To The Farmer And The Common Man: Time To Unshackle The Agricultural Produce Distribution System*, IIM Bangalore, (June 2004).
4. Pankaj Chandra and Devanath Tirupati, *Business Strategies for Managing Complex Supply Chains in Large Emerging Economies: The Story of AMUL*, IIM Ahmedabad (April 2003).
5. *Indias Sleeping Giant: Food*, Mckinsey Quarterly, 1997.
6. *FAIDA Revisited Realizing the Potential*, CII- Mckensey report, (January 2004).
7. *Retail Scenario in India : Unlimited Opportunity*, Mckinsey-CII report, (2003).
8. *Food Processing Policy 2005* <http://www.mofpi.nic.in>
9. B. Bowonder, Vinay Gupta, and Amit Singh, *Developing a Rural Market e-hub: The case study of e-Choupal experience of ITC*
10. P. Ramesh, Mohan Singh, and A. Subba Rao, "Organic farming: Its relevance to the Indian context", *Current Science*, 88(4) (2005)
11. [http://www.mofpi.nic.in/venturesetup/foreign\\_collabration/foreign\\_collabration.htm](http://www.mofpi.nic.in/venturesetup/foreign_collabration/foreign_collabration.htm)
12. <http://www.mofpi.nic.in/>





# 2 Corporatization of Villages - Strategies for Rural Business Transformation

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## 2.1 Abstract

The need for transforming rural India into a sophisticated vibrant activity center is well recognized. In this research, we present a strategy for Rural Business Transformation which involves creating an efficient delivery network of all the stake holders in Business, Logistics, and IT. The creation of business in and out of rural India will be facilitated by orderly flow of goods, information and finance. Improving the quality of life in rural India is subject to marketing of value added products and services at affordable prices. Innovation in every layer is fundamental for this whole process. Technologies like mobile refrigeration, temperature controlled facilities; packaging technologies can improve the quality of the produce. Food processing technologies and diversification in food processing must be employed to create market for Agri produce. Call centers and media can act as procurement information channels in the rural supply chain. The aim of our research is to provide a methodology which emphasizes on logistical and information connectivity within rural areas and from rural to industry centers. This will subsequently make rural marketing farmer friendly and rural retailing a reality. Our approach includes the application of concepts of manufacturing to the rural sector and defines a Village production system. The aim of the research is to present a strategy and an organizational structure through which Corporatization of villages becomes a reality.

## 2.2 Background

The World population is around 7 billion out of which the rural population accounts for 4 billion. A typical rural economy is agriculture based and the quality of life in rural areas has always been an issue of concern around the world. Poor living standards manifest themselves in the form of lack of basic amenities such nutritious food, safe drinking water, organized healthcare, education, etc. This is an issue of much concern particularly in developing countries. These conditions prevail because of poor resource utilization of the rural sector, and lack of alignment of the industrial sector products towards rural community. The penetration of development programs and strategies by agencies such as the Worldbank, World Health Organization and others is far below expectations.

Strategies and development initiatives have been implemented across the world to alleviate rural areas from these afflictions by formulating revenue generating programmes. For example, in the

US, agricultural prospects of different regions have been identified and a cluster mechanism has been adopted. In South Africa, policy measures have been taken to alleviate the rural community by providing agricultural lands on grant basis [?]. In Thailand and Japan, the concept of One Village One Product has evolved which improved the prosperity of rural communities in these countries. The idea of micro credit Bangladesh gave birth to the model of Gramin Bank<sup>1</sup>. All these are some of the initiatives to mention which transformed the way in which rural communities operate.

In India, 51% of the land is cultivable. It has diversified climatic conditions, live river systems, and a variety of agricultural, and community practices. These are all essential resources in the rural context which enable development. India is ranked in the top 5 list in many agricultural produce like vegetables, fruits, milk, animal husbandry etc. But the revenue generated from these resources is not in match with its optimal potential. With growing importance for processed foods, the food processing industry in India still remains at 1.6% while in countries like Thailand, Brazil it is 65-75%. The wastage that goes into the agri-produce is almost 30%. Because of the poor quality and supply driven pattern of agriculture farmers are unable to find remunerative prices for their produce. The procurement patterns are so very obsolete in comparison to the standards of developed countries and some developing countries. In terms of GDP, contribution from agriculture is on the decline. It is 23% of the countrys GDP and provides 66% of employment[?]. The growth of agriculture, manufacturing and services sectors are mutually reinforcing and one promotes to the growth of the other.

We have studied the germinal initiatives in rural sector in the present and past that have become very successful. These initiatives can be classified based on their operating mode and its effect on rural transformation. Initiatives studied:

#### 1. Procurement & Business;

- Cooperative Movement- AMUL and Banas dairy;
- ITCS e-Choupal and Choupal Sagar;
- Appachis Integrated Cotton Cultivation;
- One Village One Product ;
- Rural Clusters- US model;

#### 2. Rural retailing & Servicing;

- Annapurna Salt & Project Shakti of HLL;
- Byrraju Foundation;
- n-Logue Chiraag;

### 2.2.1 Procurement & Business

A striking feature of all the five cases discussed under this branch is that they have all identified the opportunity and captured it by going to the grass roots. They came in direct association with the farmers and helped them in providing a market for their produce. ITCs approach is revolutionary

<sup>1</sup><http://en.wikipedia.org/wiki/Microcredit>

in that it has implemented computers and internet to enhance the farmers reach to the market. Appachi has spearheaded a unique supply chain model for cotton where in it integrated both backward and forward linkages with the producing and the consuming communities. All the linkage players such as the banks, insurance company, farm service providers, and consuming textile units have stayed committed to the programme of Appachi. The models of One village one product (OVOP) and Rural clusters have identified the resources of rural regions and utilized those by effectively producing marketable products and services. AMUL and Banas Dairy have formed Cooperatives and created a supply chain for milk where the farmers are benefited the most.

ITCs interest is in Soybean, Wheat; Appachis in Cotton. The network they built in order to maximize the producers profit is basic and does not include a complete penetration of technology, pre & post harvest knowledge, storage & handling techniques, and other necessary practices required for a healthy produce. In the case of ITC, it was Internet alone used for giving fair prices to farmers. Apart from price information there are other factors like transportation, banking, packaging which the farmer needs to be helped. Appachi, although no IT used, supported the farmers by door delivery of farm inputs, crop insurance, pre harvest practices, and buyback of final produce from farmers doorsteps etc. These initiatives have been implemented in select regions which are of interest for the firms. The models of ITC and Appachi cannot function for rapidly perishable produce like fruits, vegetables which require highly controlled cropping methods. This can be provided by employing innovative means created out of scientific and technological investigations into the pre & post harvest practices. Using technologies like computers, Internet for the purpose of information is a less friendly means than television and telecom which have greater penetration in rural areas. It is leading to an underutilization of technologies like satellite TV, 3G etc which can provide the same information as what a computer are used for in these cases. Installing a Computer system in a village costs around Rs. 50,000 but a television equipped with the technology for communication of information would not cost more than Rs. 10,000. Also, there is a social constraint in accepting a computer aided communication process since there would be a natural aversion, owing to lack of dexterity in availing the service. Transportation logistics of the produce is a major concern with almost nil presence of technology. Cold storage initiatives such as refrigeration, temperature sensitive transport are more important in the case of perishable goods like fruits, vegetables, sea foods etc. The success of a procurement process lies with creating a supply chain which involves not just information flow, but also flow of goods, technology, money, knowledge processes which are made available to the rural producers without any strains.

Knowledge processes are vital for adding value to the rural produce and deriving higher returns. An organizational set up like in the case of OVOP and Rural Clusters is a determining factor for achieving operational excellence. Identifying agriculturally prosperous regions and providing them with all the supply chain channels is possible only if there is a hierarchy based organizational set up right from the village level.

### 2.2.2 Rural retailing & Servicing

Many successful industrial firms are getting in to rural retailing identifying the customer base at the Bottom of the Pyramid. It was Nirma which first captured everybodys imagination by launching Nirma detergent. HLL followed the suit by launching Wheel, and slowly gained ground in the rural market. It also launched Annapurna salt for the urban poor and rural people in 2003. The cost of a 200g salt is Rs. 1.50 and that of a 500g is Rs. 3.75. Annapurna salt is a reinvention

in salt business which captured both the rural and urban markets by identifying the opportunity of IDD and customizing products for each economic segment. The innovation in transportation and marketing has benefited HLL by cutting down costs and capturing markets. Project Shakti increased the reach to rural market, increased awareness and influenced attitudes regarding usage of various products, promoted women entrepreneurship, and initiated rural retailing. I-Shakti project brought information into the villages and it strengthened the relationship between HLL and rural India just as in the case of e-choupal. n-Logue is working in the same direction by providing internet and voice services to the neglected small town and village people in India. n-Logue also provides services like e-governance, Childrens center, online testing tutorials, and photo studios etc. ITC has launched rural malls by name Choupal sagar. These are rural outlets located at the procurement hubs of ITC selling products ranging from batteries to tractors.

Byrraju Foundation is a non-profit organization, started by Satyam Computers, made an advent into the rural scenario by providing services which contribute towards rural transformation. They are offering health care services, educational services, drinking water services etc. The cost of treating a diabetes and Hypertension patient has been brought down to Rs. 10. The cost of bottled safe drinking water is brought down to 12.5 paisa/liter due to which 1 million people in the project site of the foundation are availing the service and are able to appreciate the health benefits of purified water. Byrraju foundation and n-Logue are treading on an unseen path where they have broken some illusions regarding serving the needs of rural areas.

These four cases provide a proof of the existence of customers in the rural areas. Food is the primary requirement in rural areas. Providing processed, safe water and hygiene redeems the rural community from most of diseases and reduces the disease burden on the Government. The realization of market in the rural areas is still absent to a large extent though there are many opportunities present as we saw in the case of Byrraju foundation, n-Logue, and HLL.

The above discussed highly successful cases are test cases for a much larger methodology. These could cover only a select few segments of the transformation process. The appreciative fact about these initiatives is that they have identified opportunities, implemented innovative means and ways for accruing profits. They have transformed the way rural market is looked at. It must be noted that all the developments described above are just scratching the surface and are germinal. To make impact, one needs to consider the rural supply chain in its entirety and make it efficient and adaptive.

It is in this direction we have tried to advance in our research and present some methodologies pertaining to the Indian scenario where rural transformation is being debated upon for many decades. In our research, we have defined the Business Transformation of Rural areas by corporatizing the villages. We have applied the concepts of manufacturing to derive a model where villages act as production houses. The models are centered on improving the efficiency of the Indian rural supply chain.

### 2.3 Rural Business Transformation Corporatization

India has an abundance of natural and human resources. The main issue is about the management of these resources towards the prosperity of the communities and the country. Business transformation of rural India needs to be addressed in a systematic and strategic way. The key players:

- Rural Communities (Farmers, Laborers, Cottage Industry, Households);

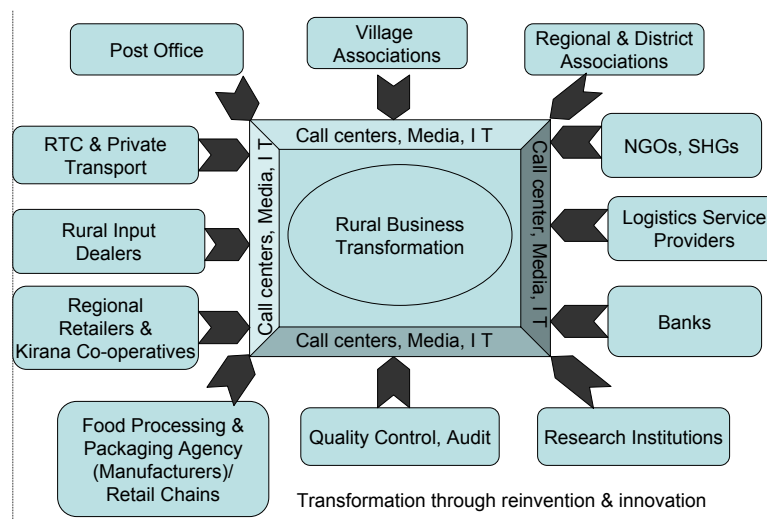


Fig. 2.1 Convergence for rural business activity centers: The players involved

- Industry Communities (Manufacturing, Logistics, Traders, Finance);
- Government bodies (Road Transport Corporation, Post-office, Panchayat);

need to be brought together to enable the rural business transformation. Use of the mobile technologies and other IT enabled services such as exchanges and call centers and creating a logistics Network around rural India thus creating a value chain for the flow of goods, information and funds from and into rural areas. In other words, a logistics network which facilitates a rural 2 rural, rural 2 urban, and urban 2 rural flow of goods and services is vital for rural business transformation to take place. While this may mean constructing and developing new rural infrastructure such as roads, our methodology uses the existing logistics network elements such as road transport, post offices and the banks. While the Government intervention through Panchayats is possible but is not necessary.

Rural areas can be compared to developing nations or businesses which have resources and market potential but are poorly managed due to insufficient infrastructure, lack of management training, awareness, and improper policies. This kind of comparison enables us to borrow concepts and best practices from manufacturing and service industries and customizing them to the rural scenario for increased efficiency. There must be a paradigm shift in the way rural areas function. Villages can be viewed as organizations with resources that need to be converted into value added products and ultimately into cash. If we identify the resources, the requirements, opportunities then there is a variety of businesses that can be created in the rural areas for the benefit of all stakeholders. This we term as the *transformation of rural areas into business activity centers* (see Figure 2.1). The aim of the transformation is to create value flow in and out of the villages. This can also be referred as *corporatization of villages*. The objective of initiating such a transformation in the rural scenario is to improve the standard of living of rural India. The vision is to bring out quality produce from rural India, derive the best out of it, generate wealth for the rural community and bring in prosperity and quality of life by providing efficient and affordable solutions to the existing problems in rural India. For this to succeed there must be a compelling vision and streamlining of the resources and operations to increase the efficiency of the value chain and also

value generation to the stake holders. Rural business transformation is an integrated approach involving the leadership, strategy, organizational structure, and operations towards this goal.

There are a multitude of problems facing the rural sector and we need initiatives for improvement in the agricultural productivity, literacy rate, healthcare, standard of living, and infrastructure. Here we concentrate tow related and mutually inclusive sectors of agricultural production and rural retailing. We must be aware of the constraints and sub-constraints under which the rural areas operate so that we can come up with actionable solutions. These include:

#### 1. Infrastructural and Technological Constraints;

- Processing industries;
- Efficient transportation systems;
- Cold chain and refrigeration technologies;
- Knowledge processes;
- Communications;

#### 2. Economic Constraints;

- Competitive marketing - prices for rural produce;
- Availability of Farm inputs, retail goods and services at affordable prices;
- Utilization of resources;

#### 3. Social Constraints;

- Improper governance;
- Unfriendly policies;
- Traditional mindset and illiteracy;

The report presents a generalized, pragmatic strategy and model through which such a transformation is possible. The generalized model includes all the players in the rural supply chain. The linkage between all the players is a communications hub which acts like an exchange and through which information is disseminated. In addition, a well designed logistics network provides timely flow of information, goods and services, and money & social capital is what determines Rural Business Transformation.

### 2.3.1 Village as a Business System

A village or region can be viewed as a business system (Figure 2.2) transforming inputs into value added marketable or demand driven products and services. It is important to realize that the rural businesses have to get integrated into the global value chains and benefit from international markets. For this to happen it is important to understand the markets and produce the goods and services that are in demand.

There are some essential manufacturing and services industries that need to be encouraged in the rural areas. Processing industry adds value to the produce by increasing the shelf life and better remuneration. Similarly, logistics service providers play the important role of proper transportation of the farmers produce to the processing industries, to the retail chains etc. Transport

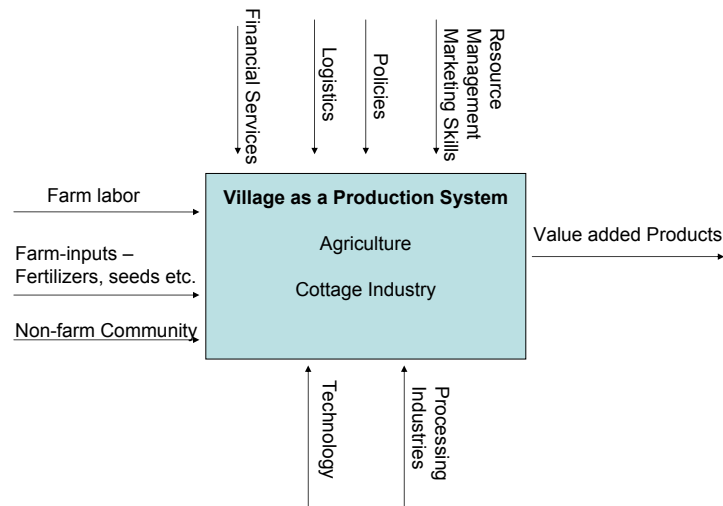


Fig. 2.2 Rural production system

technologies like the cold storage facilities, refrigerated mobile carriers, earth handling equipment etc. reduce the loss and preserve the freshness of the agricultural produce. Rural production activities need to be supplemented with resource management and marketing skills. Resource management is a lever that can open the lid of the underutilized skill basket of rural areas. Marketing is a facilitating mechanism which nurtures a demand driven market and thus gives way to an entrepreneurial approach in rural production.

Policies which tend to be hindrances in the agricultural processes need to be reformulated such that they create a competitive business driven atmosphere. A robust policy can open the gates for investment in agriculture like in the case of contract farming. This can relieve the farmer from burdens like knowledge processes, quality of seeds, authentic information etc.

A manufacturing system operates efficiently when managed as a collection of value-delivering processes. The value-delivery to the customer in an enterprise starts with a requirement from the customer and ends with customer satisfaction. This process consists of a series of activities, each performed by various subsystems of the enterprise. Rural production can be viewed in a similar way, wherein the market needs to be driven by demand and not by supply. We consider below the rural production system as a collection of value delivery processes and discuss ways for their efficient and effective management.

### 2.3.2 Rural Business Processes

A Business process can be defined as a structured set of activities ordered in time and space, designed to produce a customer-desired output [?]. A process is essentially a mechanism for creating outputs that have greater economic value than inputs in a systematic way. In rural production, inputs are labor, quality seeds, fertilizers, knowledge processes, capital, market information etc. As the produce moves through from production to processing and to the retailer a value transformation occurs. The transformation could be enabled by transportation using cold chain initiatives that preserve the freshness of the produce, handling techniques, knowledge processes leading to

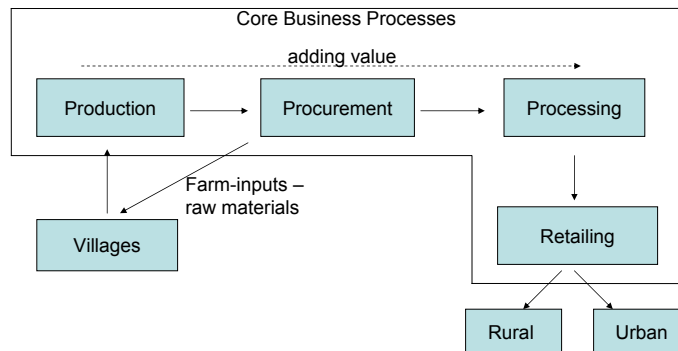


Fig. 2.3 Business process flowchart

diversity of processed foods. The effects of the transformation will be visible at the customer end in the form of ready usability, value addition such as nutritious food, easy availability, better quality and reduced cost of the final product. As in industrial manufacturing, rural production must also minimize all non-value adding activities like storage, review, and inspection. Though storage is very essential in the case of food grains and other time sustaining produce, all perishables like vegetables and fruits need a fast movement mechanism so that they reach the customers before losing any value. Logistics is an important process supporting system to preserve the freshness and transport the produce to the customers; the customers are the processing plants, retailers etc. We identify below the set of core business processes can and the support processes which enable the efficient functioning of these core processes in a rural production region.

### 2.3.3 Business & Support Processes in a rural production house

The core business processes in a rural production organization are (Figure 2.3):

- Production (Farming and Non-farming);
- Procurement (Procurement of farm-inputs, procurement of fresh produce);
- Processing (Processing of fresh produce: grains, fruits, vegetables);
- Retailing (Rural and Urban retailing);

The support processes assisting the above core business processes can be identified as follows:

- Transportation including cold chain initiatives, mobile refrigerators;
- Communications technology;
- Logistics Service Providers;
- Knowledge Processes - pre-harvesting & post-harvesting techniques, handling, packaging, and processing techniques;
- Resource management and marketing;



- Financial services;

The rural production pyramid can be represented by including the business processes, sub-processes, and stakeholders as shown in the exhibit below.

In the next section we consider the procurement and retail processes and present an efficient and effective design of those processes.

## 2.4 Rural Supply Chain Transformation

The rationale behind Rural Business Transformation lies in creating an efficient rural supply chain by bringing in all the players into the equation. The rural supply chain has two core value delivery processes.

- Rural produce procurement and processing (Value addition);
- Retail 2 rural commodity transfer;

In the following sections we will discuss the inefficiency of rural supply chain in India, a model to beat this inefficiency and the role government and industrial sectors play to bring about the convergence.

### 2.4.1 Procurement process

Procurement is one of the important value delivery processes in the rural supply chain. It is the tail end of the supply chain and also involves the most important stake holders of the supply chain, the farmers. The farmers need better remuneration and a fair deal. Within the procurement supply chain a substantial share belongs to food products which are mainly grains, vegetables, fruits, meat & poultry. There is a huge variation in the agricultural practices, the type of produce, and quality of the produce due to the variation in the soil, environment, climate, irrigation facilities and energy resources that are available. All the parameters that are essential for the success of rural procurement process such as logistics, insurance, finance etc must be brought in to action simultaneously in a well orchestrated manner.

We have identified the units of resources rural India is equipped with. Looking at the same in detail we have,

- Farmers, Farm Lands, Irrigation sources;
- Cultural Resources;
- Post-office;
- Road Transport Corporation;

The target market is processing industries, retail chains, and kirana co-operatives for all agri-based products. The customer base for cultural products is mostly the urban households. There are a group of players outside the boundary of rural areas which forms an alliance with the rural community directly or indirectly.

- Food processing, packaging and distribution agencies;

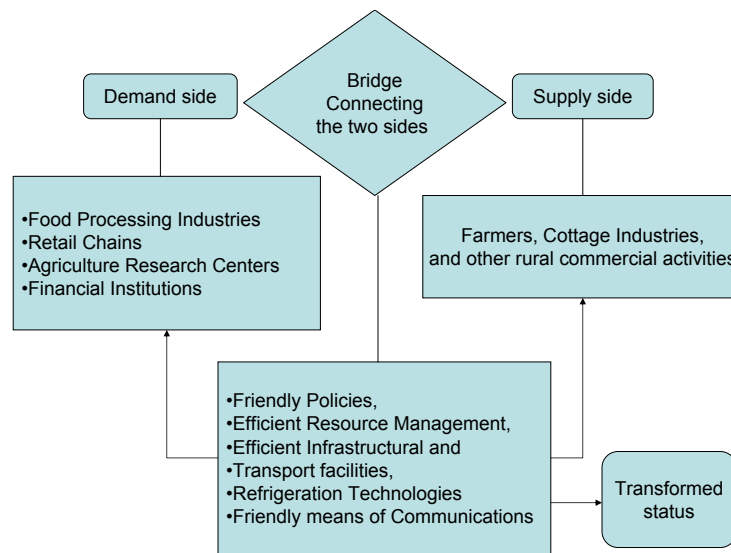


Fig. 2.4 Bridge between demand and supply sides of rural supply chain

- Retail chains, Kirana-co-operatives;
- Textiles Industry, Handicrafts Stores like Fabindia;
- Financial institutions;
- Research institutions;

In the existing system there is no proper linkage between the demand and supply side. There are a few examples viz., ITC, AMUL, PEPSICO, and HLL which could go into rural areas and work along with the farmers, eventually adding value both to the farmers and themselves.

The above exhibit illustrates the way rural supply chain has been operating in most parts of India. If the connecting bridge is reformed by employing resource management skills, favorable policies, efficient and friendly technologies then the transformation of rural supply chain will become a reality (Figure 2.4). Technology facilitates a better means of supplying Agri-produce, processing and creating market for the procured produce. Cold storage facilities, mobile refrigerators, efficient energy means, technology aided cultivation, irrigation methods are some such initiatives where technology can change the face of agricultural production. The process of creating such an efficient supply chain lies with transforming the way everybody functions at the supply side as well the demand side.

#### 2.4.2 Role of Technology and Innovation

To manage the constraints mentioned above, it is important to necessitate the use of technology in every possible way. Innovation in the way rural production is handled, transported, and processed lead to a better management of the constraints. Employing innovative means implies breaking the barriers of convention. A few such cases presently are ITC, EID Parry, HLL, and PepsiCo where they have used innovative means like computers, contract farming to help the farmer.

Mechanization of various agricultural practices, usage of renewable energy, employing communications technology, mobile refrigeration facilities, cold storage technologies, low cost processing, and packaging are some of the technological innovations that are necessary for an efficient channel for rural transformation. Propagation of innovations catering to agricultural practices has already been initiated by National Innovation Foundation. But the penetration of technology is far less than its potential. The cost incurred from implementing technological solutions may seem to be an obstacle but the benefits in the form of scaling of revenues, usage of resources and improving the standard of living are a few to list down in the long run. In rural areas the penetration of television and telecom is to a greater degree compared to Internet, Computers. One can make use of technological resources like call centers, and mobile communication services to provide flow of information. There is a high feasibility for building trucks and vans with Cold storage facilities and mobile refrigerators. Credit access to rural communities is still a hindrance to the growth process. ATMs, Smart Cards are some of the means for providing better financial transaction processes to the villagers. Technology forms an important tool kit in accelerating rural transformation.

We propose an organizational structure in the following chapter and a procurement model for the farmers produce. The organizational structure creates channels for flow of information, goods and also provides a marketing means for rural business.

## 2.5 A Model for Procurement

In a typical marketing model of rural production a list of intermediaries exist through whom the produce reaches the mandi. The intermediaries charge huge marketing fees. The farmers do not have access to price information and therefore there is nothing like timing of the sale. The actual price of the produce is decided at the auction site. The inspection of the produce always tends to favor the buyers. Lack of scientific and standard grading norms does not reward the producer and hence he is at a loss. In the case of farm produce a fraction of it gets lost during transportation, handling and packing. The number of touch points has to be reduced to limit the wastage of the produce during transportation.

Any new mechanism must remove the information barrier, intermediary, and must provide the right standards to grade the produce, and also the right price. Apart from that the procurement must include a means of transporting the produce, preserving the quality of the produce. The villagers must have a direct access to the prices and must be able to make decisions at their will. The quality of the produce has to be monitored and inputs must be provided in order to make the villagers accrue profits.

We bring one such model where the different players are connected through a communication hub (Cyber Intermediary). The communication hub consists of a call center which is connected to all the support processes and stakeholders of rural production house who; it provides services through a call center, and internet by maintaining a portal; it also acts as a cyber intermediary which is a B2B and B2C exchange and provides a platform for auctioning; the stakeholders and support processes register with the hub. With an organizational set up at the top and bottom of the chain, the whole process of procurement can be facilitated efficiently.

In the above exhibit all the parties communicate among themselves through a communication hub which is regionally located (Figure 2.5). The village associations communicate about the crop harvest and place a tender through the call center. The call center communicates the same to the district level group and food processing/manufacturing agency at the region level groups. The

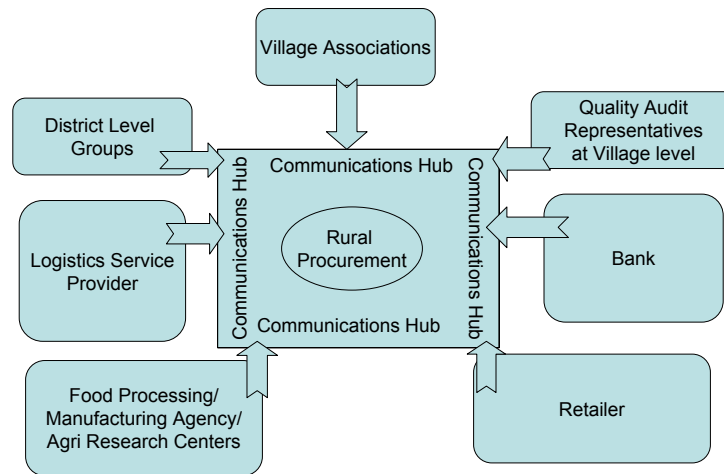


Fig. 2.5 Model for r2r and r2U transformation

food processing agency is a constituent body of the regional groups which includes the private and public enterprises interested in buying the produce of the region. The price settlement is done in bracket forms based on the quality and grade of the respective produce. There will be a price assessment wing cum commodity exchange at the district level which decides the minimum price bracket along with the quality wing. The auction of the farmers produce will be conducted by the price assessment wing. Pricing becomes spontaneous because information regarding the quality of seeds, cultivation practices etc. enables the price assessment wing to announce a minimum price bracket for the produce of the region. This stands as a benchmark and is communicated to the food processing agency. The auction process will be relayed to the village association through a television, radio or telephone from the call center; the farmer can convey his acceptance of a buying offer to the call center. Once a manufacturer wins the auction of the produce, the quality wing initiates the quality representative at the village level to inspect the produce. After the inspection, the deal will close at the appropriate price and will be communicated to the manufacturer. The manufacturer decides a price bracket and announces it to the call center which communicates the same to the logistics service providers. The interested Service Provider will negotiate a price and heads towards the village to procure the produce and delivers it to the manufacturer at the Food Processing Agency. The complete details of the deal will be communicated to the Bank by the call center which sees through the monetary transfers.

The village associations consist of groups of farmers, cottage industry laborers, quality inspectors, agri research representatives, and franchises. The food processing units are customized to the kind of produce grown in a region. The logistics service providers also customize their vans, trucks to the produce in a region. The retailers interested in procuring the processed, and fresh produce in the region also will be part of the food processing agency and the village associations.

### 2.5.1 Description of Flowchart

1. Communication of the details of the produce by the farmers to the call center (Figure 2.6);

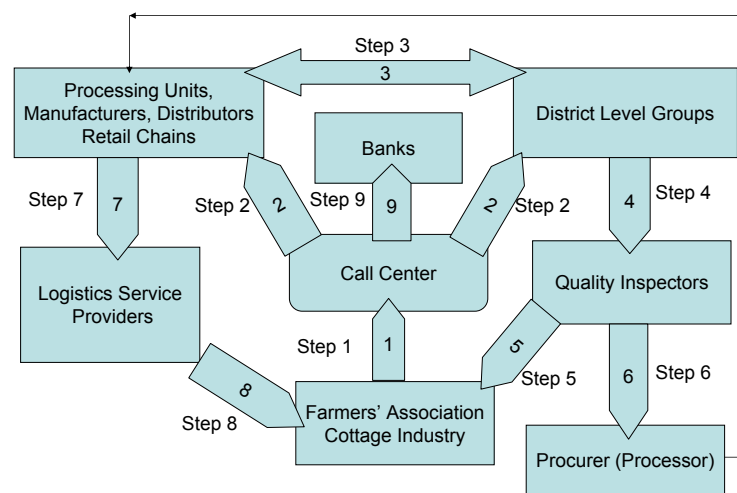


Fig. 2.6 Procurement flowchart

2. The call center communicates the information to the District Level Groups and the Processing unit;
3. The price bracket will be set up by the price assessment wing and the quality wing at the District house. This bracket is the Minimum Procurement price bracket. The bidding for the produce is conducted by the price assessment wing;
4. After a player in the processing unit wins the bid, the district level quality wing initiates the quality inspectors at the village level;
5. The quality inspector goes to the village and inspects the produce;
6. The quality inspector communicates about the quality of the produce to the procurer and closes the deal;
7. The procurer communicates via the call center with the logistics service provider. A price bracket will be announced by the procurer to the call center. The call center conveys the price to the service providers in that region;
8. The service provider who is interested in the price communicates with the call center about his acceptance and proceeds to the village;
9. The call center finally communicates the complete set of details of the deal to the Banks. The monetary transfers are completed by the banks. All the banks are connected through internet;

It is important to note that the means of communication may vary from region to region depending upon the penetration of technology. In that case instead of a call center one would have a communication hub (Cyber Intermediary). But the idea we want to put forth here is that the existing communication technology can transform the way procurement takes place by bringing in flow of information which is vital for any business. The hub can also act as a financial gateway and maintain security of the financial transactions.

One can also have different names to the organizations at all the three levels mentioned in the model viz., Village Production House, District Production House and so on. The villages can be allotted codes by the District Production House and the village house communicates to the communication center using the code. Database of the production details and the account details of the house can be maintained by the district house as well as the call center for managing the deal. Above the Village Production House, communication can take place through the internet thus facilitating a much faster processing of the deal. A case on mango harvesting is discussed below to highlight the importance of technological inputs and management of the post harvest produce.

### 2.5.2 Case on Mango Procurement

*Harvesting* It is carried out with picking poles either from the ground or climbing the tree and dropped to a catcher below (some trees are easily 12 m tall). Most of the damage occurring at this point is not seen until later during ripening. There are at least three areas where mechanical damage can occur:

1. during harvest as the fruit falls into the bag of the picking pole (fruit to fruit). This is increased as more fruit are collected in the bag before emptying;
2. As it is caught by hand by the catcher on the ground;
3. More than likely, the catcher then drops the fruit onto the ground where the latex is supposed to drain. He does not bend down to place every fruit on the ground. There is limited control of latex flow that almost always results in staining of the fruit;
4. Additional problems may occur when the fruit is placed on the bare soil as soil sticks to the latex, essentially creating a sandpaper effect which scratches the skin;

*Transport to Collection Centers* The fruit at this stage is probably handled 4 or 5 times and it is placed in piles on the floor, sorted by the buyer into another pile, or is moved again to another pile inside a room for holding and then loaded into crates or into pick-up trucks. The multiple handling of individual fruit guarantees mechanical damage of all forms, which will be noted at the pack house reception or when the fruit begins to ripen. In addition to damaging of the fruit, this method is highly inefficient both in terms of the time required and also in the grading process. The stores or holding areas are small and enclosed with little or no ventilation. Fruit stacked in piles on dirt floors under these conditions for any length of time results in rapid quality loss.

*Field to Packinghouse Transport* Transport systems ranged from loose fruit on a pick up truck to a container truck with fruit in bins and crates. People, spare tires and other items were normally seen on top of the mangoes. From the point of loading the fruit to off-loading at the packing house each individual fruit was handled up to four times. While some roads did appear good, there were also many roads in somewhat poor condition that would definitely contribute to mechanical damage.

From the above case it is evident that there is a lack of skill in every way right from harvesting techniques to packaging. The formation of Village Farmers Association nurtures entrepreneurial spirit which will mobilize the farmers towards using better techniques in order to save the resources. The lack of pre-harvest research and post-harvest research knowledge to the farmer

is an impediment. Poor access to technology and packaging facilities, storage facilities lead to wastage of the produce which is a loss to the farmer. Lack of better processing practices; varieties in processing also limit the use of the damaged produce. Already practices like mango cake, mango juice out of damaged fruits are existent presently. Having separate groups for managing the above mentioned problems creates a profitable market for the farmer. Better transportation facilities, temperature controlled storage, better seeds, agri inputs etc. will lead to a better quality produce and creates a business for the produce.

## 2.6 Retail 2 Rural Transformation (R2r Transformation)

Till now we have been discussing about the procurement of rural produce. In the definition which we have adopted for Rural Transformation there are two dimensions. One side is the issue of bringing the best out of rural India, generating wealth and banishing poverty. This side is given relatively more importance. But the other issue is bringing quality into rural India, improving their standard of living by providing better services. Rural India needs attention in many basic requirements for a healthy, prosperous life like Food, Sanitation, Education, Credit Services, Healthcare, and Energy. Just like rural communities even Industry community must also see a paradigm shift in their perception of rural markets. The penetration of retailing in rural markets is low. Most of the buying in rural areas happens either through the local shop keeper, or through the haats, melas.

As said earlier, transformation is initiated by having a compelling vision. The vision in the case of R2r transformation is to provide quality food products, processed food; sanitation, safe drinking water, energy, and education etc. 70% of the countrys population live in villages [?] . There is a huge customer base in rural India which has been mostly neglected all these years. Business in rural areas is based on scale, price, and quality. Usually consumption patterns of rural areas mostly are on daily basis. Also they buy in small amounts compared to urban people due to monetary constraints. They look for both quality and price and even though somebody is offering them a quality product but at a higher price they would decline the product. Their tendency is to save money instead of spending it. So they choose cheap products in most of the cases. From buying toothbrushes to television sets they compromise on quality due to the price levels of the products they desire to have. So the industry production houses are losing business. Therefore there is a need to shift from the conventional way of producing goods to a more differentiated, quality added, affordable set of goods which are accessible to the rural community. The important driver of such a transformation is innovation. Innovation is dependant on identification of opportunity. Many times due to lack of information about a market, about the consumption patterns and consumer behaviors, opportunities go unidentified. There are cases like Narayana Hrudayalaya, Annapurna Salt, and Nirma etc [?] , where opportunities have been identified and innovation has been employed to deliver customized products addressing the needs of middle and low income community.

Customizing products to the needs of rural community is very important. Channels through which information about the requirements and consumption patterns can be gathered play an important role in initiating market activity. Technology is a vital tool for such a process. Apart from technology, means of transportation is the driver of R2r transformation. The above discussed are some of the constraints which have to be taken care of in initiating R2r transformation (Figure 2.7).

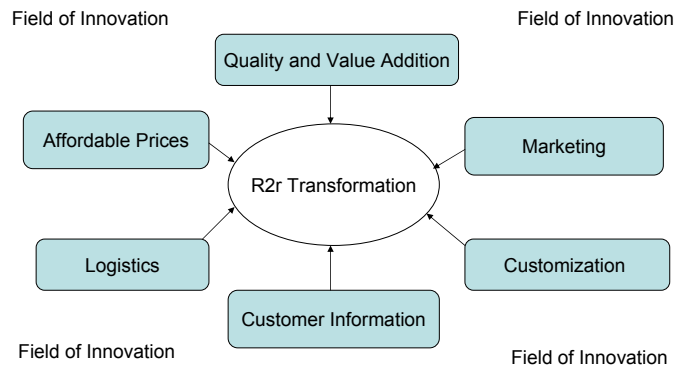


Fig. 2.7 Constraint in R2r transformation

Innovation is the key for R2r transformation. It can influence all other constraints if leveraged properly. Logistics issues presently exist in the form of efficient transportation of products into the rural community. Usually, a small shop owner buys goods and transports the goods on a moped or auto rickshaw. He procures the goods according to his choice, governed by his knowledge about the customers at his place. This along with his meager investment levels leads to generic goods and locally manufactured products which may be harmful. The quality will be inferior and the result is a compromising customer base that remains unaware of the many new services and products that are offered to the upper customer segment. An insight into the customer behavior is a crucial element of Rural Marketing [?]. Once customer patterns are known, then customizing the services and goods to the rural market is essential in creating customers out of rural areas. Marketing of the services creates awareness among the customers and generates willingness to buy the goods. If the services and goods are offered at affordable prices, and with value addition and quality then an active participation of the rural customer base will be witnessed. All this can happen only if the Field of Innovation is applied in managing all the constraints.

C K Prahalad in his article titled *The Innovation Sandbox*, debates that Innovation in one leads to innovation in others. It is important to underscore the starting point of such an Innovation. Innovation has to be triggered in all the layers which are essential to design a successful R2r business model. In some cases, reinvention itself can be termed as innovation. Reinvention can be more applied to the lower end of the chain where service channels are very important. For example, consider the case of supplying products to the rural consumers. If one looks at the transportation resources in rural areas then Post office and RTC are the major drivers. Transforming the way these bodies function can provide a better channel in bringing products into rural areas. In rural areas, periodic markets happen at melas and haats [?]. Transforming the way these periodic markets function can facilitate a marketing means for businesses. Communication technology can be an effective means of marketing, information gathering, credit issuing, and transportation of goods. In the subsequent sections we discuss one such model where innovation at all levels can initiate R2r transformation.



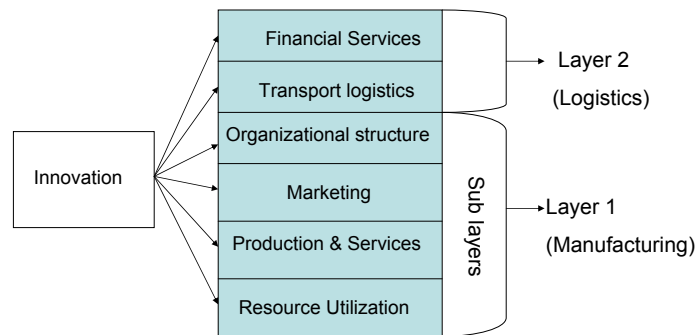


Fig. 2.8 Innovation layers

### 2.6.1 A Model for R2r Transformation

We have identified players at the village level like the RTC and Post-office which can play a very important role in building a supply channel between rural and urban . These players identified will be a part of the R2r transformation by providing services to the Marketers.

If we look at the rural social structure, there are primarily three classes of people, viz.

- Higher income class;
- Middle income class;
- Low income class;

One of the important requirement of a rural community, like other communities is Food. To cite an example, in Tamil Nadu the number of children attending schools has increased due to the mid-day meal programme [?]. So providing quality food either fresh or processed is a big opportunity for retail food chains and stores. The needs of all the three classes mentioned above must be understood thoroughly and served accordingly. For instance, an individual belonging to a higher income class has access to basic food. So his aspiration levels will be more towards a processed item (ready to cook), variety food items. In the case of an individual belonging to middle income class, the aspiration levels would be a mixture of both the upper and lower class. And for an individual belonging to lower income class, his basic food is that which satisfies his hunger and provides nourishment. So the food stores must relegate their services to all three kinds and hence innovating the products. The result of the innovation will manifest in the price levels, quality and value of the food products. The same argument holds for other goods like apparel, FMCGs etc. In the case of healthcare services it is important to know the health demographics of a cluster. This will help in distributing medicines in the right proportion. Paramedical services play an important role in rural areas where the access to a doctor is difficult. Hospital services can launch Mobile Health Vans to treat people in villages<sup>2</sup>. Even the cost of medicines also has to be brought down for the low income individual to have access. The layers of innovation have been identified to be the following shown in the exhibit (Figure 2.8).

<sup>2</sup><http://www.byrrajufoundation.org/>

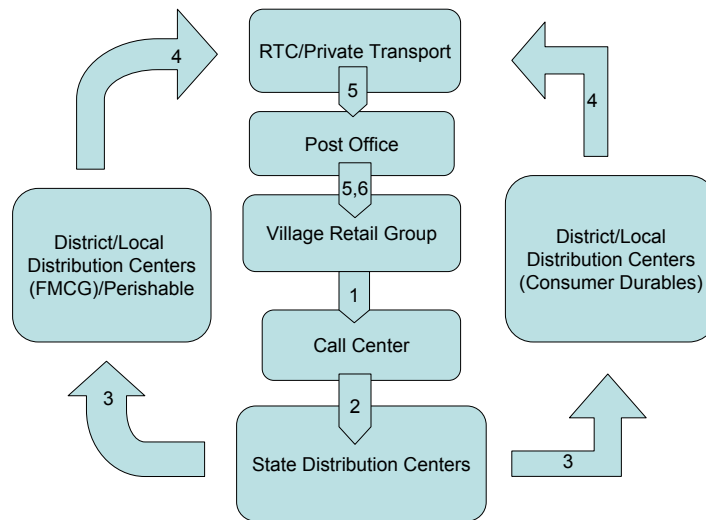


Fig. 2.9 Rural retail flow chart

Innovation in each of these layers is fundamental for the transformation of rural retailing and rural marketing. The same, in fact holds for the rural procurement model. In the following section we discuss supply models for different services and products.

#### 2.6.1.1 Rural retail flow chart

1. The Village Retail group places an order with the Call order (Figure 2.9);
2. The call center will communicate the order to the State distribution center;
3. The State Distribution Center will pass on the details of the order to the District/local distributor located near the Village;
4. Depending upon the type of order the goods can be delivered. All Consumer durables can be delivered by Post office mobile vans. Perishable and FMCG goods can be delivered by RTC to the Post office who can distribute it to the Village Retail group;
5. Delivery of the goods to the Village Retail group. The payment for the goods will be handed over to the agent from the distribution center;

#### 2.6.2 Generalized Model: r2r, r2U and R2r Convergence

Unification of the models for both procurement and R2r transformation into one generalized version will give a better picture of the players who can influence the transformation of rural areas into Business activity centers. The tool linking all the players is an efficient communications network which constitutes of call centers, media and Internet; an efficient logistics network; Call centers and media are the principal communication channels to the rural areas. With the support of efficient logistics, knowledge processes and services, one can achieve convergence of r2r, r2U and R2r transformation. The penetration levels of telecom and television is more into rural

India than Internet and these services can be utilized more efficiently by transformation through reinvention and innovation.

Government assistance is an accelerator and a catalyst for Rural Business Transformation. Good governance, policy making and research initiatives by making and allowing investments in technology and innovation provide a good environment for rural transformation. Friendly policies like removal of barriers to entry, tax exemptions, infrastructural assistance are a few to mention. To encourage entrepreneurship in rural areas, government must launch supportive schemes and policies. Rural entrepreneurs and small businesses have limited access to financing. Venture capital investments must be encouraged in local entrepreneurs and small businesses.

We have to understand that the success of the models discussed in this research is subject to the efficiency of governance. There should be transparency maintained in all the dealings and the authorities must exercise equity in every possible way. Equity in setting up price brackets, distributing resources, funds, information and other important drivers of the transformation is mandatory for a successful functioning of the models. Government bodies like the RTC and Post office have to implement best practices and methods in exercising their functions. There should be collaboration between public, private and nonprofit organizations for sustainable Rural Business Transformation. Retailing in rural areas becomes an issue of transportation of the products once they are customized for the rural community. Whether it is health care; food retailing; or retail banking, mobile means is by far the best way to reach the customers. The information can be communicated between the demand side and the supply side using call centers and help lines. The retailers operate from a nearby town or city and provide services and goods through mobile transport.

*2.6.2.1 Food, FMCG, and Apparel Retailing* Retailers have choices like Mobile refrigerated carriers, vans, and franchise system. The carriers will be fitted with refrigeration, micro oven and other cooking facilities. They also have containers for ordered goods that are to be delivered to the customers. These carriers can operate from a nearby town or city to the village clusters and provide the needed service and delivery. Franchise system can also be employed in the case of villages which cannot be reached, where the franchise markets the goods. RTC and Post office can provide service in the form of mobile carriers by customizing their vans and buses.

*2.6.2.2 Healthcare Services* Healthcare services are very important as they are not available in proper way to many diseased people. Health representatives, mobile hospitals, paramedical services are some of the means through which medical care can be provided to the rural community. Health representatives are at the village level that can provide medicines in cases of urgency.

*2.6.2.3 Financial services* Credit issue, Insurance policy, and other financial services can be provided to the rural community using mobile banks, and through post office. The concept of micro-finance has revolutionized the way issuing of credit is dealt with in rural areas. Post offices serve as effective service providers of financial services at the village level. Urban and Gramin banks can tie up with post office in providing these services.

Similarly opportunities are there in the areas of Education, Energy, and Sanitation services. Sanitation problems can be addressed by creating awareness among the rural community and advocating the need for investing in safe environments. Small retail sanitation outlets can be operated around village clusters. The sanitation materials can be produced in bulk and sold cheaper to the rural people. Ground water resources can be utilized to provide bottled safe drinking water

to the rural community. One such initiative has already been taken by Byrraju Foundation, a non-profit organization operating in Andhra Pradesh. Energy resources for rural community are mainly wood, charcoal, Cow dung etc. Electrification of Rural India is still in the process and people mostly rely on kerosene lamps, candles. Awareness is growing among rural communities about LPG cylinders, stoves etc. People who can afford them are shifting to them but the low income class still is using wood and other natural resources available for cooking which lead to health effects. Efficient usage of biomass by generating alternate fuels, biogas can provide safe and economical energy solutions. Rural electrification can be addressed by utilization of alternative technologies like Solar cells, wind power, small scale hydro power. Solar power in particular is an attractive option to generate electric power useful for agriculture, household application, schools etc. As discussed in this section there are opportunities in the rural sector which have to be turned into businesses that provide quality, value added services and products. Capturing these opportunities depends a lot on the alignment towards the vision of improving the quality of life of rural community and transforming the way businesses work by incorporating innovation in every possible way.

## 2.7 Conclusion

Transformation of rural areas requires a paradigm shift from supply driven to demand driven business structures. Rural areas must be perceived as production houses which function like an Industrial manufacturing enterprise. To achieve this, there are lessons that have to be learnt from the successful attempts of the past in agricultural sector. We discuss the elements of the strategies we presented in this research vis--vis the attempts that have been already made in the rural sector.

### 2.7.1 Similarities and Variations

1. The flow of information is a very recognized aspect of the rural sector which has been facilitated by using internet and other technology tools. Existing models like ITC, HLL are using computer kiosks to deliver relevant information to the people in village. The models discussed in this research present a similar view except that the mode in which information can be disseminated is different. It proposes a rural friendly communication channel considering the easiness of people to communicate in their vernacular language;
2. The concept of contact farming and co-operatives are samples of an organizational structure implemented in agriculture. This paper discusses the importance and need for an organizational structure in managing the resources of rural areas. It discusses the Corporatization of rural production and the viewpoint of rural production houses;
3. The existing models are localized and produce specific; also the logistics aspect which is so important in managing the rural produce is not organized. This research gives much attention to the logistics part and underscores the point that rural transformation lies in efficient management of the rural supply chain;
4. Rural retailing remains a neglected area except in a few cases like HLL. This research provides a direction in which Industrial manufacturing firms must progress to capture the rural market;

### 2.7.2 Business model

In this research, we address rural transformation from a business point of view. The business model that is presented is a demand driven, customized process. The concepts of manufacturing have been applied to shape an organizational structure with attention to resource management. The model proposes Corporatization of rural sector and the organization of rural sector into production houses.

### 2.7.3 Factors leading to excellence

Rural Transformation is subject to the efficiency of the rural supply chain. A Comprehensive logistics network is a vital force in creating a robust supply chain. Rural business needs to be addressed by employing technology in the areas of agriculture and Cottage industries. A revolution not just in building information gap, but also in other areas like monetary issues, knowledge processes, resource management need to be addressed. Apart from technology for rural people, innovation in utilizing the social, natural and community capital is a key to capture the potential of rural market.

### 2.7.4 Modus Operandi

An organizational set up is necessary which will make the rural areas operate as corporate houses that will signal the beginning of Corporatization of Rural India. The transformation of rural lives is dependant on how well the rural business is nurtured and the motivation of Manufacturers of retail goods to attend to needs of the rural customer in every possible way.



# 3 Dynamics of Retail in India & the Indian States of Andhra Pradesh and Punjab

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## 3.1 Introduction

The time has come for Indian retailing. The signals are there all over. The newspapers, business, press, the governments, the CEOs of large corporations, all talk about it day in and day out. Booming employment opportunities, rising urban disposable income and credit card ownerships, changing lifestyles and demographic profiles are all showing a favorable skew towards a rising consumerism culture, boding well for retail growth. Consumer groups aged between 20-45 years are emerging as the fastest growing consumer group spending across all the retailing channels of grocery, non-grocery and non-store. Indias burgeoning middle class will drive up nominal retail sales through 2010 by 10% p.a. At the same time, organized retail is becoming more important. At present organized retail accounts for a mere 3% of the total; by 2010 this share will already have reached 10%. Thus most of Indias growth in retail is in the future, not the past.

Huge population base of 1.08 billion, growing at about 1.6% per annum, provides a large and growing domestic market for food products. While food accounts for only 9.7% of the total private consumption expenditure for an average American, 15% for the Japanese and British, for the Indian it is the principal component of their consumption expenditure, accounting for as much as 53%. Further, rising per capita incomes, changing life-styles and a growing younger population with preference for convenience food are the driving factors for this sector. Moreover, with liberalization of trade in the post-WTO regime, India has the opportunity to export agricultural and food products to the world. Over the last decade or so food processing has grown at a rate of 7.1% per annum. According to recent data from Indias Marketing White book by Business World, India has around 208 million households. Of these only a little over six million are affluent that is, with household income in excess of INR 215,000. Another 75 million households are in the category of well off immediately below the affluent, earning between INR 45,000 and INR 215,000. The challenge for organized retailers, distributors and consumer goods manufacturers is to capture more consumers in the large category of well off, as well as increasing consumer goods penetration and returns in the small category of affluent. There are considerable opportunities for organized retailers in the kind of rural territories that many companies have failed to address.

If infrastructure allows the businesses to reach the new markets at reasonable cost, then retail growth will be absolutely explosive[1].

Transformations in the global food system are causing changes in food production and marketing in India. There is a growing domestic market for horticultural produce, in both traditional and exotic vegetables. The horticulture sector of India contributes about 24.5% towards agriculture GDP from only about 8% of the cultivated area. Besides, providing nutritional security, livelihood security, helping poverty alleviation and employment generation, this sub-sector sustains a large number of agro-industries, which generate huge additional non-farming employment opportunities. The range of horticultural products includes fruits, vegetables, spices, coconut, medicinal and aromatic plants, mushrooms, cashew, cocoa etc. India accounts for 10 per cent of the total World production of fruits and stands second after Brazil; and is second largest producer of vegetables after China, contributing 13.4% of the Worlds vegetable production<sup>1</sup>. Production and marketing arrangements are responding to changing demand, driven by urbanization and diet change. Government-sponsored schemes in horticulture have mixed results, generating more jobs than cereal production. Beyond direct government interventions, new forms of contractual and sharecropping relationships are emerging between private dealers and farmers [2]. If these advantages can be leveraged, India can be a leading food supplier to the world. Progress in agriculture made the country being able to meet its minimum needs for agricultural commodities. In order to safeguard the interest of farmer community, it is essential to have food processing industries and value added agriculture schemes<sup>2</sup>. However the agricultural sector faces many complex problems and often conflicting issues:

- inefficient supply chain;
- high marketing fees of intermediaries;
- too many varieties of produce often not the type required for global markets due to lack of market intelligence;
- poor quality and wastage due to contamination at post harvest stage;
- volumes lost due to multiple handling and poor storage techniques;
- lack of large organized sector participation;
- limiting the market size for processed products [3];

### 3.2 Food and Retail in India

Food Processing Industry (FPI) has enormous significance for Indias development for the vital linkages and synergies it supports between industry and agriculture - the two pillars of economy. Food processing industries have a crucial role to play in providing nutritious food to the population, increasing the shelf life of the produce and also in the reduction of post-harvest losses. India's upbeat economy presents enormous opportunity for organized retail. The mood in Indian retailing is bursting with optimism, with the hope that the government will introduce favorable

<sup>1</sup>Tenth Five Year Plan 2002-07, (Chapter 5.1 Agriculture) (<http://planningcommission.nic.in>)

<sup>2</sup><http://punjabsewa.gov.in/citizen-services>



legislative relaxation in real estate and partial FDI reforms in retailing. This will encourage retailing to remain in investment mode. Domestic retailers are likely to exploit the improving economic environment as well as the relatively stable political situation and increase their presence.

### 3.2.1 Food Processing Industry

Food processing industries have a crucial role to play in value addition to the agricultural sector. The most important point in the food industry is that a substantial portion being rural based it has a very high employment potential with significantly lower investment. The fruits and vegetables farming for processing is not only employment intensive, but also enhance the gross as well as net returns of the farmers [4, 5, 6]. Agro-industry also generates new demand on the farm sector for more and different agricultural output, which are more suitable for processing [7]. On the other hand, the development of these industries would relax wage goods constraint to economic growth by enhancing the supply of their products [8]. While agriculture sector in India contributes one fourth of country's GDP and provides employment to approximately two thirds of the population, today the FPI alone accounts for 6% of the GDP. The quantity of processed food produced in the country is under 1.6% while in countries such as Thailand, Malaysia and Brazil it is 65-75%. India's fast growing consumer markets are slated to include 500 million consumers by 2010, with the FPI expected to treble from 6 to 20% with its share in the global agro-trade expected to rise to 3%. So far, between August 1991 and January 2006 cumulative FDI in food processing has been of the order of 1,177 million US dollars, representing only 3.6% of the total FDI inflow. With liberalization of trade in the post-WTO regime, India has the opportunity to export agricultural and food products to the world. Over the last decade food processing has grown at a rate of 7.1% per annum [9]. The sector has great potential for employment generation, both direct and indirect, across the supply chain in production of raw materials, storage of produce and finished products, distribution of food products to consumers, besides enhancing the shelf life of agricultural products and reducing wastages. The chain of intermediaries in the marketing of fruits and vegetables is very long and this leads to very small fraction of every rupee of profit to the farmer [10, 11].

A combination of reasons, such as high taxation levels, infrastructural inadequacies, long and fragmented supply chain, regulatory distortions, multiplicity of laws including some antiquated ones, poor scale economies and retarded flow of credit for the sector, has stymied the natural and healthy expansion of the food processing industries. In India, due to a variety of factors, processed food prices are substantially higher than fresh food. There is an urgent need to take measures to reduce costs, and make processed food affordable. Lack of continuous availability of raw material remains a critical area of concern for the sector. In the horticulture sector itself there are huge post harvest annual losses of around 30-40% of the produce (about Rs. 50 000 Crore). Closer interface between research institutions and the farmers, through aligned responsibilities, is essential for effectively tackling location-specific pre-harvest management requirements of various crops in varied agro-climatic conditions.

### 3.2.2 Public-Private Sector Initiatives in Agriculture sector

**3.2.2.1 Agro-Export Zones** The Central Government has released a food processing policy in 2001. However the role of the State is considered vital [12]. The concept of food parks, agri-export zones (AEZs), human resource development have been initiated besides several incentive

schemes by the Govt. of India. The concept of AEZ attempts to take a comprehensive look at a particular produce located in a contiguous area for the purpose of developing and sourcing for raw materials, their processing and packaging, and finally their export [13]. AEZ have been approved by the Govt. of India (GOI) with a total envisaged investment of Rs 1,325 crore. A total number of 48 AEZs have been approved in 19 States of India. Since the AEZ was flagged off in the 2001 Export-Import (Exim) Policy, the actual investment flows from both the State governments as also private sector was only Rs 145 crore in 2002<sup>3</sup>.

**3.2.2.2 Contract Farming** Contract farming is one of the most significant and powerful means by which farmers are integrated into national and international commodity markets and agro-industrial markets. The nature and structure of contract farming systems vary widely from country to country, but a fundamental element is the vertical concentration of producers in which the States attempt to supervise and condition the production patterns of growers [14]. Many researchers view this institutional form as an integral element in the *new international division of labor in agriculture* and the *new internationalization of agriculture*. Contract farming considerably increases the power of agro-industrial companies and it *shifts the control away from the farm towards the agro-industrial enterprise*. Contract production is very prominent in the horticultural and tree crops, floriculture and industrial animal husbandry sectors. In Asia and Latin America, rubber, cocoa, palm oil, tea and banana plantations are generally managed through contract farming by transnational corporations and in certain cases by state run agencies. In the United States, 90% of chicken farms and 20% of pig farms were integrated into agro-industrial conglomerates in 1994 [15]. In India, contract farming is also fast developing. One instant is the Kuppam project initiated in 1997 by an Indian Corporation (M/S BHC Agro) with support from the Govt. of Andhra Pradesh. Export crops such as potatoes, gerkhins and chillies are grown using expensive imported Israeli technologies for dry land farming. The land is leased from small and medium farmers who are offered work as laborers on the consolidated holding managed by the company [15]. Contract farming is popular across the country and corporate are forging alliances with state governments for contract farming. For instance HLL's joint venture project with the Madhya Pradesh government to grow wheat. The project was started three years ago to cultivate wheat in 250 acres. The area has now been increased to almost 15,000 acres. It is the aggressive policies of some state governments that are encouraging private sector investment in contract farming. States like Punjab and Uttar Pradesh are amending the rules to promote contract farming. Uttar Pradesh government has recently amended the Agriculture Produce Marketing Committees' (APMC) rule what said that the entire farm produce has to be kept with mandis. Because of this amendment, corporate can now directly procure goods from farmers. Punjab has also amended a similar rule.

**3.2.2.3 Private Sector Initiatives - Contract farming** The Government of India's National Agriculture Policy envisages that *Private sector participation will be promoted through contract farming and land leasing arrangements to allow accelerated technology transfer, capital inflow and assured market for crop production, especially for oilseeds, cotton and horticultural crops*. There are several initiatives under this scheme. Over here we mention two of them. Hindustan Lever Ltd (HLL), Rallis and ICICI formed an alliance with the farmers. Under this alliance, Rallis supplies agri-inputs and know-how, and ICICI finances (farm credit) the farmers. HLL, the processing company, which requires the farm produce as raw material for its food processing industry, provides the buyback arrangement for

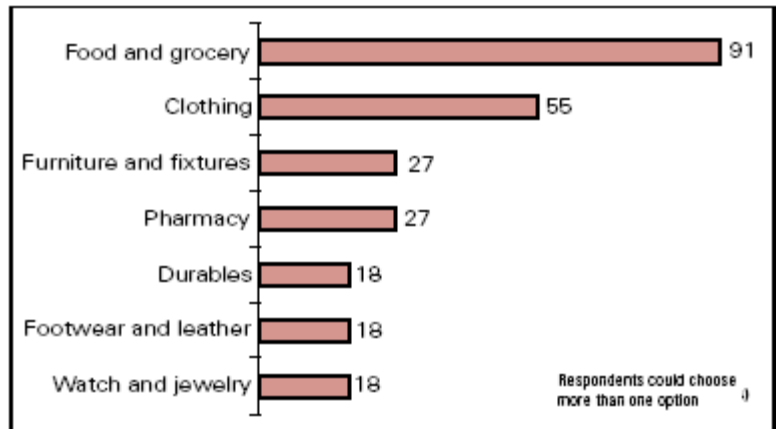
<sup>3</sup>Agri-export zones potential yet to be fully tapped, cited in *Business Line* by G. Srinivasan, New Delhi, Nov. 30, 2003

the farm output. In this arrangement, farmers benefit through the assured market for their produce in addition to timely, adequate and quality input supply including free technical know-how; HLL benefits through supply-chain efficiency; while Rallis and ICICI benefit through assured clientele for their products and services. Launching its agro-business in India with special focus on exports of value-added processed foods, Pepsi Foods Ltd. (PepsiCo hereafter) entered India in 1989 by installing a Rs 22 crore state-of-the-art tomato processing plant at Zahura in Hoshiarpur district of Punjab. The PepsiCo model of contract farming, measured in terms of new options for farmers, productivity increases, and the introduction of modern technology, has been an unparalleled success. The company focused on developing region and desired produce-specific research, and extensive extension services. It was thus successful in bringing about a drastic change in Punjab farmers production system towards its objective of ensuring supply of right produce at the right time in required quantities to its processing plant [16]. Several thousands of alliances as above are needed in all the states to reap the benefits of huge natural resource base and India's agri business potential.

### 3.2.3 Organized Retailing in Urban India

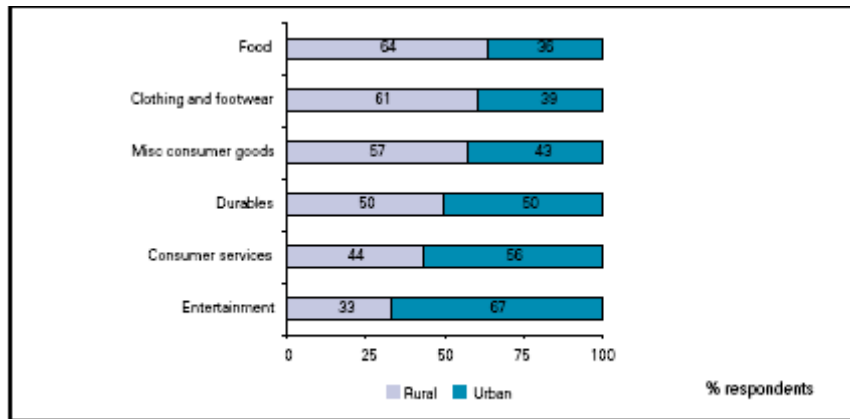
Industry conglomerates such as Reliance are proposing to invest heavily in retailing and are seeking avenues to establish and expand as they prepare to take retailing in India by storm. Over the next few years, Indian retailing is expected to expand at a constant value CAGR of 6%, approaching Rs 5 trillion by 2010. Estimates of the size of the retail sector vary, with recent calculations putting the annual value of Indian retailing anywhere between US\$180 billion and US\$292 billion in 2003. Expanding at 8% in current value terms over 2004, retailing took a big leap forward in 2005. This was due to strong GDP growth and a stable economic climate that fuelled consumer optimism. Ascending consumer disposable incomes backed by low interest rates and higher ownership of credit cards allowed for inflated spending within key consumer groups in urban and rural India. Demographics continued to show a positive skew to spur retailing growth. Consumers aged 20-45 years is emerging as the fastest growing consumer group and the mean age of Indians is now pegged at 27, a mean age that reinforces spending across all the retailing channels of grocery, non-grocery and non-store. The AC Nielsen Online Omnibus Survey 2005 rates India in the highest category of Aspiration Index in Asia, along with China, Indonesia and Thailand.

The existing Indian retail sector is largely made up of the unorganized sector. This sector consists of small family-owned stores, located in residential areas, with a shop floor of less than 500 square feet. At present the organized sector accounts for only 2 to 4 percent of the total market although this is expected to rise by 20-25% by 2010. Many of the companies believe that the potential size of this market is underestimated. They consider that there are considerable opportunities for organized retailers in rural territories that need to be addressed. Companies expect retail growth in the coming five years to be surpassing the GDP growth. The structure of retailing is also developing rapidly. Shopping malls are becoming increasingly common in large cities. The number of department stores is growing much faster than overall retail, at an annual rate of 24 percent. Supermarkets have been taking an increasing share of general food and grocery. Several builders have announced plans for at least 150 new shopping malls by 2008. Grocery retailers continued to be the staple of retailing in 2005, accounting for 3/4 of overall retailing value sales as shown in Figure 3.1. There was a moderate growth of 7% in current value terms for grocery retailers in 2005 over the previous year.



Source: KPMG in India Retail Survey 2005

Fig. 3.1 Fastest growing retail segments in India



Source: NSSO 5th round; KPMG in India Analysis 2005

Fig. 3.2 Share of urban versus rural markets

### 3.2.4 Rural Retailing

The higher income group in rural India is growing at a phenomenal rate, and the concept of brands and quality are very much prevalent. These current consumption trends provide compelling opportunities for marketers to capitalize on the increasing mass market in India for almost all product categories. Both corporations and entrepreneurs are exploring the rural retailing. ITC's Choupal Sagar, HLL's project Shakthi and Mahamaza are some of the models that are being tried out. Many more such concepts are likely to be tested in the future. The case for Indian retailers to explore rural markets is strong. Given the size of the rural population and the agricultural income growth in rural India, the rural market is definitely an opportunity for retailers with an innovative retail proposition. A clear indicator of this potential is the share of the rural market across most categories of consumption as shown in Figure 3.2.

### 3.3 Food and Retail in Andhra Pradesh

Andhra Pradesh is considered as the *ice bowl of India*. It accounts for about 8% of the countrys net sown area and around 7% of the countrys food-grain production. The State produces various fruits accounting for 29% of the countrys mango production, 25% of citrus, 12% of pineapple, 88 of grape and 7% of Banana and Guava. Agriculture contributes 12.9% of the State GDP and employs 62% of the total workforce [17]. The Vision 2020 document anticipates that by 2020, Andhra Pradesh will have a thriving horticulture sector and will be the countrys leading supplier of fruits and vegetables to both domestic and international markets. Horticulture is expected to account for 10-15% of the States GDP and contribute convincingly to higher per capita agricultural incomes<sup>4</sup> Horticulture crops cover a wide variety of fruits, vegetables, tuber crops, mushrooms, floricultural, medicinal and aromatic plants, plantation crops, spices. They provide a remunerative means for diversification of land use for improving the productivity and returns and also provide raw materials for agro-processing industries. The state is identified as *Horticultural Bowl of India*. The strategy for achieving this growth in horticulture is through private sector investment in infrastructure and food processing. It also includes strengthening of the fresh produce value chain through farmer co-operatives and the provision of institutional support. This includes the establishment of AEZs [18].

#### 3.3.1 Food Processing Industry in Andhra Pradesh

Andhra Pradesh is the second biggest contributor (10% to the net value added in ood industries and beverages in the country and first among south Indian states [19]. The state witnessed high growth rate in food processing industries in the 1980s than that in the all-India level and maintained the same rate in the 1990s. The growth rate in the net value added increased marginally from 8.98% during 1981-82 to 1990-91 to 9.01% during 1991-92 to 1999-2000 [20]. So far Rs. 1210 crores have been invested in 5350 factories in organized food processing. The agro-based industry in Andhra Pradesh employs around 65 percent of its total population. The state produced 14.9 MMT of food grains in 2004-2005. Production of oilseeds and cotton stood at 2.6 MMT and 2.74 million bales of 170 kg respectively. There is a large potential for production of a variety of processed products from the various agricultural produce such as rice, mangoes, orange, oil palm, chillies, turmeric that are grown in the state. It contributes 20-30% to the total seafood exports in the country. Less than two per cent of meat is converted to processed product in spite of having second largest livestock of buffaloes and sheep in the country. Andhra Pradesh ranks first in poultry, second in sheep and goat, and fourth in bovine population in the country. It is the countrys largest egg and poultry meat producer. It contributes about a third of countrys egg and about one fifth of broiler meat production<sup>5</sup>. The state is annually producing 69000 M.Ts.of Beef, 48,000 M.Ts, of Mutton, 1,30,000 of M.Ts. of poultry meat and 12,000 Million eggs. It is having high potential for export of meat, eggs and chicken. The state is also encouraging large players in poultry and meat sector to achieve annual growth rate of 6% in egg production, 10% in broiler production and 2.5% in meat production for next 20 years. Dairy has been identified as an important growth engine in the state and has tremendous potential for increasing income levels in the rural areas of the state. Enormous investment opportunities exist for creation of adequate infrastructure for

<sup>4</sup>"Food processing industry to grow by 15%," *The Hindu*, Hyderabad, Feb 20, 2005.

<sup>5</sup>Industry MonitorAndhra Pradesh (<http://www.ciionline.org>)

processed food industry including packaging. Entrepreneurs are invited to come forward for setting up cold chains, ice plants, freezing plants, processing plants, feed mills, hatcheries, setting up of fishing harbors, fishing boats, and state of art technologies in packaging industry.

The state is keen to improve the research infrastructure in the agro sector and has established several organizations. Several MNCs like Conagra and Krafts foods, have established their facilities in the state. It has about 106.03 lakh operational land holdings<sup>6</sup>. Small and marginal farmers are the major land holders and account for 81% of the holdings. The area under cultivation by small and marginal farmers is only 42%. The industries in food products contribute 19.36% to total industrial production in the state.

### 3.3.2 Public-Private Sector Initiatives in Agriculture Sector

*3.3.2.1 AEZs in Andhra Pradesh* Though agro-processing is identified as one of the growth engines in Vision 2020<sup>7</sup>, the policy support level has been slow. The Government of Andhra Pradesh (GoAP) formed five AEZs for different fruits and vegetables in line with the policy of the Government of India. But there are no major initiatives harnessing livestock potential and exports. The major activities of the AEZs are extensive pre and post harvest training programs, adoption of IPM agri-information system, setting up of processing industries, convergence of facilities available under various departments and organizations.

*3.3.2.2 Contract Farming in Andhra Pradesh* The State government encouraged contract farming in early 1990s to expand the area under oil palm. The government of India identified 4 lakh hectares of area in 10 districts of the State, as suitable for growing oil palm [21].

### 3.3.3 Opportunities for Improvement

*3.3.3.1 Grains* Grain processing is the biggest component in the organized sector sharing over 40% of the total value. To be competitive in international market, the cost of production should be reduced along with post-harvest and milling losses. Appropriate care must be taken in threshing, drying, storage and processing to reduce these losses. There is 25% post harvest loss due to bad thrashing, storage and processing practices. Rice mills give poor quality rice (15-20%) which cannot be exported. There is no incentive to modernize the process of production. Therefore it is profitable to sell to FCI than invest in mill up gradation. There is problem of double taxation (domestic & export). Permits are needed from civil supplies to move stock. There is no rail wagon allotment.

*3.3.3.2 Horticultural Crops* There are 157 fruit and vegetable processing units in the state mainly in the small and medium sector. Some of the processors are also manufacturer exporters. At present there are 21 pack houses in the state which are used for the sorting, grading and packing of grapes, pomegranates/sweet oranges, mango and vegetables. A total of 80 pack houses have been proposed by the end of 2006. The current capacity of old stores is 8,570 tonnes. This is proposed to be increased by 40,000 tonnes by adding a total of 8 cold stores across the state in 2006 [17]. Horticultural crops being perishable in nature are subject to post harvest losses. Factors

<sup>6</sup>Indian States Economy and Business, Andhra Pradesh, August 2005 (www.ibef.org)

<sup>7</sup>Vision 2020 Andhra Pradesh, Government of Andhra Pradesh, Hyderabad (1999)

**Table 3.1** AEZs in Andhra Pradesh.

S.no	Name of AEZ	Districts covered	Fruits / Products	Total estimated cost (crore Rs.)
1	AEZ Vijayawada	Krishna	Mangoes	18
2	AEZ Hyderabad	Ranga Reddy, Mahabubnagar and Medak	Grapes and Mangoes	57
3	AEZ Gherkins	Ranga Reddy, Mahabubnagar, Medak, Karimnagar, Warangal, Nalgonda and Ananthapur.	Gherkins	20
4	AEZ Chittoor	Chittoor	Mango pulp and vegetables	11
5	AEZ Chillies	Guntur	Chillies	—

Source: A.P Horticulture Department.

**Table 3.2** Contract farming: A new frontier.

Company	Crop	Area (ha)	District Covered
Sical, Godrej, Palmtech Mark fed.	Oil palm	38000	East & West Godavari
Cadburys India Ltd	Cocoa	8500	East & West Godavari
BHC Agro	Vegetables	417	Chittoor
Global Green, Capricorn Foods Ltd.,	Gherkins	3333	AEZ-Gherkins Districts
A.V.Thomas Co.	Marigold	208	Ananthapur
Dabur India	Amla (Indian Gooseberry)	417	Across State
Exim Foods Pvt. Ltd.	Baby corn	208	Around Hyderabad
Venkateshwara Hatcheries	Broiler birds	50-75 farms	Around Hyderabad

Source: A.P Horticulture Department.

like respiration, ethylene production, evaporation, temperature and relative humidity affects the keeping quality of these products. Post harvest facilities from production linking to the market and consumption points help in the reduction of losses due to wastage. There is 30% loss in post harvest (field-10%, transport & packaging-7%, storage-9%, Processing-4%). Unhygienic and manual processing of pulping is followed. There is limited export potential of the produce due to poor quality and diseases.

*3.3.3.3 Processing of Meat, Poultry and Fish* Livestock production is an integral part of farming systems in the state hence it plays a very important role in the states economy. Less than two percent of meat is converted to processed products. These are value added products (ready-to-cook, ready-to-eat and ready-to-serve) or the products that may require less time for preparation. With growing urbanization and increasing quality consciousness, the market for scientifically produced meat products is expected to grow rapidly. There is also a growing domestic demand for ready to eat and semi processed meat. The fastest growth is anticipated in case of inland fish production, and fresh water prawn production. The state has a good network of infrastructural facilities like hatcheries, feed mills and processing plants. Also in the case of domestic markets there is a good scope for value added products, ready to eat fishery items.

### 3.3.4 Initiatives by the State Government

The Government of Andhra Pradesh has established AP Invest as the proactive nodal agency, to promote Andhra Pradesh as the best Business State in the Country and thereby attract investments into the state. AP Invest is the single point of contact that facilitates investments in Andhra Pradesh and which would function along the lines of a Corporate MNC under the Chairmanship of the Chief Minister. The State has emerged as the back office to the world, and it is the preferred Investment Destination for the Global ICT Industry. BPO to KPO, Services to Application, Technology to R&D, Design to FAB, EMS to Telecom, and Animation to Gaming are the range of sectors of the global ICT industry present in Andhra Pradesh. Some of the leading names are Microsoft, Oracle, Computer Associates, IBM, Dell, Computer Sciences Corporation (CSC), GE, HSBC, Bank of America, Deloitte, Motorola, Nokia, Qualcomm, Convergys, Cypress Semiconductor, Google, Satyam, Infosys, Wipro, HCL Infosystems, Celetronix, Dataquest, Colorchips, Nipuna and a host of other companies working in different areas.

*3.3.4.1 Hardware park* The State has developed a Hardware Park at Shamshabad, 25 km from Hyderabad in an area of 5,000 acres in close proximity to the upcoming international airport. This is being developed as an integrated logistic hub with warehousing and container depots, distribution facilities, multi-modal transportation facilities, high speed direct customs clearance facilities, integrated township having housing, hotels, clubs, recreation and sports facilities, state-of-the-art infrastructure with abundance of power, water & sewerage, and with excellent road connectivity.

*3.3.4.2 The preferred investment destination* The Government of Andhra Pradesh has identified that, for the economic development of the state, aggressive steps for investment promotion would be the critical strategy. To ensure maximum returns-on-investments, the three most important needs of investors; world-class infrastructure, skilled manpower and connectivity are being pro-



vided making the state of Andhra Pradesh the preferred investment destination. There is a mega opportunity in food processing in the state.

### 3.4 Food and Retail in Punjab

Punjab has been an agriculturally rich state of India and still maintains its status as a leading food supplier for India. The economy of the state depends primarily upon agriculture. It leads the other states in terms of contribution of wheat and rice to Central Pool. The principal crops of the state are barley, wheat, paddy, maize and sugarcane. Among the fodder crops are bajra and jowar. It contributed 55.0% of wheat and 37.2% of rice to Central Pool in 2004-05 (P). Horticulture crops are currently grown over an area of 2.05 lakh hectares, which accounts for 4.8% of the net sown area. Fruit crops are sown in 0.47 lakh hectares (ha) and 1.58 lakh ha is under vegetable crops [17]. Kinnow, orange, malta, lemon, guava, pear, mango and grapes are the main fruits grown in Punjab.

#### 3.4.1 Food Processing Industry in Punjab

Punjab is a land of boundless opportunity for agro based industry, 4.2 million hectare sown area with 186% cropping intensity and 100% assured irrigation makes it the *Granary of India*. With 24.86 million tons of food grain production, 9.85 million live stock and 15.3 million poultry population, Punjab is most suitable for agri business. Livestock contributed 11.77 percent to the Gross State Domestic Product (GSDP) at constant (1993-94) prices in 2004-05(Q). The per capita availability of milk in the state was 901 grams per day in 2004-05. There are 57 milk plants and chilling centers in running condition in the state. The production of poultry eggs was 3680 million in 2004-05<sup>8</sup>. Apart from the food grains large quantity of fruits and vegetables is available for processing<sup>9</sup>. The total Geographical area of the state is 50.36 lakh hectares out of which 42.24 lakh hectares are under cultivation. The agriculture in Punjab state is highly intensive in terms of land, capital, energy, nutrients, agriculture inputs and water etc. The area under cultivation is about 85%<sup>10</sup>. Punjab has essentially an agrarian economy with a low industrial output. There are 194,000 small scale industrial units in the state in addition to 586 large and medium units. Punjab has entered the global business mainstream, with major players from around the World forming joint ventures in the field of agri-business. The state is determined to accelerate its annual industrial rate of growth. Going by the availability of raw materials and the thrust areas identified by the government, investment opportunities exist in the following areas<sup>11</sup>: processing of major and minor crops; industries based on agricultural waste/ residue (wheat/ paddy straw, paddy husk); processing of fruits and vegetables; dairy or poultry based units; meat processing; infrastructure modernization and development; export oriented units.

To encourage diversification in agriculture and to build up a climate for industrial investment by providing linkage between agriculture and industry, the Governor of Punjab provides the additional incentives to the defined Agro-Industries, under the Punjab Industrial Incentive Code

<sup>8</sup>Government of Punjab, Agriculture & Allied Sector, 2006 (<http://punjabgovt.nic.in/Economy>)

<sup>9</sup>Punjab: Land, 2000-2005 (<http://www.webindia123.com/punjab>)

<sup>10</sup>Government of Punjab, Agriculture, 2006 (<http://punjabgovt.nic.in/Economy>)

<sup>11</sup>*Indian States: Economy and Business: Punjab*, August 2005 ([www.ibef.org](http://www.ibef.org))

under the Industrial policy<sup>12</sup>. Incorporated in 1996, as a state government undertaking, Punjab Agro-Industries Corporation (PAIC) today has a strong extension service network and excellent rapport with the farmers. The corporation has an equity capital base of Rs.466.6 million and employs about 1000 people at different levels in its regional, district and corporate offices. It is the nodal agency of the state government for promotion of agro-based industries in Punjab<sup>13</sup>. PAIC is currently implementing 15 agro-industrial projects in the areas of agro products, agro-chemicals, food and horticulture at the total capital cost of about Rs.15, 000 million. PAIC has launched 21 successful projects costing about Rs.3, 500 million. The valued partners are: Pepsi Inc., USA; Food Engineering Services, USA; Dairy Tek, USA; Institut Armand-Frappier, Canada; Imporio Lader Wahren, Germany; Westfalia Separator, Germany; Schulle, Germany; Carmeltech, Israel; Chemtec, Israel; Sandvik Process System, Italy; AG Seeds, Australia; Rice Engineering, Thailand; Fletcher Challenge, New Zealand; TMCI, United Kingdom; Raisio, Finland; Dalsem Holland; Meijer, Holland; and IMV, France.

### 3.4.2 Public-Private Sector Initiatives in Agriculture sector

**3.4.2.1 AEZs in Punjab** There are three AEZs in Punjab. Among these, one AEZ focuses on *basmati rice* the other two AEZs on *vegetables* and *potatoes*. The vegetable AEZ, set up with investment of Rs. 26.77 crores, covering areas of Fatehgarh Sahib, Patiala, Sangrur, Ludhiana and Ropar, has given special emphasis on the cultivation of cabbage, broccoli, okra, peas, carrot, baby corn, green chillies, green beans and tomato. The private sector contribution in this AEZ is Rs. 14.94 crores. The potato AEZ covers districts like Singhpura, Zirakpur, Patiala and satellite centers at Rampura Phul, Muktsar, Ludhiana and Jullundur. The concept of value added agriculture development also calls for more food processing initiatives. According to APEDA, the central agency that promotes AEZs, five vegetable processing units have been set up with an investment of Rs. 33 crore in the vegetable AEZ region. With the state government providing the grant up to Rs. 5000 per product for development of packaging as per international standards, and providing 25% of the actual custom duty paid with a cap of Rs. 25 lakh, the AEZ is now in a take off stage. Plans are afoot to create a marketing hub in U.K., and Dubai. APEDA sanctioned Rs. 50 lakh for setting up of mechanized handling facility and Rs. 25 lakhs have been provided as financial assistance for setting up of cold storage for the AEZ. The AEZ for potatoes was also sanctioned during the same period. Around 100 MT of table variety potato worth Rs. 15 lakhs have already been exported from the zone<sup>14</sup>.

**3.4.2.2 Contract Farming in Punjab** Punjab, with its amended Agricultural Produce Marketing Act, is fast turning into a hot choice for contract farming. Pepsi, the multinational soft drink major, had a successful contract farming story in tomato. Basmati, which had almost vanished from Punjab due to un-remunerative prices, is now being grown abundantly in the state, mostly due to contract farming. Several corporate including Hindustan Lever (HLL), the UB group of Vijay Mallya, PepsiCo and Escorts are increasingly becoming involved in the contract farming of agri-products. Ahmedabad-based textile major Arvind Mills is identifying locations to start a

<sup>12</sup>Punjab: Investment Incentives (<http://www.indiainbusiness.nic.in/indianstates/punjab>)

<sup>13</sup>Government of Punjab, Industry & Investment, 2006 (<http://punjabgovt.nic.in/Economy>)

<sup>14</sup>AEZs integral to Punjab's growth plans, May 01, 2005, New Delhi (<http://www.fnbnews.com>)

contract farming project to grow cotton<sup>15</sup>. Punjab government has signed agreements for at least five projects taking the total area under cultivation to 3,00,000 acres. These include a project to cultivate basmati rice with LT Overseas and barley with the UB group. PepsiCo is also expanding the scope of its basmati rice project in the state. While most of the projects in Punjab are at the initial stages, the UB group has already harvested 1,000 acres of barley.

### 3.4.3 Opportunities in Agri-Business

In Punjab farmers produce: 20 million tons of grains every year, 3 million tons of fresh produce every year and 30 million litres of milk every day. There are more than 115 food processing units and 16 beverage companies in the large and medium scale sector that are active in the state. The number of SSI units in food and beverage sector is known to be 9,689 and 174 respectively. Three major companies have invested US\$ 2 billion in Punjab, they are: Reliance Industries, Bharti-Rothschild, and ITC Ltd. The main focus of the agri processing industries is on: export & marketing fresh farm produce, processed foods, dairy, meats; promoting safe, hygienic, sustainable, organic farm practices; and international standards for hygiene and health. Punjab has the largest integrated network at ground level comprising of 52 Rural Business Hubs which undertake: collection and purchase of produce; distribution of agricultural inputs; domestic marketing needs of farmers families. The state aims at strong farmer relationships, disintermediation and *demand led production*. There is large scope for business and investment opportunities in agri sector, viz., processing, grading and packaging; handling system; cold chain and logistics; largest food retailing network; massive export drive; productivity focus in F&V, dairy, coarse grains; farm inputs & mechanization; credit & insurance risk management; and facilitating the creation of *Common Indian Market*<sup>16</sup>. The government of Punjab has sanctioned a number of projects in food processing industry. These projects deal with integrated poultry processing; frozen ready to serve fruit and vegetable product; milk processing for manufacture of butter, ghee and lactose; integrated rice, wheat and potato processing; processing of tomatoes and chillies; etc. The Punjab State Industrial Development Corporation Limited (PSIDC) also has many projects, viz., processing of fresh fruit and vegetables; packaged fruit juices; dehydrated vegetables; grain based distillery; packaged sterilized flavoured milk; etc<sup>17</sup>. Reliance is planning for a mega foray into the farm and dairy sector to strengthen its food retailing arm and Mr. Mukesh Ambani's interest in Punjab hints at substantial investments in the state for the development in creating organized base for agriculture and milk produce. Having identified Punjab as a key state in its mega retail business plan, Reliance Industries has signed a memorandum of understanding with the state government for investing Rs 500 crore (Rs 5 billion) in agriculture projects. While the corporate leader would commit an initial investment of Rs 500 crore, the state government is expected to grant a package of concessions for setting up the mega agri projects and retail business expeditiously. As part of the project, Reliance Industries Ltd. would undertake to complete the roll out by 2012 in Punjab, envisaging forward linkages to encourage demand driven farm production and setting up of captive farms, organic farms, greenhouses along with development of infrastructure for supply chain<sup>18</sup>. Fast-food retailer McDonald's, for instance, has invested over US\$ 175 million (Rs 800 crore) in building its back

<sup>15</sup> *Agribusiness on the Rise in India*, in Economic Times by M. Sabarinath (<http://www.freeindiamedia.com/agriculture>)

<sup>16</sup> National Association of Manufacturers meeting on June 7, 2006 at Washington DC, Government of Punjab Delegation.

<sup>17</sup> Punjab-Opportunities in Agribusiness (<http://www.indiainbusiness.nic.in>)

<sup>18</sup> *RIL to invest Rs 500cr in Punjab*, July 31, 2006 (<http://www.rediff.com>)

end logistics which has helped every one in the chain to grow and set benchmarks in farming, processing, distribution and retail<sup>19</sup>. A mega food park is planned to be set up in Punjab, with an investment of 100 million USD. A MoU has already been signed between the Confederation of Italian Food Processors and ASSOCHAM (The Associated Chambers of Commerce and Industry of India), for developing this park. The food park will process food based on European Union standards (penne, pastas, tortillas (from corn), besides cookies, so that 50 per cent of the food is bought back by the European Union<sup>20</sup>.

*3.4.3.1 Agriculture Supply Chain* Several studies have indicated that the introduction of green revolution technology since the mid sixties to meet domestic food shortages amplified the role of regulated markets -being pulled out from wheat / atta (whole wheat flour) distribution to wheat procurement in the major wheat producing states, Punjab being one of these. This brought into existence dual market structures for wheat procurement in the state. Punjab State Mandi Board regulated the wholesale food grain markets. Due to the availability of assured markets for wheat disposal, farmers shifted the area under wheat cultivation from the alternative crops during the rabi (winter) season. Coupled with the availability of technology as it led to a fabulous increase in the market supplies, public sector has emerged as a market leader for the procurement of this primary product. It is distributed primarily through a network of fair price shops for the public distribution system in the deficit areas of the country [22]. As regards fruits and vegetables, the overwhelming problem is one of lack of modern cold storage facilities in the state where farmers can store produce and market the same when the prices are favorable. Investment in food processing industry on the part of the private sector is being encouraged, which would also help farmers of fruits and vegetables through backward linkages of such investments. The state amended its Agriculture Produce Market Act to enable the private sector to set up such markets. It needs to be liberally supported from the Horticulture Mission Fund for this purpose<sup>21</sup>. Punjab Agro has been instrumental in introducing post harvest management technologies for increasing shelf-life and transportability of perishable horticultural crops such as kinnows, grapes, exotic flowers by creating grading and waxing facilities, pre-cooling centers, refrigerated vans, flower auction house etc. Avenues are being explored for export of fresh fruits, vegetables and flowers, and some success has already been achieved in this direction<sup>22</sup>.

*3.4.3.2 Marketing and storage facilities* Marketing and storage facilities are crucial components of post harvest technology. As on 31st March, 2005 there were 144 regulated markets and 519 sub yards in Punjab. The average number of villages and area served per market was 86 and 350 sq. kms. in 2004-05. The total storage capacity for foodgrains decreased from 273.66 lakh tonnes in 2003-04 to 223.84 lakh tonnes in 2004-05 which comprises of 147.13 lakh tonnes of covered and 76.71 lakh tonnes of open capacity.

*3.4.3.3 Post harvest infrastructure* To strengthen the post harvest infrastructure to meet the present level of production as well as the anticipated increase in production volumes, quality at the con-

<sup>19</sup>*Retailing in Punjab: 2010 and Beyond* ([www.imagesfashion.com/punjab](http://www.imagesfashion.com/punjab))

<sup>20</sup>Government of Punjab, 2006 (<http://punjabgovt.nic.in/Economy>)

<sup>21</sup>Government of Punjab, June 2005 (<http://planningcommission.nic.in>)

<sup>22</sup>Government of Punjab, Industry & Investment, 2006 (<http://punjabgovt.nic.in/Economy>)

sumer level can be increased with appropriate post harvest infrastructural facilities [17]. Therefore, the national horticulture mission plan envisages functional infrastructure like:

- *Collection Centers:* Nine collection centres, three in each identified district is proposed under the plan. The collection centre will consist of mechanical sorting, grading and packing line. The estimated cost for each unit is 15.00 lakh and the proposed assistance is credit linked back ended subsidy at 25% of the capital cost of the project in general areas and 33.33% in case of hilly and tribal area.
- *Multi Product Processing Unit* One multi product processing unit is proposed to be set up in Abohar (Firozpur) for processing of fruits viz ., citrus and guava. The unit will be an integrated facility which will be basically for citrus, guava and tomato.
- *Cold Storage* Two cold storage facilities are proposed to be set up, one in Hoshiarpur and the other one in Firozpur for storage of citrus under controlled condition. The estimated cost of this storage is Rs. 2.00 crore per unit and the assistance is credit linked back ended subsidy at 25% of the capital cost of the project in general areas and 33.33% in case of hilly tribal areas.
- *Rural/Apni Mandi* The present haats or weekly bazaars which constitute first contact point with commercial circuits for the producers do not provide even the most basic of amenities and facilities such as shelter, water, electricity, roads etc. Bringing about an improvement in market facilities at rural level has a direct impact on farmers income. Once developed the rural markets provide improved services for buyers and create an element of market security for the growers. Haats need to be provided with mobile banks on haat days by Gramin Banks.

#### 3.4.4 Retailing in Punjab

With the highest per capita income in the country, that is nearly three-and-a-half times the all-India average, an excellent infrastructure to promote new industries and support the existing ones, coupled with high percentage of employment, Punjab stands second to none in fast becoming a favored destination for the retail industry. This state provides a grand opportunity to all the retailers at large to exploit its huge consumption potential. Punjab will possibly be the largest gainer in the process of retail revolution in the country. It ranks first in average per hectare yield of rice, wheat and cotton in the country. Punjab has earned the rare distinction of being called the food basket of the whole country. The state produces 1% of rice, 2% of wheat and 2% of cotton of the world. Thus, there is a clear opportunity in Punjab in the foods and beverages category, but more importantly, and strategically, retailers can effectively utilize Punjab as their major sourcing hub for their nationwide chain of stores in the food and grocery sector. Unlike other states, growth of consumption in Punjab gets equal support from the urban as well as rural consumers and this unique feature indicates an immense potential for organized retail, as the choice for *Location* is not really a constraint here. Thus, it is the second tier cities and semi-urban and rural towns of Punjab that represent a goldmine of opportunity for the retailers. The big cities of Ludhiana, Jalandhar, Chandigarh, Amritsar, Patiala and Mohali also provide ample opportunity for growth. As large retailers, Indian or global, get into food retailing business there will be huge investments in supply chain logistics, processing, cold chains and contract farming in this state. Reliance is planning for a mega foray into the farm and dairy sector to strengthen its food retailing arm and

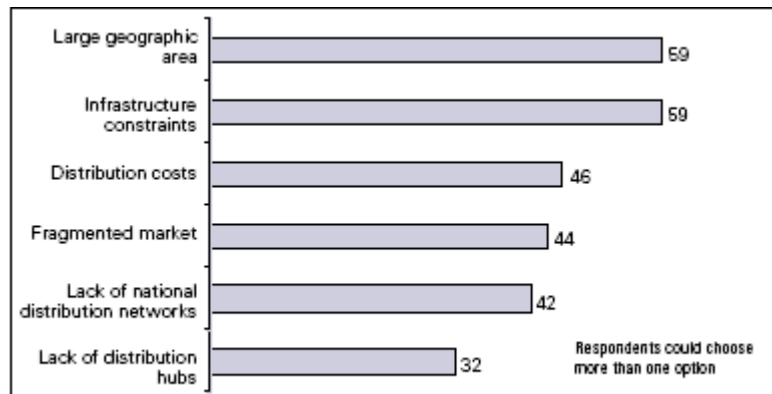


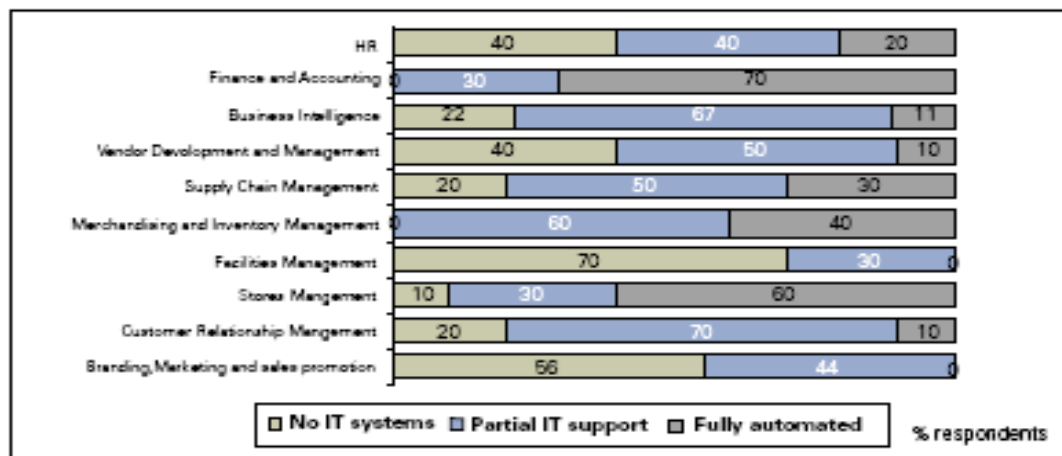
Fig. 3.3 Key challenges in Indian retail market

creating organized base for agriculture and milk produce. Corporate houses like the *Piramals*, *Tatas*, *Rahejas*, *ITC*, *Godrej*, *S Kumar's*, *RPG Enterprises*, and *The Future Group* (formerly *PRIL*) with their mega retail chains *Crosswords*, *Shopper's Stop*, *Pantaloon*, *Piramyd* etc have already announced major plans to liven up the retail sector in Punjab. Fast-food retailer *McDonald's*, for instance, has invested over US\$ 175 million (Rs 800 crore) in building its back end logistics and set benchmarks in farming, processing, distribution and retail. Once the systems are in place and the global players build confidence they would be inclined to source from India for the international markets as well.

### 3.5 Conclusion

The supply chain that connects the vast natural resources and the farmers to both the organized as well as the unorganized retail is highly inefficient with several intermediaries and manual handling. The result is lots of wastage as much as 30% and also less remuneration for the farmers. There is no supply chain integrator or channel master for Indian retail channels. The plentiful fertile natural resources are under utilized or not efficiently utilized. Agriculture has been a part of Indian rural life for a long time and it has not changed its face over the decades. There is little attention for value added agriculture in the whole country. Research on improving the farm productivity, pre-harvesting, post-harvest methodologies, processed food product development, packaging, distribution, transport, cold chain, store management, warehouse management and the entire supply chain management are very much neglected both by the central and state governments and also by the corporate.

The two surveys by KPMG last year (2005) (see Figure 3.3 and 7.9) substantiate the above statements. In addition the survey also points out supplier selection not being strategic and about limited use of IT in retail. Retail Enterprise Resource Planning Systems (ERP) and Warehouse Management Systems (WMS) are unable to track assets beyond the boundaries of the retail supply chain into the supplier base, and at times even into the retail store. This can cause a significant surplus of asset inventory leading to excessive capital expenditure or lease, rental and demurrage costs. To the other extreme, lack of visibility may also cause critical local shortages that impact both store and distribution center deliveries, and may even cause out-of-stock at individual stores.



Source: KPMG in India Retail Survey 2005

Fig. 3.4 Level of IT usage among Indian retailers

Along with these concerns, excessive costs are incurred with an increase in transportation, demurrage and lease costs, as well as an over dependence on error-ridden, labor intensive practices.

The Indian Food and Retail story has lots of future and everything points in its favorable growth. There is lot of scope for foreign investment in all aspects of food and retail. No day passes without the announcement by one of the corporate houses, such as Reliance regarding investment of *Thousands of Crores of Rupees* in retail. Reliance has announced investments in farm to plate infrastructure in the Indian States of Punjab, Gujarat and West Bengal. Reliance is also acquiring shopping cooperatives super bazaar, Sahakari bhadar etc. The retail giants such as Pantaloons, Food world, Trinetra have all announced big expansion plans. The structure of retailing is also developing rapidly. Shopping malls are becoming increasingly common in large cities. The number of department stores is growing much faster than overall retail, at an annual rate of 24%. Supermarkets have been taking an increasing share of general food and grocery. Several builders have announced plans for development of 150 new shopping malls by 2008. National real estate developers such as Rahejas, Omaxe, Ansals, Uni-Tech, Parasnath, Vatika, Vipul Infrastructure and DLF are also undertaking key retail developments. The countrys middle class has been expanding due to rapid urbanization, increasing per capita income, increased participation of women in the urban work force and globalization. Although decreasing with rapid urbanization, food is still a major spend in the Indian house holds. While conclusive evidence to identify the winning rural retailing model is not yet available, experiments such as ITC's Choupal Sagar, HLL's project Shakthi and Mahamaza are steps in the right direction. Rural retailing is witnessing explorations by both corporations and entrepreneurs through these experiments.

The Indian retail story as we mentioned in this paper is real and provides innumerable number of opportunities for high value investment as it unfolds. It can be seen easily that Indian states offer huge investment opportunities in the food supply chain area. The opportunities present themselves in a variety of ways: asset intensive malls and warehouses construction; cold chain transportation infrastructure; post harvest agriculture practices for preservation of quality and increasing the shelf life; retail logistics of home delivery; planning and execution of software and also hardware that induces efficient operation into the supply chain. These are some of the obvious

activities for collaboration. There are several others such as training, financing, development of standards etc. where there could be collaborative ventures between Indian and Foreign companies.

## References

1. *Consumer markets in India-The next big thing*, KPMG Report (2005).
2. Deshingkar Priya, Usha Kulkarni, Laxman Rao, and Sreenivas Rao, "Changing Food Systems in India: Resource Sharing and Marketing Arrangements for Vegatable Production in Andhra Pradesh," *Development Policy Review*, 21:627, (September 2003).
3. *Creating Wealth From Farm Gate to Food Plate*, Bombay Chamber of Commerce and Industry.
4. V. M. Rao, "Farmers in Market Economy: Would Farmers Gain Through Liberalisation?," *Indian Journal of Agricultural Economics*, 49(3): 393-402, (July-September 1994).
5. S. S. Acharya, "Agriculture-Industry Linkages, Public Policy and Some Areas of Concern," *Agricultural Economics Research Review*, 10(2):162-75 (1997).
6. B. K. Dileep, R. K. Grover, and K. N. Rai, "Contract Farming in Tomato: An Economic Analysis," *Indian Journal of Agricultural Economics*, 57(2):197-210, (April-June 2002).
7. U. K. Srivastava, "Agro-Processing Industries: Potential, Constraints and Task Ahead," *Indian Journal of Agricultural Economics*, 44(3), (July-September 1989).
8. B. M. Desai and N. V. Namboodiri, "Development of Food-Processing Industries," *Economic and Political Weekly*, 26:A38-42, (March 1992).
9. *Position Paper on Indian Food Processing Industry*, The Associated Chambers of Commerce and Industry.
10. World Bank, *Unlocking Andhra Pradesh's Growth Potential: An Agenda to Achieve the Vision 2020 Growth Targets*, Poverty Reduction and Economic Management Sector Unit, South Asia Region (2003).
11. Prabhu Pingali and Yasmeen Khwaja, "Globalisation of Indian Diets and the Transformation of Food Supply Systems," Inaugural Keynote Address, *17th Annual Conference of the Indian Society of Agricultural marketing*, February 5-6, Hyderabad (2004) ([www.fao.org/es/esa](http://www.fao.org/es/esa)).
12. Mahendra S Dev and N Chandrasekhara Rao, "Food Processing and Contract Farming in Andhra Pradesh: A Small Farmer Perspective," *Economic and Political Weekly*, XL(26), June (2005).
13. N. Viswanadham, *Cold Chain Management: India-Singapore Initiative*, Institute of South Asian Studies, Singapore (2005).
14. *Living Under Contract*, Edited by Peter D. Little and Michael J. Watts. Madison: University of Wisconsin Press (1994). xviii, 298 pp. (<http://dizzy.library.arizona.edu>).
15. Carine Pionetti, *Sowing Autonomy: Gender and Seed Politics in Semi-arid India*, (<http://www.ied.org>).



16. "Contract Farming Ventures in India: A Few Successful Cases," *Spice*, National Institute of Agricultural Extension Management (MANAGE), Hyderabad, 1(4): (March 2003).
17. *National Horticulture Mission: Action Plan for Andhra Pradesh*, Prepared by Rabo India Finance Pvt. Ltd for Ministry of Agriculture Government of India (September 2005).
18. *Goal 1 Promoting Opportunities: State government promotes employment in horticulture, India*, IDRC Books, Canada (<http://www.idrc.ca>).
19. Mathew Joseph, "Performance of the Southern States: A Comparative Study," *Economic and Political Weekly*, 38(37): 3915-3930 (September 2003).
20. Mahendra S Dev and N Chandrasekhara Rao, *Food Processing in Andhra Pradesh: Opportunities and Challenges*, Centre for Economic and Social Studies, Hyderabad (2004).
21. A. R. Sukumar, Status Paper on Oil Palm Development in Andhra Pradesh in P Rethinam and K Suresh (eds), *Oil Palm Research and Development*, National Research Centre for Oil Palm, Pedavegi, West Godavari District, Andhra Pradesh (1999).
22. Veena Goel, *Motives and Concerns in Supply Chain Management for Wheat Industry in India*. (<http://www.runetwork.de>) (2006).



# 4 Impact of Avian Influenza in the Indian Poultry Industry

*A Supply Chain Risk Perspective*

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## 4.1 Introduction

The out break of *avian flu* in Navapur, Jalgaon in Maharastra and Ichapur in Madhya Pradesh, India sent panic waves amongst all poultry farmers and consumers all over the country. This has resulted in losses to the tune of over INR 2200 crores to the Indian poultry industry. The potential of avian flu to turn into a pandemic is very high and it is very important that companies focus on building more resilient supply chains to prepare for the outbreak. The first step towards achieving this is to realize that the avian flu is more than a health care issue, it could harm the global economic system dramatically. In this paper, we study the impact of the avian flu outbreak in India on entire poultry supply chain from a supply chain risk perspective. This study is an attempt to understand the ramifications of a catastrophic flu pandemic on the entire supply chain by studying the risks associated with each players of the Poultry Supply Chain . We identify risks associated with each player in the supply chain and classify them in the supply chain risk framework . In July 2006, the IMF organized a seminar on *Preparedness within the Financial Sector for an Avian Influenza Pandemic*, where the Deputy governor of the Reserve Bank of India, Mr. Rakesh Mohan , in his introductory remarks stressed the need for proper coordination to arrive at a realistic estimate of the potential risk of the pandemic , align various measures within the financial sector with the alert system of health authorities, and collaboration not only in terms of financial support but also information sharing and exchange of ideas on various emerging issues relating to economic and financial system. Our study support his remarks. The paper is organized as follows. Section 4.2 reviews literature from supply risk chain risk management as well as on the impact of avian influenza across countries. In section 4.3 we give a background to avian influenza , discuss the WHO threats and economic impacts of the disease. In section 4.4, we give a brief introduction to mitigation strategies used in supply chains and examples of how countries/companies responded to disruptions in the past. In section 4.5, we illustrate the Poultry Supply Chain in India by giving an overview of the Indian poultry industry. The structure of a Poultry Supply Chain is that of a closely networked business where mutual trust between players

of the network is a mitigation strategy to risks faced by the players. We analyze the risks faced in the Poultry Supply Chain by mapping it to a 'risk-trust hierarchy framework', a framework used to analyze risks that arise in networked business environments in section 4.6. We conclude with our recommendations and directions for further research in section 4.7.

## 4.2 Literature Review

The issue of supply chain risk and vulnerability of supply chains in event of disruptions have been a topic for research and discussion in the recent years. The foot and Mouth disease in the UK, by the 9/11 terrorist attack in the US have forced managers to rethink their strategies while designing supply chains. The supply chain risk management in most places is still in its infancy with a lot more that needs to be done in this area. In this paper we analyze the impact of "bird flu" on the Poultry Supply Chain. Though there have been quite a few papers that followed analysis of the "bird flu" in other countries, there have been negligible studies from a supply chain perspective. A recent article by Tony Friscia(2006) states that "avian influenza" is a significant global supply chain issue and emphasizes that firms need contingency plans to mitigate risk in the event of an outbreak. They refer to a case study of grocery chain Alex Lee's analysis of a pandemic's potential impact on its business and a detailed readiness plan. In this section, we first review existing literature in the area of designing robust and resilient supply chains and then we present a review on existing studies on outbreak of avian influenza. The modest aim of this report is to identify the inefficiencies that exist in the poultry supply chain in India. We answer some questions by proposing measures to overcome the inefficiencies, while other questions could be used for further research in supply chain risk management.

### 4.2.1 Review from Supply Chain Risk Management

Mitroff and Alpasan(2003) state that it is impossible to plan for crises which one cannot imagine. However, they acknowledge that one can develop tools which can help managers mitigate eventualities. They provide with strategic tools to help identify causes and a firm's preparedness towards disruptive events. In a similar vein Christopher and Lee(2004) draw upon different disruption instances and illustrate the irrational decisions made by supply chain partners creating inefficiencies across supply chains. Juttner et. Al (2003) give an exhaustive literature review of the papers related to supply chain risk management and outline an agenda for research in supply chain risk management. Chopra and Sodhi(2004) discuss several supply risks that a manager must account for when planning suitable mitigation strategies. Gaonkar and Viswanadham(2003) provide with a classification of supply chain risk problems and risk management approaches. They also construct cause-consequence diagrams to analyze impact of a particular failure on the entire system. Chapman et al. (2002) discuss how to identify and manage supply chain vulnerabilities. They list out sources of disruptions and discuss about the impact of them. They emphasize on the importance of research methodology to be developed in this area and identified managerial awareness of risk as a key issue. Helferich and Cook (2002), and Peck and Juttner (2002) discuss how to identify and manage supply chain vulnerabilities. The Cranfield University report (2002) comments on the heavy reliance of corporate supply chains on public transportation, utilities, and communications infrastructures. Sheffi (2001) examines how companies can organize supply chain operations to meet challenges of operating under increased security regimes and terrorist threats.

Sheffi describes the adverse consequences of the 9/11 terrorist attack on supply chains. He has provided with some suggestions on how to deal with issues of increases security and operational efficiencies. Although it appears as a comprehensive review, it misses out on the framework one needs to analyze supply chain disruptions. A white paper by Cambridge technology partners in 2001, CTP(2001) explores the symbiotic relationship that exists between risk and trust. They develop a *risk -trust hierarchy* framework. We use this framework to analyze risks we find in the Poultry Supply Chain.

#### 4.2.2 Studies on "Bird Flu"

Rushton et al(2004) study the impact of avian influenza outbreaks in the poultry sectors of five south east Asian countries. They have intensively studied the nature of the poultry sectors in each of the countries, and have documented the losses across the poultry chain and the general economy. WHO in its report, has given recommendations to respond to the avian influenza threat. Martin(2006) has outlined business contingency plans to manage bird flu . The directorate general of health services, India has outlined its contingency plans in their report in 2005. There has been a case study CABIC(1998) highlighting the role of media in communication of crisis.

#### 4.2.3 Studies on the Indian Poultry Sector

A study by Neeta Ramnath, Rabobank (2003) gives outlook for the poultry sector where the authors give the structure of the poultry industry and highlight the key issues in the Poultry Supply Chain . Shibalee Majumdar discusses about the policy environment for development of poultry sector in India and does a SWOT Analysis of the poultry sector also. In their document, 2020 Vision for Indian Poultry Industry, Mohanty and Rajendran(2003) highlight key issues in the poultry industry in India and also discuss infrastructure guidelines They further recommend revision of poultry insurance schemes to address the needs of the farmer and emphasize on quality and hygiene aspects.

### 4.3 Avian Influenza: Background and Analysis

Influenza can be divided into three categories: a) *Ordinary influenza* which circulates constantly in the human population, b) *Avian influenza* is a disease of birds, caused by strains of the virus that are endemic in wild birds, and which do not normally infect man, though they periodically cause destructive epidemics among poultry and c) *pandemic influenza* in humans, so called because of its global spread, typically expect to infect around a quarter of the world's population within the space of a few months. Pandemics occur on average around three times a century, when a strain of avian influenza acquires the ability to infect and pass efficiently between humans. Since there is no immunity the disease spreads rapidly with high mortality rates.

Transmission of the H5N1 virus can happen in four different ways: a) Bird to Bird, b) Bird to Animals, c) Bird to Humans and d) Human to Human. Domesticated birds may become infected with avian influenza virus through direct contact with infected waterfowl or other infected poultry, or through contact with surfaces (such as dirt or cages) or materials (such as water or Feed) that have been contaminated with virus. Avian influenza viruses circulate among birds worldwide. Certain birds, particularly water birds, act as hosts for influenza viruses by carrying the virus in



Fig. 4.1 Outbreak of Avian Influenza in Different Countries. Source: FAO/WHO

their intestines and shedding it. Infected birds shed virus in saliva, nasal secretions, and feces. Susceptible birds can become infected with avian influenza virus when they have contact with contaminated nasal, respiratory, or fecal material from infected birds. Avian influenza viruses may be transmitted from animals to humans in two main ways a) directly from birds or from avian virus-contaminated environments to people or b) through an intermediate host, such as a pig.

Avian influenza virus H5N1 first infected human beings in 1997, in Hong Kong, killing 6 people. Countries where bird flu has infected humans are Cambodia, Vietnam, China Thailand, Indonesia and Malaysia. According to a recent WHO report, the number of human cases of bird flu reported so far is 225 with 128 deaths. Nature of influenza virus vaccines effective against a pandemic virus are not yet available particularly as vaccine composition changes each year to match changes in circulating virus due to antigenic drift. The outbreak map is given in Figure 4.1

#### 4.3.1 Threat of a pandemic

Since late 2003, the world has moved closer to a pandemic than at any time since 1968, when the last pandemic occurred. Countries where bird flu has infected humans are Cambodia, Vietnam, China Thailand, Indonesia and Malaysia with reported cases of bird flu being 225, out of which 128 have been fatal. All prerequisites for the start of a pandemic have been met save one: the establishment of efficient human-to-human transmission. The Ministry of Health in Iraq has confirmed the country's first case of human infection with the H5N1 avian influenza virus. The case occurred in a 15-year-old girl who died on 17 January following a severe respiratory illness. The

**Table 4.1** Six phase alerting system of WHO

Inter Pandemic Phase		
	Phase 1	Low risk of human cases
	Phase 2	Higher Risk of Human Cases
Pandemic Alert Phase		
	Phase 3	low or very limited human transmission
	Phase 4	Increased human transmission
	Phase 5	Significant human transmission
Pandemic Phase		
	Phase 6	Efficient, sustained Human transmission

girl's 39-year-old uncle, who cared for her during her illness, developed symptoms on 24 January, 2006 and died of a severe respiratory disease on 27 January 2006. Authorities in Vietnam reported the case of a 14-year old girl who was infected by her brother with a strain resistant to Oseltamivir, a generic version of the well-known Tamiflu anti-flu drug. Human cases are continuing to occur, and the virus has extended its geographical range to include new countries posing grave challenges to the health care and economies across the globe. Each new human case gives the virus an opportunity to evolve towards a fully transmissible pandemic strain. The H5N1 virus is now endemic in Asia, having established an ecological niche in poultry. Outbreaks have occurred despite aggressive control measures, including the culling of more than 140m poultry.

The World Health Organization (WHO) plays a major role in monitoring, reporting and containing the outbreak of pandemic in various parts of the world. The immediate and short-term objective is to prevent further spread of , highly pathogenic avian influenza, HPAI , in those countries that are currently infected; specific measures are tailored to the circumstances of individual countries. Inadequate capacity is the main factor limiting the eradication of HPAI; capacity-building in terms of strong and sustainable human and physical resources needs to address all aspects of disease surveillance and control, policy development and socio-economic analysis.

Country-specific projects will be formulated, under-pinned by three sub-regional, highly pathogenic, HPAI support units developing harmonized technical standards and regional policies related to live-animal movement, compensation plans, capacity building, disease reporting requirements and poultry sector restructuring.

The WHO uses a six phase pandemic alert as a system for informing the world of the seriousness of the threat and of the need to launch progressively more intense preparedness activities (see Table 4.1).

The world is presently in phase 3: a new influenza virus subtype is causing disease in humans, but is not yet spreading efficiently and sustainably among humans. For a pandemic to start three conditions need to be met: (1) A novel virus subtype must emerge to which the general population will have no or little immunity, (2) The new virus must be able to replicate in humans and cause serious illness and (3) The new virus must be efficiently transmitted from one human to another; efficient human-to-human transmission is seen as sustained chains of transmission

causing community-wide outbreaks. The first two of these conditions have been met with a novel virus (H5N1) emerging. It has infected people and animals, and has shown that it can replicate and cause serious illness. However, there is no evidence at present of efficient or sustained human-to-human transmission of the virus.

Each country responds to the threat with their own action plans and business contingency plans. The Government of India also has responded to the threat by taking adequate measures suggested by the WHO. These measures are given in Section 4.3.4

#### 4.3.2 Economic analysis

There are two main categories of economic impacts associated with outbreaks of infectious diseases such as highly pathogenic avian influenza (H5N1) in poultry and a potential human influenza pandemic: The economic consequences and costs of sickness or death resulting from the disease outbreaks; and the economic consequences and costs associated with public and private efforts to prevent the emergence or spread of the disease and to treat its effects. There are also two *levels* of potential economic costs. The economic costs of H5N1 outbreaks in Asia have been limited at the macro-economic level but very high for specific sectors and communities. The direct economic costs of the outbreaks have been estimated at more than USD10 billion. The effects of sickness and mortality on output: one main set of economic effects results from increased sickness and death among humans and their impact on the potential output of the world economy. Other long-term impacts would play out as the increased costs of preventing and treating disease reduced savings and investment. Private preventive responses to an epidemic: Another set of economic impacts would result from the uncoordinated efforts of private individuals to avoid becoming infected or to survive the results of infection. One lesson from the SARS episode is that a prompt and transparent public information policy could help reduce the economic costs of an epidemic. FAO-OIE (2005, op. cit.) elaborates policies to curb transmission among animals, including enhanced surveillance, diagnosis, bio-security measures, culling and vaccination of poultry. The cost of significantly scaling up anti-viral medicine and vaccine research and production would be a case in point. Thus careful economic analysis of different incentive schemes that could foster greater anti-viral medicine and vaccine production in efficient, cost-effective ways could make a large contribution in the effort to prevent or contain a pandemic. We refer here to Rakesh Mohan(2006). He says *"The World Bank estimates that a severe avian flu pandemic among humans could cost the global economy about 3.1 per cent of world gross domestic product, around US\$ 1.25 trillion on a world GDP of US\$ 40 trillion (World Bank, 2006)."* He briefly touched upon the risks and challenges which a severe pandemic could pose to a domestic as well as the global financial system.

#### 4.3.3 Transmission of virus in India

India's first outbreak of avian flu was confirmed on February 19, 2006 with the death of 200,000 birds in Navapur in Maharashtra's Nandurbar district. Since then, more than 3 lakh birds have been culled in Maharashtra and Gujarat in the effort to contain bird flu, and almost 6 lakh eggs destroyed. The threat surfaced again with the recent outbreak in Jalgaon, Maharashtra. India's vigilance model failed and the search for answers as to how poultry in Nandurbar and Jalgaon got affected began. Locals reported that chickens were dying in Navapur as early as January 26, 2006 but that they were buried clandestinely or, worse, sold. Bird flu was confirmed only 25 days after chickens started dying. In the absence of any grassroots awareness of bird flu, the poultry farmers





Fig. 4.2 Transmission of avian influenza virus from birds to humans

possibly mistook it for Ranikhet - a disease with similar symptoms - or covered up the deaths to protect the industry. Since more poultry deaths were reported from Navapur which mostly had commercial poultry, all attention was diverted to Navapur. It is quite possible that infection could have occurred at the same time in neighbouring Jalgaon district in western state of Maharashtra with government considering culling of 75,000 birds in four affected villages to prevent its spread. We depict the transmission of the virus in Figure 4.2.

Probable reasons for outbreak in India were attributed to a) migratory birds, b) transnational poultry industry and unhygienic factor farms, c) poultry feed, d) vaccines, e) breeders, and (f) illegal trade of caged birds. We briefly describe the potential risk each of the above factors pose below.

1. *Migratory Birds*: Some researchers blame migratory birds for the relentless spread of the bird flu virus in the "leap frog" fashion. However, the location of Navapur which rarely has any migrating birds reduces this possibility in Navapur.
2. *Transnational poultry industry*: Several studies show that transnational poultry industry, which include movement of poultry manure, as the root cause of the problem. The spread of industrial poultry production and trade networks have created ideal conditions for the emergence and transmission of lethal viruses like the H5N1 strains of bird flu. Inside factory farms viruses becomes lethal and multiply rapidly.
3. *Feed*: 10% of imported bird feed is made of meat and bone meal. This situation is very true in case of the recent outbreak of bird flu in India. Most of the poultry feed in India is from imported feed and there are no monitoring mechanisms to test feed. Import of poultry was banned two years ago, however, this does not rule out illegal import of poultry. In September 2004, Cambodian authorities noted that the source of bird flu outbreak was chicks supplied by the Thai company, Charoen Pokphand. This company dominates the feed industry and is the biggest supplier of chicks to many south east Asian countries which have witnessed an outbreak of bird flu in the recent years.

4. *Vaccines*: A newsletter of E-Pharmail said the outbreak of avian flu in Maharashtra may be due to inoculating improperly cultured vaccine (inactivated viruses) in poultry, allegedly distributed by one of the largest players in the industry. Another interesting angle to this episode is the allegations made by some industry players against the government alleging them to have created panic in order to use the "tamiflu" vaccines it had recently acquired. *"Multinational vaccine manufacturing and pharmaceutical companies, eager to sell their anti-flu drugs in India, are trying to project it as a case of bird flu,"* alleged National Egg coordination Committee (NECC) in a public notice urging both the government and the industry should strongly resist such attempts. The animal husbandry also raises concerns about illegal import of vaccines which could have been a cause.
5. *Breeders*: Perhaps it was imported poultry used for breeding purposes that brought the infection; there is one type of farmed chicken, namely breeders. These are owned by hatcheries, and lay fertilized eggs which are hatched into chicks. This could be a possible source of virus.
6. *Illegal trade in Cage Birds*: The widespread illegal trade in cage birds has transported H5N1 infected birds over large distances.

#### 4.3.4 Measures taken by Government of India

The Department of Animal Husbandry, Government of India, maintains web site <http://dahd.nic.in/birdflue.htm> to closely monitor the situation by giving weekly updates, information to media, coordinating with officials of all states about action plans. According to Minister of Agriculture, Consumer Affairs, Food and Public Distribution, "though the poultry industry had suffered heavily because of the outbreak of bird flu this year, India would be in a position to declare the country free from this disease very soon (Government of India, 2006)." Recently, the Indian Council of Agricultural Research (ICAR) has developed an indigenous vaccine for poultry against the deadly disease. Since the disease has got recurring possibility, the development of the indigenous vaccine can go a long way in tackling bird flu effectively.

The impact of avian influenza on the financial sector has been also studied. As part of measures to protect domestic poultry industry from any loss on account of avian flu, in April 2006, the Reserve Bank announced guidelines for relief measures by commercial banks and urban commercial banks, (Ref: Rakesh Mohan(2006)). Keeping in view the loss of income that occurred due to culling of birds as well as steep fall in the demand for poultry products and their prices on account of outbreak of Avian Influenza (bird flu) in some areas of the country, the Reserve Bank has asked banks to consider extending certain facilities to poultry units financed by them.

However, a gap that seems to exist has been to analyze the risks faced by the Poultry Supply Chain as a whole. In our study we analyze the risks faced by each player in the poultry supply chain and propose some mitigation strategies.

## 4.4 Supply Chain Risk Mitigation Strategies

Yossi Sheffi(2005) lists examples of how companies reacted to disruption in their supply chains. He mentions three strategies to build resilient supply chains to be (a) System wide resilience during the Anthrax scare in 2002, the USPS survived the closure of its Brentwood facility, the Trenton

facility, and other smaller facilities because of the massive overcapacity built into its system. Such redundant capacity was not the result of planning for disaster. (b) Redundant Inventory as in the case of J&J which keeps safety stock in several warehouses for use when demand for any of its products exceeds the forecast (c) Redundant capacity as the case in Boston Scientific which manufactures an array of high-tech medical devices. For these specialized products, the company uses an array of sophisticated manufacturing systems . Boston Scientific built redundant production lines for some of its most important products. These alternative manufacturing facilities are kept FDA-certified and ready to go in the event of a disruption and (d) Redundant IT systems as in the case of Merrill Lynch who could get access to all their systems within hours of the WTC attack in 2001.

In the case of a disruption like that of *bird-flu* it is unclear whether any of the known mitigating strategies would work. Hence it is imperative to study these disruptions from a new perspective and try to obtain alternate mitigation strategies. Before we analyze that we document a few of the lessons and best practices of the ways companies and countries have reacted to recent disruptions/disasters.

#### 4.4.1 Lessons from recent risk events

Here we list a few examples of how companies/countries have reacted to recent risk events.

1. SARS: The SARS outbreak happened in early 2003 with China, Hong kong and Singapore among the worst affected countries. Some of the mitigation strategies employed by companies were to
  - (a) Coping with rapid demand slumps for some and demand surges for some products- example- disinfectants, face masks, etc.
  - (b) Countries instituted travel restrictions thereby tracking movement of personnel.
  - (c) Finding the right balance between protecting and abandoning people affected.
  - (d) Improving basic health check facilities and controlling them .
2. Hurricane Katrina- Badly managed risk event
  - (a) Never ignore warnings- there were press reports which reported about the possible damage to oil facilities nearby New Orleans. These were not taken seriously
  - (b) The recovery was prolonged
  - (c) Severe supply shortages, backlogs
  - (d) Breakdown in Law and order

**4.4.1.1 Best practices** The key to preventing a pandemic are well known. They have been demonstrated both in Hong Kong in 1997, where H5N1 was effectively eradicated, and to a lesser extent in Thailand since 2003, where incidence of H5N1 in domestic poultry has been much reduced. They are:

1. Effective surveillance of bird populations, and good bio-security, including measures to separate wild and domestic birds;
2. Rapid culling of infected flocks;

### 3. Targeted vaccination of flocks to disrupt transmission cycles.

However the disadvantages faced in countries like India, China and Vietnam are that the practical barriers to such action remain formidable, particularly. The barriers include: poor veterinary infrastructure; the lack of a coordinated and efficient system of information exchange; traditional patterns of agriculture, including the huge *backyard* poultry population; and the lack of compensation arrangements for farmers, creating an incentive to send sick birds to market rather than reporting them. We look into these factors in further detail in Section 4.6.

<p><b>S</b>trengths</p> <ul style="list-style-type: none"> <li>- Improved feed technology.</li> <li>- Could see a drop in prices of feed</li> <li>- Positive role of integrators to be seen</li> <li>- Chicken sales at retail level to change- cleaner outlets</li> <li>- Ability to work on lower margins, bigger volumes narrowing the farmer-consumer gap</li> </ul>	<p><b>O</b>pportunities</p> <ul style="list-style-type: none"> <li>- Consumer awareness, perception and acceptability of eggs and chicken as healthy food.</li> <li>- Competition following lifting of import trade controls</li> <li>- Increasing use of information technology, websites, and hot news via e-mail.</li> </ul>
<p><b>W</b>eaknesses</p> <ul style="list-style-type: none"> <li>- Lower feeding stuffs prices and improved availability consequent to higher domestic production, falling exports and imports of raw materials</li> <li>- Lower bad debts and write-offs will offset higher energy and labor costs</li> <li>- Positive and negative impact of fewer but bigger operators at commercial levels</li> </ul>	<p><b>T</b>hreats</p> <ul style="list-style-type: none"> <li>- The downward trend of rate of growth of production</li> <li>- High import duty on maize imports</li> <li>- Inadequate infrastructure</li> <li>- Abolition of the quantitative restrictions</li> </ul>

Fig. 4.3 SWOT Analysis of the Poultry Supply Chain

## 4.5 Poultry Supply Chain in India

In this section we describe the Indian poultry industry and map the poultry supply chain. We list out risks at each stage of the chain with respect to bird flu.

### 4.5.1 Indian Poultry Sector

The Poultry sector in India is the fastest growing sector at the rate of 15-20% in the recent years - faster than any other meat sector in the country. Chicken Meat has proved as a ideal protein source in human food and poultry meat constitutes approximately 40% of the total meat production in the country. Indian Poultry population is 3% of the world's poultry population. The country ranks fifth in Egg production (33,550 million – projection for 2000) and 21st in world chicken, meat production (527,000 tones – 1997 figure). The overall rank is 17th in World Poultry production. The poultry industry is a success story with the industry emerging from limited backyard farming maintained under peasant husbandry practices to fully automated and integrated models. The industry, which is dominated by the private sector, is showing a trend towards integration in

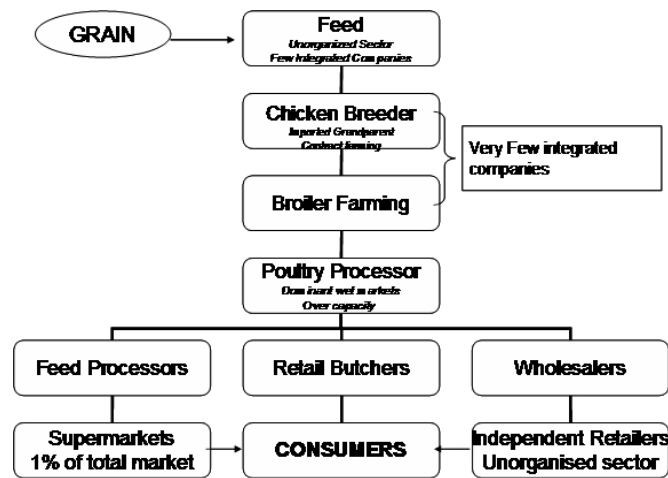


Fig. 4.4 Poultry supply chain in India

operation. In fact, the South Indian poultry industry has high levels of integration which has resulted in higher production efficiencies and lowering of poultry prices. The unorganized sector is huge with backyard flock ranging from 25 to 250 birds. The current poultry processing capacity is approximately 25000 birds per hour. The average capacity utilization is about 30%, since most of the processing facilities are not fully operational. Key players include Venky's, Godrej, Arambagh and Suguna. A SWOT analysis of the poultry industry in India is given in Figure 4.3.

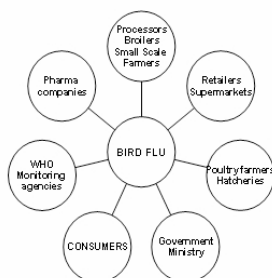
#### 4.5.2 Poultry Supply Chain

The Poultry Supply Chain is given in Figure 4.4. Some of the key features of the poultry supply chain are listed below each stages of the supply chain. As seen in the figure, there are very few integrated companies in the Feed, Breeder and Poultry Processing chain. The Poultry supply chain largely consists of the unorganized sector. The retail market is also largely unorganized and a characteristic feature is that only 1 percent of the retail is sold through supermarkets. Another point of interest is that a poultry retailer sells only poultry and not other kinds of meat. Hence a disruption in his supply would lead to closure of his business for days as is the case in what happened to many poultry retailers in Maharashtra when the general consumers stopped buying poultry meat for a few weeks. We summarize the impact of the bird flu across the main players in the Poultry Supply Chain Table 4.2.

Designs of supply chains are characterized by coordination, synchronization and collaboration between two trading partners. An important aspect that needs to be taken into consideration while designing them is the relationship between all of the stake holders of a supply chain. The stake holders in the entire poultry supply chain is depicted in Figure 4.5. As shown in the figure, this includes (a) the central agencies: The Government of India, Department of Animal Husbandry, The WHO and monitoring agencies, (b) The supply chain partners which include the Producers to retailers (c) the pharmaceutical companies and (d) Consumers. The insurance companies and media which are not included here play a crucial role in such event. We refer to CABIC(1998) for further details. There is a strong interdependence between the stake holders of the supply chain.

**Table 4.2** Impact of avian influenza on the economy across the poultry supply chain

Part of Supply Chain	Losers	Winners
Supply	Feed and day old chick suppliers	Vaccine producers
Production	Producers with high capital cost	Other live stock producers
Retail	Sole traders of poultry	General live-stock traders
Consumers	Rural poor	Rich who could afford other livestock



**Fig. 4.5** Stake holders of the poultry industry

The key issues in the poultry supply chain in India include

- Quality and hygiene levels in wet market- chicken droppings, feed, feathers spread micro organisms while being transported within the city.
- Quality and hygiene inspection of processed meat - The certification is outdated with provisions not applicable to the current industry. The certification is of no relevance to the customer.
- High supply chain costs- Feed constitutes 60% of the total broiler costs. Fluctuation in prices of common feed such as maize and oil meals significantly affects poultry producers.
- Livestock markets- the markets are primitive with no veterinarian support to certify animal health. In Delhi, the government has now placed a team of doctors in the main poultry market - the Ghazipur Mandi. It is only after a thorough checkup and a clean chit is given to the chicken, that it can land finally on the frying pan in someone’s kitchen. This chicken is known as ‘certified chicken’.

- Safety net for farmers: the poultry insurance scheme which was launched in 1997 turned to be unattractive for farmers as it was only for exotic and cross bred birds. Major diseases like Ranikhet disease, fowl pox which commonly occur were excluded from coverage.

## 4.6 Risk Management in Supply Chains

It has been well researched and documented that major disruptions cause supply chains to break down and take a long time to recover. Hence, it is very important to have mitigation strategies to build resilient supply chains. It is very important to balance agility of the supply chain with cost efficiency. The effect of major disruptions on supply chains have been well researched. Gaonkar and Viswanadham broadly classify supply chain risks in three categories: 1) Disruptions, 2) Deviations and 3) Disaster. Types of risk include intellectual property compromise/loss; hazard; operational disruptions and catastrophes.

Since avian influenza or the human pandemic is a threat, we can classify the threat to supply chains due to a pandemic to fall in the disruption category. We need to build supply chain with ability to restore operations in event of a pandemic. We identify the risks faced at each stage of the supply chain and classify the same in the risk hierarchy framework and relate it to the trust mitigation measure.

### 4.6.1 Risk-Trust Hierarchy Model

Cambridge Technology Partners [CTP, 2001] present the following definition for trust in the area of networked business: *trust is the degree of vulnerability participants to an exchange are willing to assume in pursuit of a mutually positive outcome.* The definition above [CTP 2001] contains four critical elements:

1. trust is a one to one phenomenon, relationship dependent.
2. It is not directly associative.
3. Interdependency: The partners in the exchange are dependent on each other,
4. There is a contextual component depending on the objectives of the exchange assessing trust and
5. In the long term collaboration, mutually positive benefits are anticipated; the given exchange must exceed the benefits of an alternative exchange.

CTP, 2001 develop a risk-trust hierarchy frame work to match risk and trust, where each level builds on the previous one. The framework identifies four distinct forms of trust that exist in networked relationships: calculus -based , communal, obligational and relational. Calculus based trust is based on pure economic pay off assessments, obligatory trust occur where principal agent relationships are the norm and the social attributes of an exchange first emerge, relational trust occurs when partners are viewed as equals and communal trust when each partner has internalized each other's social norms and can, in some cases, act as proxies for each other.

We now focus on analysis of collaborative risks. Risk in collaborative environments can be classified as below:

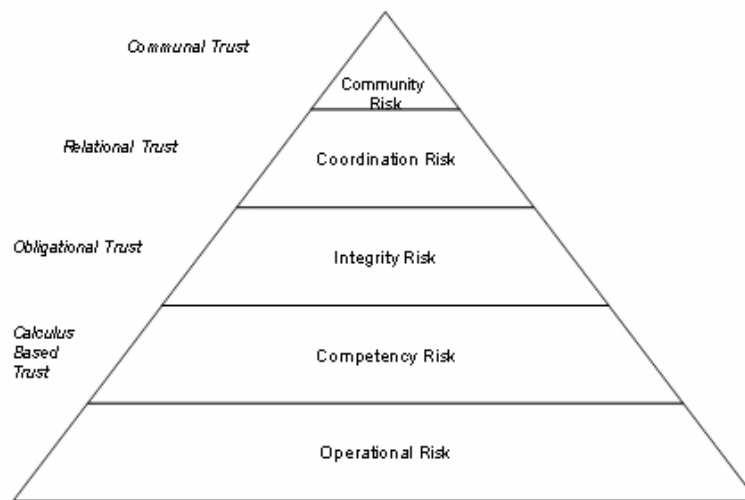


Fig. 4.6 Risk-Trust Hierarchy Model

1. *Competency risk*: Risk that a network member lacks the resources or competence to fulfil its obligations.
2. *Integrity risk*: Partner in network uses private information to exploit partners or discloses sensitive information.
3. *Coordination risk*: Ability of network partners to coordinate and integrate processes.
4. *Community risk*: Partners misinterpret each other's needs.

The above risk factors can be mapped to a Risk-Trust Hierarchy framework and with each risk variant mitigated by a corresponding level of trust between partners. Calculus based trust has levels of vulnerability and risk. Obligatory trust is typified by deep dependence between partners, the main risk here being partners exploiting others in the network, thus increasing risk factors associated within them. The dominant player has control over the *fate* of other players in the network. In such settings, conflict resolution is handled by enforcement agencies typically government driven. In relational trust settings, poor execution of a network member's process will have a ripple effect on the partners in the network. Hence the challenge in such settings is coordination in the execution of member's processes. Such setting arises in industries which have a high degree of demand uncertainty coupled with short product life cycles. The highest order of trust is communal trust which occurs when partners have fully internalized each others value and belief systems. It is very critical to take the above factors into consideration for design of robust supply chains. The Risk-Trust Hierarchy Model is given in Figure 6.3

#### 4.6.2 Risk Hierarchy model applied to the Poultry chain

In this section we analyze the Indian Poultry Supply Chain in the risk-hierarchy framework and give mitigation measures to avoid future attacks of avian flu and human pandemic. As mentioned earlier, the poultry supply chain in the Indian scenario is dominated by a few big players with the



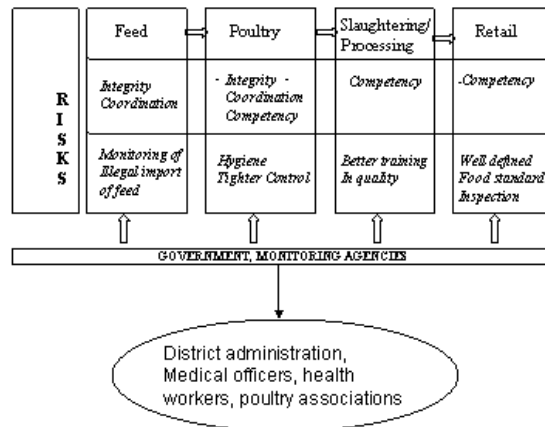


Fig. 4.7 Recommendations to mitigate avian influenza in poultry supply chain

retail markets being dominated by the unorganized wet market sector. The upstream hatcheries also has a significant number of back yard farmer using primitive methods of poultry farming. The types of risk that could arise in this chain are

1. *Competency risk*: The back yard farming and the unorganized wet market sector lack the resources to track infected poultry. The tracking mechanisms are very poor. It is very imperative that tracking mechanisms are placed along the entire supply chain, so that one can track an infected poultry. This risk is present at the poultry , processing and retail links of the chain. This risk can be mitigated using a better monitoring methods, having higher standards of quality and hygiene and training the unorganized sector in being better prepared for such disasters.
2. *Integrity risk*: We emphasize this case here. As said earlier, there have been press reports of a major player not revealing information about dead chicks for almost 15 days. Had this player exhibited high levels of integrity , then perhaps the problem could have been detected and controlled more efficiently. Another way of looking at the problem is the allegation made by some poultry farmers against multinational drug companies. They allege that the scare was created to sell off vaccines. Hence the question of *trust* between partners is very important. If we look in Figure 4.5 we see the interdependency among the stake holders. If we map the same onto the *risk-trust hierarchy* framework, we see that the risk here is that of partners exploiting each other and the need for obligational trust. This can be achieved by having tighter control mechanisms
3. *Coordination risk*: Lack of coordination between the partners.
4. *Community risk*: Poor execution of the unorganized sector causes ripple effect upstream and vice versa. This can be mitigated with a level of *relational trust* . There is a need to have well defined food standards and inspection mechanisms .

The recommendations are summarized in Figure 4.7

## 4.7 Conclusions and Discussions

We have analyzed the possible reasons for risk in the poultry supply chain and have proposed a few mitigation strategies to avoid large scale disruptions in future. The current study throws open a lot of questions which need to be answered in a structured way. The first question is how does one integrate financial losses in efficient design of supply chains. In our opinion, an efficient supply chain is one where partners in the supply chain share risks which include operational and financial risks. To achieve this, a coordinated approach taking into consideration the financial losses faced by the poultry sector in wake of a disruption of this kind has to be included as well in the analysis. Another question of interest is to study the crucial role of media in such cases also has to be studied in detail. The role played by insurance companies in events of disaster is also an interesting question. As mentioned in the speech by Rakesh Mohan(2006) the role of insurance companies has to be studied in detail. A coordinated effort from all the stake holders of the supply chain which includes the Government, central bank, pharmaceutical companies, media would perhaps aid in designing such supply chains. The formation of cooperatives could perhaps be a solution and a study can be undertaken to check the feasibility of such a solution. We conclude by emphasizing the need for building trust among partners in a supply chain which could lead to design of more efficient supply chains.

## References

1. *Crisis Communication: The Asian Bird Flu* CABC, Centre for Asian Business Cases, HKU015, (1998).
2. P. Chapman, M. Christopher, U. Jüttner, H. Peck, and R. Wilding, "Identifying and Managing Supply-Chain Vulnerability," *Logistics and Transport Focus* 4 (4) (2002).
3. M. Christopher and H. Lee, "Mitigating supply chain risk through improved confidence", *International Journal of Physical Distribution & Logistics Management* 34 (5) (2004), 388-396.
4. S. Chopra and M. Sodhi, "Managing Risk To Avoid Supply-Chain Breakdown," *MIT Sloan Management Review* 46(1): 53-61 (2004).
5. *Supply Chain Vulnerability*, Cranfield University, School of Management, Executive Report prepared for Department for Transport, Local Government and the Regions, Home Office, Department of Trade and Industry. United Kingdom (2002).
6. *Trust within Networked Business*, A New Economy White Paper from Cambridge Technology Partners, CTP 2001 (<http://www.ctp.com>) (2002).
7. T. Friscia, "Supply Chain Risk Management and the Avian Flu: Is Your Supply Chain Ready?," *AMR Research Article* (2006).
8. R. Gaonkar and N. Viswanadham, "A Conceptual and Analytical Framework for the Management of Risk in Supply Chains," Submitted to *IEEE Transactions on Automation & Systems Engineering* (2003).
9. Helferich, O. K., Cook, R. L., Securing the Supply Chain. White Paper: Management Report. Council of Logistics Management. Oakbrook, Illinois(2002).

10. U.Juttner., H.Peck, and M. Christopher., Supply chain risk management: outlining an agenda for future research, *Int. J. Logistics*,6, (2003), 197–210.
11. Neeta Ramnath, *Outlook for the Indian Poultry Sector*, [www.rabobank.com](http://www.rabobank.com) (2003).
12. R. Martin, *Managing Bird Flu: Pandemic*, Asian Institute of Mangement Paper, (2006)
13. R. Mohan, *Avian Influenza Pandemic- Preparedness within the Financial Sector*, Introductory remarks at the IMF seminar on "Preparedness within the Financial Sector for an Avian Influenza Pandemic", Mumbai 24 July 2006.
14. Mohanty, S. and K. Rajendran , "2020 Vision for Indian Poultry Industry" in *International Journal of Poultry Science*, 2(2), 139-143. Department of Agricultural and Applied Economics, Texas Tech University(2003).
15. I.I. Mitroff and M.C. Alpasan, *Preparing for Evil*, *Harvard Business Review*, 81(4) (2003), 109-115
16. H. Peck, and U. Jüttner., *Risk management in the supply chain*. *Logistics and Transport Focus*, 4(11), (2002), 17–22.
17. J. Rushton, Rommy Viscarra, Emmanuelle Guerne Bleich and Anni McLeod, *Impact of avian influenza outbreaks in the poultry sectors of five South East Asian countries (Cambodia, Indonesia, Lao PDR, Thailand, Viet Nam) outbreak costs, responses and potential long term control*, Report for FAO's TCP/RAS/3010
18. Shibalee Majumdar, *Policy Environment for Development of Poultry in India*, in *Food Processing Five Sectors Project report of India Development Fund*, <http://www.idfresearch.org/pdf/Policyen.pdf>
19. Y. Sheffi, *Supply Chain Management under the Threat of International Terrorism*,*International Journal of Logistics Management*, 12 (2) (2001), 1-11.
20. Y. Sheffi,*The Resilient Enterprise*, M.I.T., Cambridge, MA.(2005)



# 5 Design of Special Economic Zones as Economic Engines of Growth

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Special Economic Zones are growth engines that can boost manufacturing, exports, and employment.

—P. Chidambaram, Finance Minister

## 5.1 Introduction

India is a booming economy and is the fourth largest in terms of purchase power parity. Past couple of years it is a favored destination for foreign direct investment. India has the advantage of a large domestic market as well as favorable export markets. The Government of India is introducing several policy reforms to make India a destination of choice for foreign companies and countries. The Special Economic Zones act - 2005 is one such initiative. The SEZs are projected as Engines of growth and must have embedded in them the national manufacturing strategy.

There is considerable amount of literature on SEZs and their impact on the economies and their performance. However, there is no literature on the design of SEZs. There is lots of management literature on a related topic of Clusters which are special cases of SEZs. The World Bank is interested in the SEZ topic and has large number of reports have appeared basically surveying the performance of the SEZs in developing countries. There are surveys on SEZs in India by both KPMG and the Confederation of Indian Industries and the government of India maintains a website on sezindia.

In this paper, we briefly summarise the SEZ concepts and their purpose and presence around the world. We then trace their evolution in India and summarise the performance of existing SEZs in India. At the same time, we discuss the design of SEZs taking into account the logistical, informational and value chain requirements. There are several Singapore companies and agencies active in India and we describe their presence and activities as relevant in Indian SEZs project. We also highlight the factors involved in project selection in a SEZ. Finally, we conclude this paper on a positive note.

Our concern is about the design of special economic zones (SEZs) as engines of growth. Currently, the SEZs are treated as a real estate development where in any company owners looking for tax breaks set up their shops inside the SEZ. The result is a multi product SEZ with no sharing of logistics or human expertise, each product belonging to a different industry vertical such as information technology (IT), pharmaceuticals, food, leather, gems and jewelry. It is known that their performance is not up to expectations and the reason is that they are not well designed.

We consider two problems here in this report:

1. A multinational corporation (MNC) or a foreign country wants to enter India and establish an SEZ. We have to resolve the location problem which involves determining the State in which the SEZ is established and also the city in the State. The SEZ may be either:
  - (a) A multi product SEZ where several companies belonging to different industry verticals with varying logistics and knowledge requirements; and
  - (b) A cluster oriented SEZ where companies in the zone have the same logistics, maintenance and repair knowledge and financial requirements and can share the corresponding facilities.
2. The design of the SEZ or the composition of the SEZ consists of companies taking care of inbound, outbound, MRO and manufacturing logistics activities, information infrastructure for common procurement and communication among the companies within the SEZ as well as outside of it, venture capital firms, human resource training in global supply chain excellence, global marketing and logistics and several others to complement the above activities.

Our aim is not to use mathematical techniques such as multi-attribute decision analysis or mathematical programming techniques but to discuss the issues that are important in the problem formulation that leads to a good decision.

## 5.2 Background on SEZs

An SEZ or Free Trade Zone (FTZ) is typically an enclave of units operating in a well- defined area within the geographical boundary of a country where certain economic activities are promoted by a set of policy measures that are not generally applicable to the rest of the country. These zones are known by different names such as Industrial Free Zone, Export Processing Zones (EPZ), Bonded Free Zones, Maquiladoras (Mexico) and Special Economic Zones (China). These zones offer high quality infrastructure facilities and support services, and allow duty free import of capital goods and raw materials. In addition, attractive fiscal incentives, relaxed labor laws and simpler procedures are also offered in such zones. Over a period of time, this concept has expanded and evolved to encompass larger areas, higher levels of integration within the defined geographical boundaries and an increased integration with the local economy.

Since the 1950s, most of the countries around the world have adopted export zones as a growth strategy including the United States, Puerto Rico, Thailand, Taiwan, Singapore, Ireland, Mexico, United Arab Emirates and, currently, coastal China. The first example of such a zone is the Shannon EPZ in Ireland, which was set up in 1958. This was set up as a traditional EPZ model of a bonded designated enclave. More recent examples include the Kaoshiung EPZ in Taiwan, the Santacruz Electronics EPZ in India, both of which were established in the late 1960s and the Masan

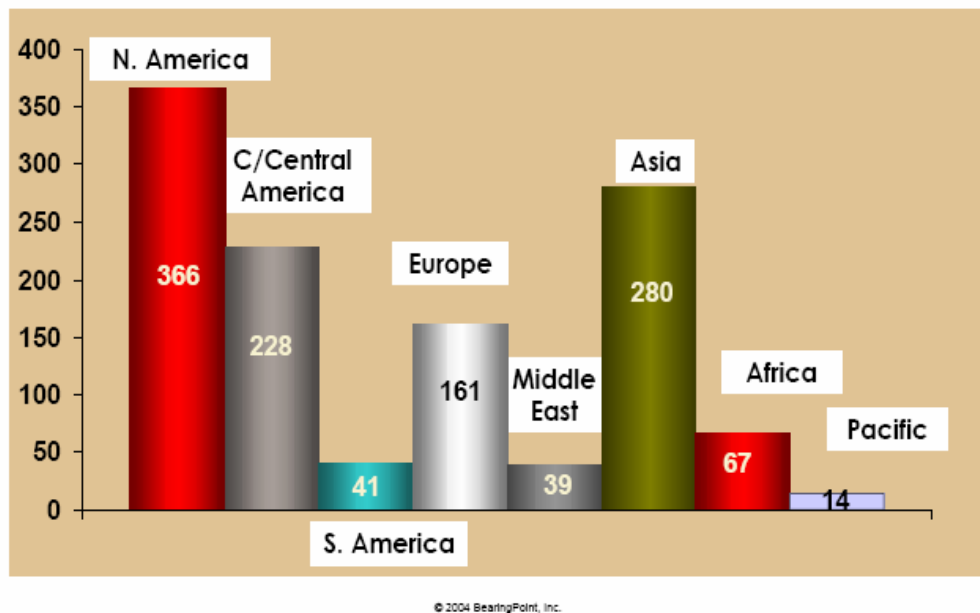


Fig. 5.1 Distribution of SEZs by Region (2004)

FTZ in South Korea, set up in the early 1970s. Currently SEZ models have been implemented in more than 100 countries around the globe accounting for more than 3,000 free trade zone projects. The main objectives often considered by governments for setting up such zones are:

- Attract Foreign Direct Investment (FDI)
- Earn foreign exchange and contribute to exchange rate stability
- Create jobs and raise standard of living
- Transfer new skills and expertise to local human resources
- Create backward and forward linkages to increase the output and raise the standard of local enterprises that supply goods and services to the zone
- Develop backward regions by locating such zones in these areas and attracting industries
- Stimulate sectors regarded as strategically important to the economy, for example, electronics, IT, research and development, tourism, infrastructure and human resource development

Governments have also promoted such zones as *pilot projects* to test policy reforms before introducing them across the country. Given the difficulties involved in strengthening the general infrastructure base in the country and in reforming country level policies, these *islands of excellence* with relatively superior infrastructure and policy environment served as useful policy tools which were later extended to other parts of the country, especially in large countries such as China and India. The vision of all the economic zones is generally in tune with the host country's economic policies. They have arisen out of different economic compulsions. The Jebel Ali Free Zone and Sharjah Airport International Free Zone were more concerned to diversify the economy which is

overly dependent on the oil sector. Poland, on the other hand, had severe employment problems, so the emphasis of SEZs in Poland was more on labor intensive industries. Singapore is an export dependent economy with excellent resource management skills and IT and logistics infrastructure. The emphasis in Singapore's case is to attract MNCs to Singapore. China's objective was to initially attract high level of foreign investment with open foreign investment policy and later on to infuse high technology into the economy.

International institutions like the World Bank, United Nations Industrial Development Organization (UNIDO), International Labour Organization (ILO) and United Nations Conference on Trade and Development (UNCTAD) have played an important role in creating and legitimizing the concept of EPZs. While, UNIDO has been instrumental in the creation of the World Export Processing Zone Association (WEPZA), UNCTAD has contributed greatly to legitimizing the idea of EPZs through basic studies on the costs, benefits and advantages of these zones. ILO has also been playing a deterministic role by formulating guideline for labor policies in the EPZs.

### 5.2.1 The Chinese Example

The Chinese government first considered large FTZs to attract foreign capital in the late 1970s, and in 1979, four such zones were created in Shenzhen, Zhuhai, Xiamen and Shantou. All these areas were in the south-east coast of the country, in close proximity to the main trading and financial centres like Hong Kong, which was not then under Chinese control. Subsequently, the entire island of Hainan was declared as a SEZ. More such zones in the Yangtze and Pearl River deltas, Shandong peninsula and Pudong near Shanghai followed.

After a slow start, these zones started attracting foreign capital in a big way and were mostly responsible for the emergence of China as a manufacturing super power. Liberal regulatory controls, cheap labour and location advantages helped these zones to become major growth drivers for the entire Chinese economy. More importantly these zones covered large areas, hundreds of square kilometres in some cases, which ensured that the infrastructure was developed in an integrated manner, with sufficient room to expand, once these zones started attracting investments in large scale.

### 5.2.2 Indian SEZs

Indian SEZs are primarily set up with the objectives of attracting FDI, promoting export, generating employment and infusing new technologies. Indian SEZs can leverage the factor advantages and also the comparative cost advantages in various industry sectors to capture a share of these investments. Also, the rising cost of manufacturing and service operations in several Asian economies offers an opportunity for Indian SEZs to gain a share of the relocating investments. Domestic investment in export oriented activities is also a distinct market opportunity for SEZs.

The concept of designated industrial zones to promote exports is not new to this country. The Kandla EPZ was set up in 1965, even before the Chinese thought about such zones. The Santa Cruz Electronic EPZ (SEEPZ) in Mumbai followed in 1972. Subsequently, the government set up more such EPZ in select locations across the country.

These zones were not really "free trade" zones in the real sense and were nowhere as successful as those in China ones for a host of reasons. With an average area of just 200 acres each, these early zones lacked sufficient space to grow. They failed to attract large-scale foreign investment as those days overseas investors were not enamored of India as an attractive manufacturing location.



The total exports from the existing EPZs, notified as SEZs after the SEZ Act, for the financial year 2004-05 totalled Rs18,300 crore. Nearly 45 per cent of the total exports came from just one such zone, SEEPZ, the most successful among these early zones.

### 5.3 SEZ Policy 2005

The recent Indian SEZ policy is the latest and most ambitious of export boosting efforts. The SEZ 2005 policy goes much further than the existing SEZs in the world, in that it seeks to radically change the environment for exports and FDI, by offering a hassle-free business-friendly environment and world class infrastructure over an unprecedented large geographical area. It allows the government to experiment with radical economic reform on a localized basis, introducing reforms that are difficult to implement at the national level, given the country's large size.

The SEZ policy offers a host of incentives to developers of such zones and units within such zones with very minimum regulatory controls. The SEZ Act says the area inside an SEZ would be treated as foreign territory as far as application of commercial laws is concerned. Apart from wide-ranging tax benefits, 100 per cent FDI is permitted in SEZ units, except in select strategic sectors. Such units can keep full export proceeds in foreign currency and repatriate such earnings as they wish. They can borrow up to US\$500 million from overseas markets every year and can outsource production and other activities to overseas units.

The SEZ Act provides for very liberal fiscal benefits to SEZ developers and SEZ units. These benefits far exceed those available under earlier export promotion schemes and hence have attracted criticism.

1. Units in an SEZ are exempt from customs duty on imports of capital goods and inputs and excise duty on purchases from the domestic market. These units would be exempt from income tax for the first five years and would get 50 per cent exemption for another two years. Investment allowance of 50 per cent of reinvested profits is also available.
2. Domestic units supplying goods to SEZ units will be exempt from central sales tax and service tax and can claim income tax exemption under Section 80 HHC as their supplies would be considered as deemed exports.
3. Tax benefits to SEZ developers are even more liberal. Apart from customs and excise duty exemptions on purchase of capital goods and other material, they get complete income tax exemption for 10 years. Individuals investing in SEZ developments are also eligible for tax exemptions.
4. Developers of large, multi-product zones with a minimum area of 1,000 hectares are required to utilise only 25 per cent of the SEZ for industrial purpose. The rest can be utilised for residential and shopping purposes, hotels, malls, and the other trappings of *development*. Moreover, the developers have a completely free hand to allocate space and other facilities within the zone on a commercial basis.
5. Though there are conditions that only the units within that zone and their employees can use such non-core facilities inside an SEZ, there is no way that these ventures can be prevented from being mis-utilised as upscale, residential townships for sale or *resale* to those who may have nothing to do without the core activities of the SEZ.

6. The policy on de-notification of a failed SEZ and the exit options for developers has either been left deliberately opaque or is non-existent.

### 5.3.1 Profile of SEZs approved in 2006

Since the Special Economic Zones law was enacted in February 2006, there has been a rush for blocking the land since there was a cap of 150 on the total number of SEZs to be finally approved. Subsequently, however, the cap was removed and currently there is no upper limit on the number of SEZs that can be operational. On March 17, the government approved 148 proposals for setting up SEZs, covering about 40,000 hectares of land and involving a total investment of Rs100,000 crore. All these will enjoy the several benefits that have been offered under the recent SEZ policy framework and are expected to be operational within three years in order to be entitled to them.

As many as 85 of the 150 SEZs, which have obtained "formal approval" from the Board of Approvals for SEZs so far will be devoted to the category of information technology and IT-enabled services. These IT/ITES zones will be located in 14 states, but the largest number of approvals are in the states of Andhra Pradesh, Karnataka and Tamil Nadu (each 16), followed by Maharashtra (10) and West Bengal and Uttar Pradesh (five each). Thus these six states account for 68 of the 85 zones in the IT sector. Understandably, however, these zones account for a small portion of land area allotted to the SEZs as a whole.

In terms of the number of approved SEZs, the next in ranking sector-wise are pharmaceuticals and biotechnology (14), multi-product (10) and textiles/apparel (9) and electronic hardware and telecommunication equipment (9). There has been some overlapping of sectoral categories in the case of some zones like IT hardware and software/ITES, electronics and pharmaceuticals and biotechnology. Other SEZ categories approved include leather and footwear, engineering, glass and ceramic. It is expected that 94 SEZs to become operational by April 2008 and the number of jobs created by the SEZs would be to the tune of 500,000 by December 2007.

There are basically three formats of SEZs: integrated multi-product SEZs with complex infrastructures on a huge landmass; single industry-based SEZs being set up on huge landmasses by large companies like Reliance and Posco for own use; and single-product SEZs, such as a garment SEZ or a gem and jewellery SEZ. There is also a fourth category of SEZs for the service industries such as it that need only a couple of multistoried buildings supported by infrastructures.

The SEZs are supposed to be a robust format for the creation of a globally competitive environment for manufacturing, processing and exports. This has been achieved in other Countries including China by promoting the first or second kind of mega-SEZs. In India, the approvals have shown a trend in the direction of approving large number of small SEZs. Further, more the bids for SEZs included prime farm land involving displacement of large number of small farmers.

### 5.3.2 Road Blocks in SEZ Implementation and Uncertainty how many SEZs will actually take off

There have been several recent events that have taken place and decisions that have been announced by Government agencies and opinions expressed by some political parties, non-government organizations and activists which may dampen the enthusiasm and also put a break on the SEZ rush. Any policy will carry critics with it always. This is just another example of "resistance to change" and few political parties are blowing it big. But, the government is determined to develop

SEZs with democratic sense. We mention below some of these issues which may affect the final number of SEZs that will finally take off.

*SEZs treated as real estate* The RBI today ruled out concessional finance to developers and units in these zones. Special Economic Zones treated as real estate for purposes of loans granted by the Banks. The RBI has clarified to commercial banks that all loans to SEZ developers and for acquiring units in SEZ should be considered as exposure to commercial real estate. In other words, such loans would not be treated as industrial advances and hence the interest costs would be much higher. Banks are generally very conservative when it comes to exposure to commercial real estate, mostly because of the fluctuations in market prices. The RBI decision is aimed at limiting the exposure of commercial banks to SEZs and could also lead to an increase in interest rates for such projects as real estate funding carry a higher risk weight. RBI's decision to treat SEZs as real estate projects was bound to affect the economic viability of these projects as the cost of lending would go up.

Taking this criticism from RBI, the commerce ministry has recently issued detailed guidelines for the developers of the SEZs. Developers need to have a net worth of at least Rs 250 crore and invest a minimum of Rs 1,000 crore for a multi-product SEZ. For sector-specific zones, the Board of Approvals fixed the minimum investment at Rs 250 crore or a net worth of Rs 50 crore. This would pressure on the developers since borrowing from public financial institutions gets expensive.

*Fate of existing schemes* While there is euphoria over the new SEZ scheme, the fate of the existing Export Processing Zones, Export-oriented Units Scheme, Export Intensive Area Sub-Plan, Infrastructure Development Scheme (aimed at developing 93 'no industry districts') etc. is uncertain. While these schemes have not made any significant impact so far, they will lose their attraction altogether once the new SEZs come into being.

What is more disappointing, even the fairly successful experiment of setting up Software Technology Parks (STPs) may suffer a major setback. The IT Ministry fears that many of the 6,500 companies located in the 47 STPs would prefer to shift to new IT SEZs, rendering the STPs across India unviable. The companies located in these STPs have been exporting software worth about Rs 1,00,000 crore per annum and the software exports from these parks are set to increase further at a healthy rate in the coming years.

Against this backdrop, the National Association for Software Service Companies (Nasscom) has demanded SEZ status for the 47 STPs, but the Commerce and Industry Ministry has rejected this demand. The Commerce Ministry feels that it is for the IT Ministry to decide the future of the STPs.

## 5.4 Economic and Technical Issues concerning SEZs

Several concerns have been raised by economists, Finance ministry, Reserve Bank on the technical problems that will be encountered and also the implementation would lead to creating two Indias as a result of the growing inequalities. While the SEZs will have a glittering landscape of malls and multiplexes, the other presents a dismal scene of farmers committing suicide. We will discuss some of these below.

### 5.4.1 Lack of Forward and Backward linkages

The central bank had openly stated that mushrooming of SEZs would lead to a diversion of resources from domestic tariff areas, besides revenue losses to the government. In its annual report of 2005-06 released in August 2006, the Reserve Bank has said The SEZs are envisaged to act as catalysts for growth. The simplification of the procedures for development, operation and maintenance of the SEZs and the fiscal incentives are expected to spur investment and promote industrial activity. At the same time, there are concerns that the SEZs could aggravate the uneven pattern of development by pulling out resources from less developed areas. Revenue implications of taxation benefits would also need to be factored. The revenue loss for the Government in providing incentives may be justified only if the SEZ units ensure forward and backward linkages with the domestic economy.

Traditionally, export-processing zones have been characterized by narrow industry focus with high import intensity in exports. This resulted in many such zones being insulated from the rest of the economy, thereby giving rise to fewer economic spin offs. Backward linkages with the local economy in the form of movement of raw materials, labour and sub contracting in the domestic tariff area, i.e. out-zone processing, are necessary for susceptibility of such zones. Countries such as China and South Korea have pursued this strategy of uniting with the interior in developing their SEZ's This has contributed to rapid indigenization of production, technology absorption and import substitution Similarly Forward linkages in the form of sales in domestic tariff area (DTA) have been an important motivation for investors especially when the domestic market size is large and growing. Investors in the SEZ's in China view the vast domestic market in China as extremely promising in the long run. This has been an important determinant of their investment decisions. Also, limited sales in DTA provide a safety net to hedge against possible swings in international markets besides providing the opportunity to test domestic markets. Most countries have well defined policies for sales made from SEZ to DTA. The policies are combination of quantitative restrictions and concessions duty structure. Most of the countries allow a certain percentage of the output to be sold to DTA. In many countries the DTA sale attracts concessions duties.

*Loss of Revenue and Legality of the Tax Incentives* The Finance Ministry resisted the attempt to remove the cap on the number of SEZs by arguing that the policy would lead to large revenue losses because of tax exemptions. According to Finance Ministry's estimates, SEZs could lead to a revenue loss of Rs 175,000 crore in direct taxes, customs and excise duties over the next five years while the Commerce Ministry says the zones will lead to Rs 44,000 crore revenue gain for the government in a year and 500,000 jobs next year. Others point out that the tax subsidies being offered by the government may well be challenged in the World Trade Organization, and could attract trade retaliatory measures from importing countries. IMF Chief Economist Raghuram Rajan criticized the perverse economic incentives offered by the zones. His concern is if you focus on tax incentives to set up these special economic zones, the incentives diminish and you hurt the revenues of the government." "Overall, it becomes yet another give-away which the government cannot afford." The Reserve Bank argued that these zones would lead to large-scale resource diversion from other areas widening the industrial inequity since the majority of SEZ applications appear to be in the industrially advanced states.

#### 5.4.2 Size and Location

Another contentious issue in the SEZ Act relates to the size and location of these zones. Though multi-product SEZs are required to have a minimum area of 1000 hectares that specified for service sector zones is only 100 hectares. In the case of single product zones, such as IT and gems and jewellery, it can be as small as 10 hectares. Despite the Finance Ministry's opposition, the Commerce Ministry had its way with the Empowered Group of Ministers and managed to retain the minimum area for IT and biotech zones at 10 hectares. *"About half of India's small special economic zones may not really take off,"* says Morgan Stanley economist Chetan Ahya in Mumbai. *"In today's highly competitive, globalized world, the concept of small-sized special economic zones is completely outdated."*

The major attraction for real-estate developers is that most of these SEZs are going to be located near big cities and towns where land is scarce and the State governments are supposed to offer it at concessional rates. Ideally, new SEZs should be located far from cities and towns to build new towns and should be spread over a minimum 1000 sq. km. Instead of offering all kinds of tax holidays and concessions, the Government should provide infrastructure support to such zones by building highways and expressways to connect them to ports, airports and other large towns and cities. This would involve minimum displacement of population and help in developing some underdeveloped regions.

#### 5.4.3 Manufacturing strategy totally neglected

The task of design of the portfolio of industries and their logistical and knowledge synergies with the local resources and environment is left with the developer. The type of industries and their potential for export and employment generations could be big issues if not taken care.

### 5.5 Performance of the Indian SEZs

Thirty years ago, 80 SEZs in 30 countries generated barely US\$6 billion in exports and employed about one million people. Today, 3,000 SEZs operate in 120 countries and account for more than US\$600 billion in exports and 50 million direct jobs. By offering privileged trading terms for manufacturing-based exports, SEZs can attract investment and foreign exchange, spur employment, and boost the development of improved technologies and infrastructure.

Despite their appeal, critics claim that SEZs attract investment only by offering distortion incentives rather than building underlying competitive conditions. They also argue that these incentives create a fiscal burden on the taxpayer and hurt environmental and labor standards. In addition, critics believe that the direct and indirect costs of maintaining zone privileges do not benefit the rest of the economy and, instead, lead to enclaves of prosperity.

Active linkage programs, adequate social and environmental safeguards, and private sector involvement in zone development and operation can go a long way in ensuring that the benefits of SEZs are maximized. Moreover, SEZs must be seen in the context of an overall strategy to promote private sector-led growth, rather than as a substitute for a good investment climate.

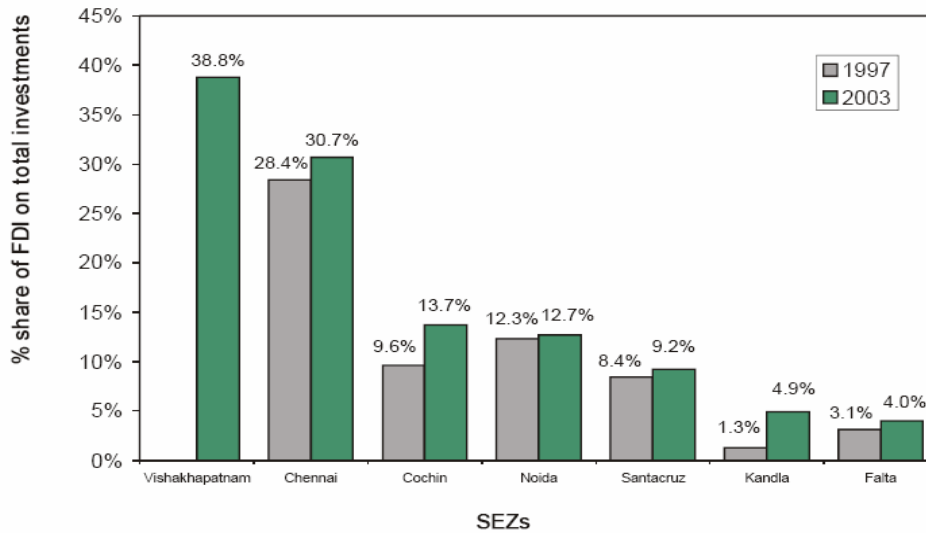


Fig. 5.2 Share of FDI in total investment in Indian SEZs

### 5.5.1 Generating Foreign Exchange

This first goal of EPZs, generating foreign exchange for the countries in which they are active, has not been an across the board and unequivocal success. The establishment of EPZs seems to be synonymous with the country providing a multitude of tax breaks and tax holidays to attract FDI to their zones. The other costs incurred are the investments for the planning, construction of the zone the cost of maintenance, administration and promotion of the SEZ, and the cost of the different incentives and subsidies offered by the government to investing companies.

All countries offer similar tariff-free imports and export, free repatriation of profit and market access. The length and extent of tax provisions varies across nations. The foregoing of the income is partially offset if backward linkages and forward linkages are created between the SEZ and the domestic firms.

The corporate policies of international firms may discourage them from creating a long term relationship with a domestic supplier. These firms may find more flexibility in securing a competitive international supplier.

### 5.5.2 Employment Creation

Job creation is considered one of the primary goals and one of the most important contributions of any SEZ to the economy. There has no doubt been a great deal of knowledge spill-over effect from the creation of EPZs in developing countries. Some employees also receive training at the managerial or supervisory level, thus enriching the entrepreneurial capital of the country.

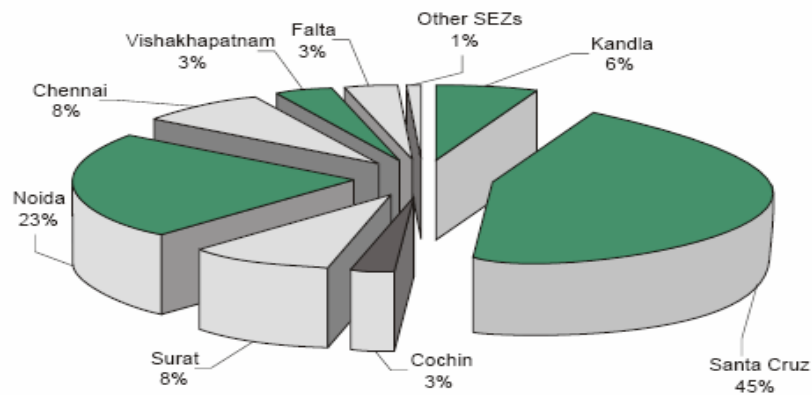


Fig. 5.3 Zone-wise composition of exports from SEZs in 2004-05

## 5.6 Market Attractiveness of Indian States

In India there are opportunities for investment in all the 28 states and Union territories in India. The decision of selecting a state in India for investment is a very complex one. Some states are more advanced in terms of the infrastructure and may also provide higher returns on investments. The issue of where to invest depends on the nature of product, the resources needed and other factors including the political and social compulsions. The situation is that states are now competing with one another to attract customers into their SEZs. This is a good situation and prospective investors can negotiate with the states. In this context of strategic location and multi modal connectivity Mumbai in Maharashtra, Chennai in Tamil Nadu, Kolkata in West Bengal, Cochin in Kerala, Vishakhapatnam in Andhra Pradesh, Ahmadabad in Gujarat automatically select themselves as favored locations for industries requiring sea transport. Delhi has good air transport facilities. There are already SEZs in operation in those cities and these cities are also very congested.

### 5.6.1 Investment Climate

Investment climate measures such as the strength of property rights, rule of law, and level of corruption are also well correlated with growth. It refers collectively to four components of the external (economic) environment within which business operates, namely, physical infrastructure, government regulation, the macroeconomic-cum- trade policy regime, and financial and business services.

The quantity and quality of investment flowing into any specific region depend upon the returns that investors expect and the uncertainties around those returns. These expectations can be categorised as follows:

1. Economic and political stability and national policy towards foreign trade and investment.

	<b>FICCI</b>	<b>World Bank</b>	<b>Rediff</b>
<b>1</b>	<b>Maharashtra</b>	<b>Maharashtra</b>	<b>TN</b>
<b>2</b>	<b>Gujarat</b>	<b>Delhi</b>	<b>Gujarat</b>
<b>3</b>	<b>Karnataka</b>	<b>Gujarat</b>	<b>Kerala</b>
<b>4</b>	<b>TN</b>	<b>AP</b>	<b>AP</b>
<b>5</b>	<b>AP</b>	<b>Karnataka</b>	<b>MP</b>

Fig. 5.4 Top 5 ranking of states by independent studies (2005)

2. Efficacy of a countrys regulatory framework relating to the issues of entry and exit, labor relations and flexibility in labor use, efficiency and transparency of financing and taxation, and other legitimate public interests.
3. The quality and quantity of available physical and financial infrastructure, such as power, transport, communications, banking and the availability skilled workers.

Based on the World Bank investment climate report, the Indian states are ranked as shown in Figure 5.4. There are several problems with the selection of the SEZ site from the investment climate data.

1. The data is not sensitive to the industry vertical and is the same for Petrochemical to Apparel. This obviously is not admissible since the logistical, backward linkage requirements are different for different verticals.
2. The list of the evaluation indices is arrived in rather ad hoc manner by industry surveys and misses several important factors such as resource management skills (such as global sourcing, global marketing and multinational, multi cultural human resource management), intellectual property issues, free trade agreements, etc to name a few.
3. The decision makers for changing the evaluation indices are not clearly identified.

Our model for SEZ is in an abstract setting and from the four factors we can derive the indices in the lower levels until we arrive at the evaluation indices which are measurable are reached.

## 5.7 Design of SEZ

An SEZ is a geographic concentration of interconnected companies, specialized suppliers, service providers, firms in related industries, research institutions, consultants and associated institutions in particular fields that compete but also cooperate.

In our view, an SEZ incorporates four interdependent operational and policy making components industry product and process value chains to meet the competitive markets, connecting technologies (information and logistics), resource management and knowledge creation and finally the



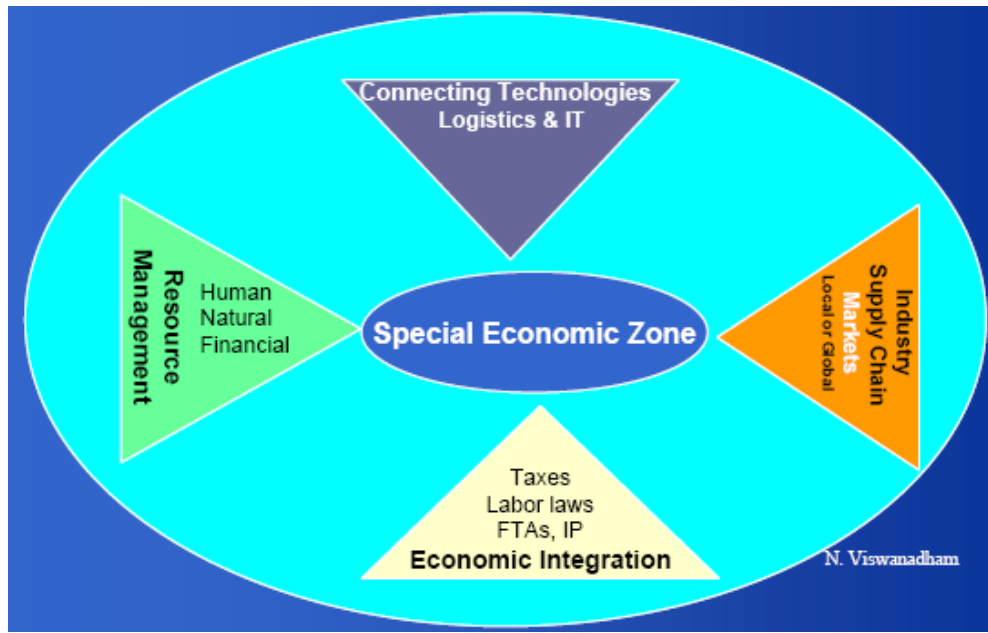


Fig. 5.5 Special Economic Zone - Design Components

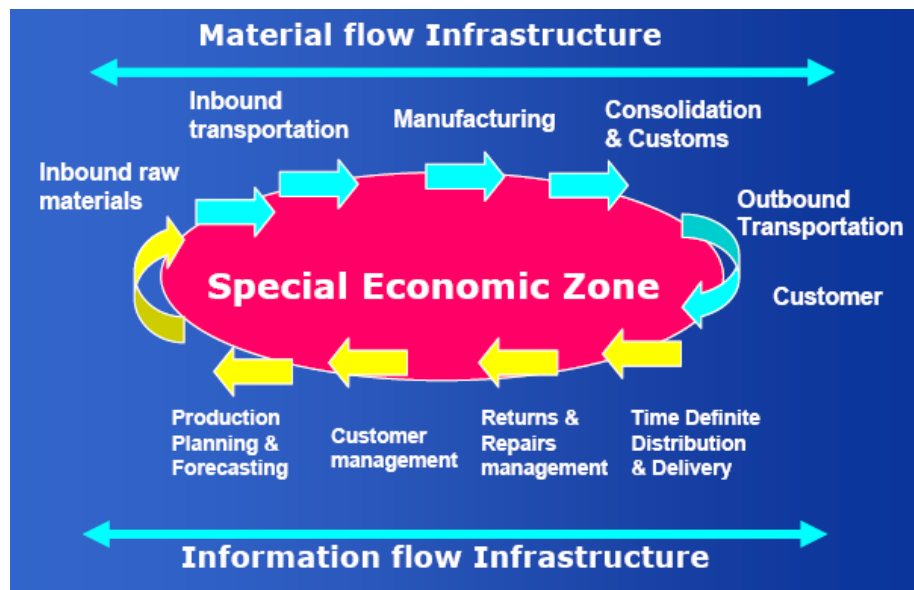


Fig. 5.6 Connecting Technologies in an SEZ

global integration of the region in which the SEZ is located in to economic world (see Figure 5). One way in which the competitiveness of the SEZ and its performance can be enhanced is by identifying the various factors that influence the above four components of the SEZ and adopting an integrated approach in nurturing all of them. Specific actions should be driven by a strategy of balanced investments since each factor enhances the SEZ in different ways to different degrees depending on the industry vertical under consideration. These four elements of the SEZ are discussed below in detail.

### 5.7.1 Connecting Technologies

A logistics cluster is a part of this SEZ and comprises of shippers, logistics service providers, IT vendors, port and airport infrastructure providers, regulatory agencies, and other logistics-related organisations that leverage on the interdependencies between them to provide highly efficient and effective logistics solutions and create innovative new solutions.

As shown in Figure 5.6, a good logistics and transportation infrastructure is the basis for a world-class logistics industry. Development of physical infrastructure for intra- country and international movement of goods is very important given the global nature of trade today. The development of a world-class infrastructure requires a phased approach towards investment in various sectors of industry that comprises this physical infrastructure cluster.

In today's globally connected business environment global information networks have an increasingly important role to play. It is possible that some of the limitations of the physical logistics infrastructure can be overcome by a superior information infrastructure. Real-time information systems and decision-support tools are the key to increased supply chain productivity and efficiency. It has been widely reported that computerization and internet-based business interaction has contributed to a growth of 1.5 per cent to the GDP of the United States economy. Similar to the investment strategy in physical infrastructure, investments in information infrastructure need to be undertaken in phases so as to build up the various segments of this cluster.

### 5.7.2 Resource Management

We have so far looked at investments in infrastructure that will drive the competitiveness of the logistics industry. However, the true potential of these investments will not be realised until competent manpower and breakthrough ideas and solutions become available to fully harness the power of these investments. Global human, natural and financial resource management skills are crucial for development of a competitive SEZ. In particular global sourcing, and global marketing skills are needed to make an economic impact and attract FDI. Educational institutions and research centers have a crucial role to play in imparting these skills.

### 5.7.3 Vertical Industry Supply Chain Network

The product and process developments and their modularity are important for the SEZ products to be competitive. Ultimately the companies in the SEZ need to be world class and their products need to be globally competitive. Global manufacturing needs outsourcing to low cost countries, efficient logistics and supply chain visibility. Approaches towards developing industry modular supply chains will need to be focused on specific vertical industries, since the approach to be adopted will be very different from industry to industry.

#### 5.7.4 Economic Integration

The SEZs by definition are regions where export and import rules are relaxed to attract MNCs and FDI. The success of the products created in the SEZ in the global market depends on the extent of integration of the host country in to the global economy. The FTAs, IP, excise duties, real estate ownership laws all matter a great deal.

In our view, attention to all four components would be needed for the SEZ to succeed. Design of SEZ involves a balanced investment in all four components for enhanced performance.

### 5.8 Selection of Location

The decision to invest in India is an easy one but where to invest in India is a tough one. There are opportunities for investing in existing SEZ or in initiating a green field SEZ project or participate in some of the new initiatives in the country or participate and turnaround an existing SEZ. In a specific SEZ, the opportunities for investment include

- *Developer*, including a co-developer, engaged in the establishment and development of the zone, including individual components of infrastructure such as roads, water and drainage system.
- *Operators*, which are enterprises engaged in the operation and/or maintenance of all/ any infrastructure facility in the zone
- *Tenant/units*, which are the occupant enterprises within the zone and include enterprises engaged in manufacturing, services and trading

There are various kinds of build, operate and transfer models available depending on the context. There is a large amount of literature on what is called the location problem. We discuss below some international best practices which may guide the site selection, industry focus and possible joint partners.

Strategic location and multi modal connectivity with major trading destinations are critical factors for success of SEZ's. It has been observed that the most successful zones are strategically located giving the units in the zone an easy gateway to international trade. For example, the location for Chinese SEZ's and FTZs were consciously selected along the east coast close to Hong Kong, Macau and Taiwan. These countries have served not only as transshipment points for exporting to international markets but also as consumption centers. Proximity to the seaports and airports of Hong Kong and Taiwan has played a critical role in the growth and success of these SEZ's. Likewise, free zones in Malaysia, Indonesia and Thailand are located near the capital cities with minimum distance from seaports and airports. Middle East and Caribbean free zones are also favorably located close to airports and seaports.

Earlier, we dealt with the design of an SEZ and the four factors that are important for making an SEZ a location of choice. We use this four factor model for the location choice of an SEZ.

The location of an SEZ is a very important decision-making problem for a multinational corporation. Classical location theory, as represented by A. Weber, was based on a particular hypothesis with a small number of location factors, such as transport costs and labor costs.

Traditional factors are still important, but they are becoming less dominant, and non- economic factors such as living conditions are receiving more attention than in the past. When a manufac-

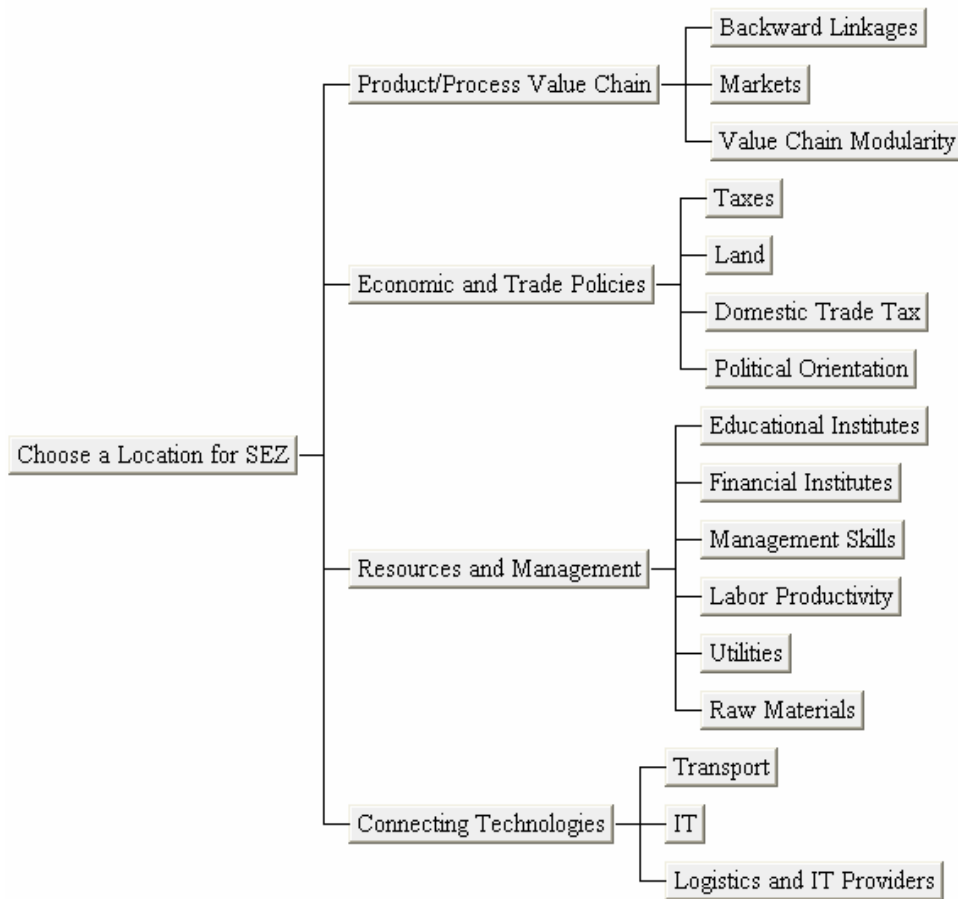


Fig. 5.7 Hierarchical structure of location factors for SEZ selection

turer sets up his plant in the SEZ, the location selection process involves two fairly distinct stages: the selection of states and the final decision on a specific SEZ in a state. The SEZs are approved by the Central Government but the state Governments has mainly a stake in it. The land and work force and some of the taxes are in the domain of the state government.

The location factors for SEZ selection are divided into the following groups:

1. Factors directly related to production activities and value chain such as raw materials, suppliers quality, design and other value chain related functions.
2. Factors relating to connecting technologies such as port and airport infrastructure, transport, IT connectivity, logistics and software service providers.
3. Factors related to the government policies such as land allotment, tax breaks at both central and state level, taxes when outsourced locally outside the SEZ and also when sold.
4. Factors relating to the availability and quality of the resources: natural resources such as raw materials, water, industrial inputs such as power, human resources and their produc-

tivity, management skills for global sourcing, global marketing and global human resource management and availability financial inputs such as venture capital firms and so on.

We have shown in Figure 6.3 three levels of indices. Each of the level three indices can be subdivided into evaluation indices for which numerical values can be assigned. For example under IT one can have the indices such as B2B connectivity, number of internet connections, software providers and their quality and so on. Using this information one can work backwards using techniques such as AHP to find the relative importance of the various factors and finally the score of the SEZ with references to these factors.

Our method here is more abstract and come from the factors important in the design to the evaluation indices. This is in contrast to a number of studies including the World Banks investment climate where the selection of the evaluation indices was rather ad hoc. Our methodology also allows us to change one of the evaluation parameters such as the port dwell time or the corporate taxes.

### 5.8.1 Project Selection

Foreign direct investment is usually sub-divided into three-types. The investment could be in producing goods and services for export or for domestic market. Investments in infrastructure are the third category. Investing in SEZs involves all the three types of FDI. Investing in infrastructure is the riskiest for the investor and probably the most useful for the country receiving the FDI. With the promise of reliable power, telephone, transport network and information technology networks for the SEZs by the governments, the risk may not be as great as earlier. Multiple partners from different countries may be a wise option for risk pooling. Investments in companies inside the economic zones have the potential of large profits in the near term.

Indian domestic market is huge, FDI can be in units producing new products and services that were previously unavailable in the market probably using new production processes. Further more; with SEZs opening up in other South Asian developing countries the opportunities for using the learnings from the Indian experience in other countries are immense.

What kinds of projects should be selected for location in an SEZ is the question that each developer faces. The projects selected should fit in to the geographic and economic environment of the SEZ. The location of the SEZ should have the backward linkages for procurement of the raw materials and the project should thrive in the location industry environment, the internal and external logistics infrastructure to carry the products to the local or global markets, the local human skills to support the manufacturing and marketing and the financial institutions to support the venture. The projects also gain from other selected projects some times with complementary products. For example a petroleum refinery project will benefit by the presence of a third party logistics provider and a shipping line. Equally important is the investment analysis for each project: investment amount, recovery period, returns rate and risk of capital. Thus economic and technical evaluation of each project and comprehensive joint evaluation of all projects is needed. Methodologies for evaluating and ranking a set of proposed projects based on identifying and quantifying certain key target criteria and for joint evaluation projects include simulation, multi-attribute analysis, analytic hierarchy process etc. We believe the selection of the right kind of projects is a must for the overall competitiveness of the SEZ.

## 5.9 Conclusions

India is booming and the signals are there all over. Several companies and countries are interested in investing in India. Investing in India has dual advantage of producing for a huge domestic market as well as access to fertile natural resources and skilled and unskilled human resources. Investment in an SEZ in India will save time and effort involved in the bureaucratic processes for setting up operations in India. The Indian market size can absorb all that is produced; however, the investors have the option of export and repatriation of the proceeds. Singapore companies have worked in India and have implemented flagship projects such as the Bangalore Technology Park. The opportunity India provides is real and there will be other immense future opportunities as the India story unfolds.

The recent renewed interest in the creation or revival of regional trade/integration arrangements (RTA/RIA) has raised questions regarding the potential status and role of SEZs in such economic entities. This relationship is multifaceted and complex. Whether SEZ firms and countries in which they operate would be hurt by the creation or revival of an RTA/RIA is determined by the membership in or exclusion from such an arrangement.

## References

1. Ashok Kundra, *The performance of Indias export zones: a comparison with the Chinese approach*, Sage publications (2000).
2. Wei Ge, *Special Economic zones and the Economic transition in China*, WorldScientific (1999).
3. Nirupam Bajpai and Nandita Dasgupta, "Multinational Companies and Foreign Direct Investment in China and India," *CGSD Working Paper No. 2* (January 2004).
4. Aradhna Aggarwal, "Export processing zones in India: Analysis of the export performance," Working Paper no. 148, *Indian council for research on international economic relations* (November 2004).
5. W. A. Porter, "Clusters and the new economics of competition," *Harvard Business Review*, pp: 77-90, (Nov-Dec 1998).
6. The World Bank, *India: Investment Climate Assessment 200*, Washington and ND, Finance and Private Sector Development Unit South Asia Region (November 2004).
7. Dorsati Madani, *A Review of the Role and Impact of Export Processing Zones*, The World Bank, Development Research Group (November 1999).
8. FICCI-KPMG study, "Driving Growth through Special Economic Zones," Theme Paper, *International Convention On Special Economic Zones* March 21 - 22, New Delhi (2002).
9. CII Northern Region, *Special Economic Zones-Engines for Growth* <http://www.sezindia.nic.in/> (May 2006).
10. Shigeru Yurimoto and Tadayuki Masui, "Design of a decision support system for overseas plant location in the EC", *Int. J. Production Economics* 41:411-418 (1995).

# 6 FDI Attractiveness of Indian States and Location Choice of MNCs

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Not everything that counts can be counted and not everything that can be counted, counts

—Albert Einstein

## 6.1 Introduction

A global supply chain spans several countries and regions of the globe. Trade liberalization (European Union, NAFTA) and information technology have accelerated the growth of global supply chains, whereby a firm can invest and trade across national borders. It is now a competitive requirement that firms invest all over the globe to access markets, technology, and talent. Firms could trade across national borders either by intra-firm-trade (FDI) or arms-length-trade (foreign outsourcing). International trade and foreign direct investment FDI have been among the fastest growing economic activities around the world. FDI is the movement of capital across national frontiers in a manner that grants the investor control over the acquired asset. FDI includes corporate activities such as building plants or subsidiaries in foreign countries, and buying controlling stakes or shares in foreign companies.

FDI stocks now constitutes over 20% of global GDP, which in effect has contributed to the economic growth of developing countries. Firms located in industrialised countries pursue vertical disintegration of their production processes by outsourcing some stages in foreign countries where economic conditions are more advantageous. For example, Intel Corporation assembles most of its microchips in wholly-owned subsidiaries in China, Costa Rica, Malaysia, and the Philippines. With proven results that FDI by multinational corporations (MNCs) increase employment, exports, revenue, and knowledge spill over to host country's private/public sectors, many governments have introduced various forms of investment incentives, to encourage foreign owned companies to invest in their jurisdiction.

Pre 1990, India allowed only up to 40% FDI, selectively in few sectors. The FDI policy reforms that started in 1991 has resulted in tremendous increase of FDI flows into the country. Currently FDI up to 100% is permitted in all sectors except a few. The total inflow of FDI has increased

almost 1321% from USD 264.1 million in 1991 to USD 3.8 billion in 2004 [16]. The sectors attracting investments are diverse including software, transportation, food processing, chemicals, and metallurgical industries. The top ten countries investing in India include Mauritius, Japan, and South Korea in addition to USA, Germany, France, and Switzerland.

One of the strategic decisions faced by an MNC is the location decision of the subsidiary within India. Usually the location choice problem of MNC is only considered at a national level in the literature. This national level choice is made in tandem with other organizational decisions like mode of FDI (joint venture, acquisition, greenfield), investment budget, level of activities at the new subsidiary, etc. Choosing a nation for FDI is hence related directly with many other firm-level decisions. In this work, we consider the location choice at the subnational level, with focus on location choice in India.

A MNC with greenfield FDI has to set up a new subsidiary in India. The diversities in India pose great challenges and also opportunities in choosing an optimal location. We consider in this work a single plant location. Given the type of the business undertaken by the MNC, it is relatively easy to list the potential locations in India. However, choosing the optimal one taking into account the objectives of the firm and the location characteristics is a non-trivial problem. One can obtain substantial amount of information regarding the locations from specialized sources or the statistical data provided by international and national independent research agencies. We develop a decision support framework, which helps in using the above vast and diverse information in a rational and systematic way to arrive at the location decision.

Specifically, we are concerned with ranking of  $N$  alternate locations based on  $M$  location attributes. This is a multiple criteria decision analysis problem. The paper is not about location selection for particular industry like automobiles or for a specific kind of facility like warehouse. In contrast, we develop a generic framework that can be used by the decision maker for location selection problems in global supply chains. It is obvious that every location selection problem is unique in the requirements of the investing firm and the intended business activity. However, they all share certain generic characteristics and in this paper we identify and formalize these characteristics. We propose a hierarchical structuring, called as the PERC model, to homogeneously cluster the  $M$  location attributes under appropriate criteria. Following this analysis stage is the synthesis, where the weights for the attributes and the criteria are first elicited from the decision maker using the above hierarchical clusters. This is then combined with the information about the  $N$  locations for the  $M$  attributes to arrive at the final ranking. For this stage, we recommend the use of *analytic hierarchy process* (AHP), though in principle other multicriteria decision techniques like *multicriteria utility theory* can be used. We illustrate the applicability of the framework using an hypothetical biotech firm that intends to locate its R&D activity in India.

The remainder of the chapter is organized as follows. The problem of multiple criteria evaluation of locations is described in Section ???. Section ??? briefly reviews the literature related to location selection studied by different schools of thoughts. The PERC model used for the analysis stage of the decision framework is proposed in Section ???. The analytic hierarchy process, which is used for the synthesis, is briefly described in Section 6.6. Section ??? presents a stylized case study of locating a biotech R&D in India using the proposed framework. Final notes and conclusions are drawn in Section ???.



## 6.2 Subnational Location Choice Problem

India is administratively divided into 28 states and 7 union territories. Due to the diversities in geography, climate, culture, language, tradition, resources, and political governance, economic performance of Indian states vary drastically. For example, the gap in per capita incomes is lot wider between the states Maharashtra and Uttar Pradesh, or Punjab and Madhya Pradesh, than it is between India and China [42]. The investment climate variations within India is very significant: almost all the FDI were attracted by the following high performing states: Maharashtra, Delhi, Gujarat, Andhra Pradesh, Karnataka, Punjab, Tamil Nadu, and Haryana.

With such diversities in India with respect to economics, politics, resources, and technological advancements, it is mandatory for both business and public policy decision-makers to consider the location choice problem at a more explicitly *local* level. The development of areas of free trade and free factor mobility, such as EU and NAFTA, have led to researchers take into account factors pertaining to the level of the region or city rather than at the level of the nation. A decision-making process for plant location in EU [46] consisted of selection of country, followed by the selection of the sites within the country. Different factors were considered for the above two decisions. Hence, it is important to identify the differences in the location choice problem at the national and the subnational level.

### 6.2.1 Location Choice: National vs Subnational

An MNC faces two kinds of location decisions in FDI. The first location decision of an MNC is to select a nation for FDI from a set of predetermined nations. This decision is a complex one as it subsumes within it the following decisions [34]:

- *Mode of entry*: whether the FDI is implemented through a *greenfield* investment or an *acquisition* or *joint venture*.
- *Industry of entry*: whether the FDI occurs in the main line of business of the parent MNE or represents a diversification away from this business.

Once the country for FDI is determined, the firm has to choose the location within the country for its intended subsidiary. If the mode of entry is through acquisition, one of the deciding factors is the location of the firm being acquired. However, for greenfield investments and joint ventures (in some cases), the MNC faces the subnational location choice problem. This problem inherits many of its characteristics from the national level problem. Based on the nature of the firm, the location choice problem is defined differently.

With relevance to this work, we identify three different types of firms:

1. *Single-plant firm*: A MNC which wishes to locate a *single* plant or business activity. The location choice problem is to find a single location from a given set of potential locations.
2. *Vertical multi-plant firm*: A firm with a multi-plant production process and plans to locate each plant in a different location. Here the location choice problem is to choose the location for each plant simultaneously, taking into account their interactions.
3. *Horizontal multi-plant firm*: A firm with decentralized plant locations across the country, catering to the demands locally from the nearby plant. The location choice problem in this

case is similar to the classical *facility location problem* [11]. Given the demand patterns and a set of production facilities with production costs and transportation costs, the problem is to choose a set of production facilities to open and determine the amount of flow between the opened facilities and the demand points, such that overall cost is minimized.

In this work, we consider the location choice of a single-plant firm. Henceforth, unless specified, the words *firm* and *MNC* refer to a single-plant firm and the *location choice* refer to the subnational location choice of the single-plant firm.

### 6.2.2 Dynamics of the Subnational Location Decision

Consider the example of an MNC interested in setting up a drugs and pharmaceutical plant in India. The industry is clustered in the following four cities: Ahmedabad, Mumbai, Delhi, and Hyderabad <sup>1</sup>. The MNC is interested in locating its subsidiary in one of the above four locations. Given such a scenario, the dynamics of the location decision process can be summarized in the following steps:

1. Evaluate and rank the four locations with respect to various attributes and the MNC's firm level characteristics and objectives.
2. Choose, say for example, two of the top ranked cities and negotiate with the respective state governments for possible incentives.
3. Based on the outcome of negotiations, goto step 1 and evaluate the locations using the new information. If further negotiations are not possible, choose the top ranked location as the location for the plant.

The above dynamics is illustrated in the figure 6.1. Thus there are two decision problems: *evaluation of locations* and *negotiation with state governments*. The incentives and the hospitality of the host governments play a major role in location decision at the national level. This also holds true for subnational location choice, as the Tamil Nadu government's hospitality was one of the influencing factors of Ford's choice of Chennai for its integrated manufacturing facility (in addition to other factors like skilled workforce, ports, electricity, water, etc) <sup>2</sup>. It has been pointed out that the location of FDI is a two player game between the MNC and the host government. The host government attempts to elicit desired behavior from the MNC using direct (through legislative and executive controls) and indirect (through incentives) stimuli [28]. The literature on the interaction between the host government and the MNE is comparatively smaller, since in the international business intellectual tradition, the firm is always assumed to choose amongst several alternative locations, greatly reducing the bargaining power and role of the host government [34]. The multi-lateral interaction of the MNC with several host governments simultaneously can also be modeled as a auction game with competitive bidding [10]. In this work, our focus is on the evaluation and ranking of the locations, which is the integral component of the location decision.

With respect to the current drug and pharmaceutical MNC, the evaluation and ranking of the locations can be explained as follows. Firstly, the MNC is assumed to possess the following information:

<sup>1</sup>[http://www.nifindia.org/bd/list\\_industrial\\_clusters](http://www.nifindia.org/bd/list_industrial_clusters)

<sup>2</sup><http://www.chennaibest.com/cityresources/Automotive/fordinterview.asp>

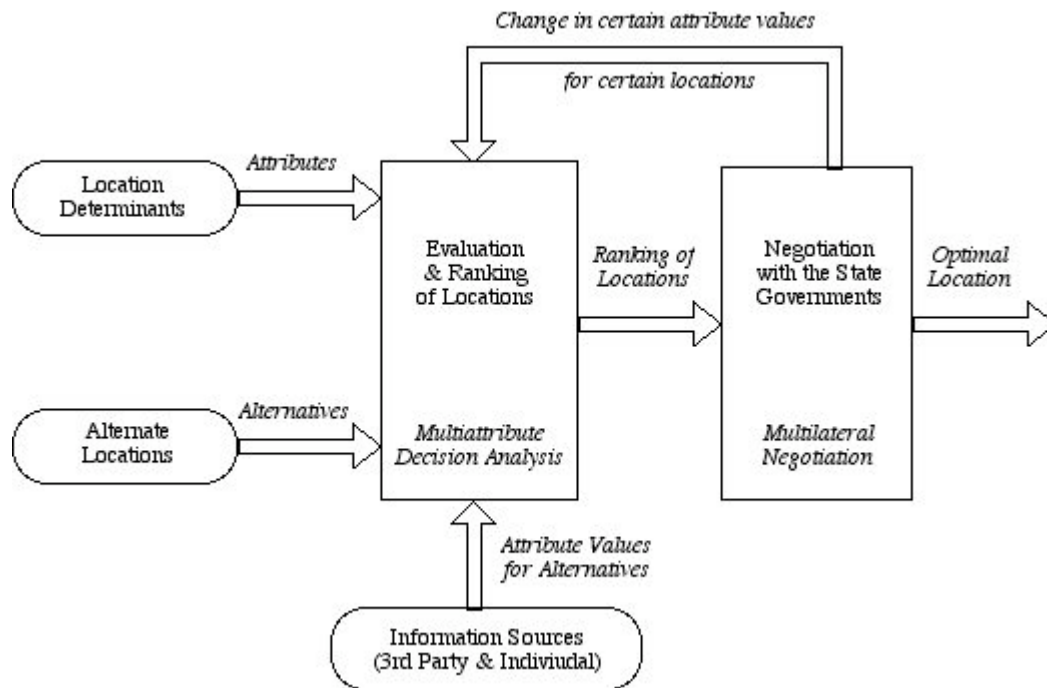


Fig. 6.1 Dynamics of the Subnational Location Decision Process

- *Potential locations*: Ahmedabad, Mumbai, Delhi, and Hyderabad.
- *Firm level characteristics*: Imports, exports, local market, size of the firm, etc.
- *Location determinants*: Transportation costs, labour costs, availability of suppliers, ports and logistics network, corporate tax, corruption, electricity, etc.
- *Location information*: Information about the four locations with respect to the above location determinants. The information can be obtained through individual investigation and/or third party databases (World bank <sup>3</sup>, Indian Investment Centre <sup>4</sup>).

Given the above information, evaluation and ranking of the locations is a *multi-attribute decision analysis* problem [47]. Given a set of finite *alternatives*, a finite number of *attributes* or *criteria*, the problem is to evaluate the alternatives with respect to the different attributes. The has to evaluate a location based on multitude of information like transportation costs, tax, etc. The evaluation is achieved through the use of *scores* and *weights*. The scores are the attributes values for the locations. The weights reflect the relative preference of the firm for the attributes. The relative preference or importance of the attributes is based on the firm level characteristics. For example, if the firm has considerable exports and imports, then presence of a port in the location is relatively more important. Each location is evaluated by combining the *scores* using appropriate *weights*. The

<sup>3</sup><http://www.worldbank.org/sar>

<sup>4</sup><http://iic.nic.in/>

Location Choice	Multi-attribute Analysis
Locations	Alternatives
Locations determinants	Attributes
Firm level characteristics	Weights for the attributes
Location information	Attribute values

**Table 6.1** Mapping of the location choice problem as a multi-attribute analysis problem

mapping of evaluation of the locations as the multi-attribute decision problem is summarized in Table 6.1. In the next section, we review the related techniques and models for the location choice in the literature.

### 6.3 Related Literature

The industrial location choice problem is addressed by *location theory*. The location theory is concerned with the geographic location of an economic activity and hence it has become an integral part of *economic geography*, *regional science*, and *spatial economics*. The MNC location behavior, in particular, has been studied by *international business* and *management science* community. The problem has been studied with various assumptions and views by the above disciplines. It has been noted that the above disciplines in isolation are unsuitable to explain the current MNCs location behavior [30]. However, the above disciplines, though varying in their perspectives, have identified several significant location determinants and decision insights, which are used to develop our decision support framework. We briefly review the related literature by broadly classifying them based on the conceptual frameworks.

#### 6.3.1 Location-Production Models

These are the earliest and simplest analytical models and referred commonly as Weber's and Moses models. These classical and neoclassical microeconomic models analyze the production behavior of an individual stylized firm in relation to the spatial economic costs. These costs include local labour prices, land costs, transportation costs, and telecommunication costs. The objective is to locate a plant in the plane by minimizing the weighted sum of Euclidean distances from that plant to a finite number of sites corresponding to the markets where the plant purchases its inputs and sells its outputs. Some of these models also consider the production as a decision variable, which often depends on the location. Interested readers are referred to [29] for an excellent review of the range of microeconomic location-production models. In our location choice problem, we consider only the location decision and production levels are not variables in the model. These models are still popular and currently used in the early stages of location selection (step 2 in Section ??) to identify the  $N$  alternate locations. The common feature of the above models is the consideration of the firm or plant in isolation without any competition from other firms.

### 6.3.2 Agglomeration Economies

The inclusion of other firms from the same or related industry in the analysis, brings out a new set of factors for location decision. The regional science community use the term *economies of agglomeration* to describe the benefits that firms obtain when locating near each other. It is related to the idea of economies of scale and network effects, in that the more related firms that are clustered together, the lower the production cost and the greater the market. The production costs are lower due to availability of specialized resources, such as competing suppliers, skilled labour, and infrastructure. On the demand side, the informational externalities from other firms and the reduction in consumer search costs are beneficial for total market demand. Several studies show that the agglomeration economies are dominant factors in the location choice of MNCs for FDI [21, 8, 6, 4, 19].

This agglomeration phenomena, from management science literature, is explained using the *clusters* [36]. Clusters are geographic concentrations of interconnected companies and institutions in a particular field. The linked industries and institutions can consist of suppliers to universities to government agencies. Clusters promote both competition and cooperation. For a firm, location in clusters is a source of competitive advantage. The other related model is *core periphery* model that explains why certain regions or cities attract more industries than the others. Such clustering of industries are explained through *cumulative causation* or *multiplier effect*. *New economic geography* [18] uses general equilibrium models to explain the location of industrial and economic activities. All these models reinforce that the presence of other firms in the same or related industries is an important location decision factor.

### 6.3.3 International Business Literature

A firm in a global supply chain is essentially an MNC and hence location decisions from international business literature are relevant to this paper. The Dunning's eclectic OLI (ownership, location, and internalization) [12, 13] framework is the widely accepted model for the study of MNCs. The OLI framework suggests that a firm will prefer FDI to trade and become a MNC if the following three conditions are satisfied. First, the firm must possess *ownership* advantages not available to other firms in terms of superior technology, firm size, brand name, etc. Second, the foreign market should offer *location* specific advantages like market size, cheap resources, and infrastructure. Finally, there should be *internalization* advantages, which eliminates the transaction and coordinations costs associated with market interaction and internalizes these activities by bringing them inside the hierarchy of the firm. The framework is also used in the analysis of location decision [33] and mode of entry decision [7]. Accordingly, the location decision is contingent on ownership and internalization factors. This framework is more useful for location choice at the national level, which also takes into account the mode of entry.

### 6.3.4 Multiattribute Decision Models

Except for the location-allocation models, the above are not prescriptive decision models that can aid a DM to select a location. A linear additive MAUT based location evaluation was used to locate a manufacturing facility in [25]. AHP has been used extensively for a wide variety of location problems: generic plant location [43, 45]; sure service terminal location [22]; landfill siting problem [15]; location of international consolidation terminals [32]; overseas plant location [46];

global facility location-allocation problem [3]; industrial plant location [1]; international location decisions [2]. All the above models first created a hierarchical structure of criteria and used the multicriteria technique (AHP/MAUT) for location evaluation. These models are also used for measuring the investment climate and market attractiveness of different locations .

### 6.3.5 Industry Best Practices

Location consultants aid the firms in the complex decision making of selecting a location for expansion or investment or relocation. They usually support the whole location selection process (all the steps outlined in Section ??), starting from the initial search of locations till the negotiations on investment subsidies and agreements on land and/or buildings. The book by [31] is an excellent source on industrial location selection process with real world cases and experiences. It should be noted that the location consultants do a lot more than the evaluation of locations, which is the main theme of this paper. However, the author who has worked on more than 1500 location cases states that this step (step 5 in Section ??) is the most difficult and least understood part of location studies [31]. The author uses a multicriteria model with assigning of weights directly in a one to ten scale and many of the location consultants use this simple linear additive technique. IBM Plant Location International<sup>5</sup> uses a hierarchy of criteria clustered as quality factors and cost factors. The weights are directly assigned based on experience. Many popular location consultants listed by Global Direct Investment Solutions<sup>6</sup> use the technique of directly assigning and combine them in a linear additive fashion to get a final rank.

Buck Consultants International<sup>7</sup> (BCI) developed a cost-quality matrix to compare different locations. The matrix has a vertical axis showing all costs for the next 5 years (labour costs, transport costs, occupancy costs, etc. minus investment subsidies / grants), and a horizontal axis showing the quality of the investment climate in a weighted form (labour quality and flexibility, labour regulations, technological expertise available, logistics qualities of the location, availability of suppliers, etc.). An optimal location is the one with low costs and high quality business environment. DealTek<sup>8</sup> provides a web based decision support software called as DEALS to search and rank locations in US. The software combines the economic and demographic data with the user inputs to rank the locations. The user inputs include the usual project specific information and financial projections. The innovative feature of the software is that it allows the user to input possible business scenarios, under varying assumptions on the economy conditions, like *Optimistic*, *Most Likely*, and *Pessimistic*. The locations are first shortlisted using user selected criteria from a set of pre-defined criteria like labor cost, labor availability, etc). Then these locations are ranked taking into account the business scenarios, financial projections, etc. The software also includes *what-if* sensitivity analysis module, which allows the user to vary the parameter values to see their effect on the rankings.

The above brief survey is intended to provide an overview of the location selection problem studied from different perspectives. For a more expository review, see [44] and references therein. The reader would have also noted how the location problem has changed with the evolution of

<sup>5</sup><http://www.ibm.com/bcs/pli>

<sup>6</sup>[http://www.gdi-solutions.com/profsvcs/lists/location\\_consultants.htm](http://www.gdi-solutions.com/profsvcs/lists/location_consultants.htm)

<sup>7</sup><http://www.bciglobal.com>

<sup>8</sup><http://www.dealtek.com>

a single isolated firm to be a part of a global supply chain. In the following we describe our proposed two stage analysis-synthesis decision framework.

## 6.4 Methodology

### 6.4.1 Multiple Criteria Evaluation of Locations

The industrial location decision making is a highly complex process with multifaceted characteristics including tangible and intangible elements that are very difficult to measure and evaluate [20]. The basic steps involved to arrive at the best possible location recommendation are [31]:

1. The basic requirements of the location project are first identified, usually by using an all-purpose location questionnaire. From this, critical and desirable factors for the locations are determined. Critical factors are mandatory factors that play a prohibitive role in identifying locations. For example, if seaport is a mandatory factor then locations without seaports can be eliminated for consideration.
2. A list of  $N$  alternate locations are shortlisted that satisfy the mandatory critical factors. Matching algorithms are sometimes used to determine these locations by estimating matching scores between the locations and the desirable location factors.
3. Based on the intended investment and the nature of the investing firm,  $M$  location attributes are identified. These are the location factors over which the  $N$  locations are to be evaluated.
4. Information about the  $N$  locations for each of the  $M$  attributes are obtained using public databases, private investigations, and personal meetings with the local authorities. This includes quantitative information like economic cost analysis of non-recurring and recurring costs, prediction of future sales, return of investment, production efficiency, government incentives, etc. Also qualitative information like living conditions and political climate are also determined.
5. The  $N$  locations are ranked with respect to the  $M$  attributes. This is a multicriteria decision analysis problem.

The first two steps are relatively easier. They are both dependent on the industry level characteristics and firm level characteristics. There are some mandatory requirements for any business investment. For example, the new manufacturing plant should have easy access to a port on the eastern coast is a mandatory requirement. This may be because the new plant will have foreign trade with Singapore and Malaysia. With this constraint, one can list the possible locations. With several such mandatory requirements or constraints, identifying the possible locations is a constraint satisfaction problem. If there is only one location that satisfies all the constraints, then the location choice is solved. If there is more than one location, then the optimal has to be chosen.

The optimality is measured with respect to a set of location factors. Identifying the location factors depends on the industry and firm level characteristics. For locating a R&D unit, *number of research institutions* and *IT connectivity* are important location factors. On the other hand, for locating a manufacturing plant, *land cost*, *labour wage*, *electricity charge*, *water availability* are the factors. Depending on the firm to locate, the number of factors can vary from 10 to 100. A list of location factors considered in several studies [46, 16, 42] is tabulated in table 6.2 under different categories.

**Table 6.2** Factors influencing location decisions

<b>Industry Inputs</b>	Industrial electricity charge; industrial water charge; availability of land; land cost; labour wage; overstaffing rate; number of white-collar workers; number of blue-collar workers; educational & training institutes; collaboration with local universities;
<b>Agglomeration &amp; Network Economies</b>	Localization economies measure; economic diversity: Chinitz-Jacobs diversity measure and Herfindhal measure; location quotient;
<b>Communication Technologies</b>	Number of days to get connections for various technologies: telephone, wireless, internet; bandwidth; network readiness index; mail & postal;
<b>Transport</b>	Distance to nearby sea port, airport, railway station; transportation costs for various modes; domestic and international connectivity;
<b>Laws &amp; Regulations</b>	Difficulty of interface with various government departments: labour, customs and excise, income tax, pollution control, electricity board, water board; corruption level; amount of time spend with government officials; frequency of government official visits;
<b>Economic &amp; Financial</b>	Corporate income tax; imports tax; exports tax; financial incentives; availability of funds and loans; GDP; growth rate; buying power;
<b>Risks</b>	Political stability; intellectual property protection; friendliness of the government; conflicts with the neighboring governments; communal disputes;
<b>Living Conditions</b>	Consumer price index; crime rate; real estate prices; number of hospitals;
<b>Third Party Services</b>	Legal; advertisement; logistics;

The list is not exhaustive and some of the factors are interrelated. However, it provides a higher level view of the factors that can influence the location choice decision.

The main theme of the report is the last step in the above process, which is to evaluate and rank the locations. If there is only one location factor, then the problem is trivial. With more than one location factor, the problem is a multi-attribute decision analysis problem *i.e.* evaluating the locations with respect multiple number of attributes or factors. For this evaluation, the decision maker requires the information regarding the locations for each of the factors. If the location factor is number of research organizations, then the decision maker should know the above for each of the locations. With this information, one can determine how good or bad a location is with



		Location Factors (Attributes)					Total Scoring for the Location		
		Att <sub>1</sub>	⋯	Att <sub>j</sub>	⋯	Att <sub>M</sub>			
		(Weights)	$w_1$	⋯	$w_j$	⋯	$w_M$		
		(Scores)							
Locations (Alternatives)	Loc <sub>1</sub>		$s_{1,1}$	⋯	$s_{1,j}$	⋯	$s_{1,M}$		$\{W^T\}\{S_1\}$
	⋮		⋮	⋮	⋮	⋮	⋮		
	Loc <sub>i</sub>		$s_{i,1}$	⋯	$s_{i,j}$	⋯	$s_{i,M}$		$\{W^T\}\{S_i\}$
	⋮		⋮	⋮	⋮	⋮	⋮		
	Loc <sub>N</sub>		$s_{N,1}$	⋯	$s_{N,j}$	⋯	$s_{N,M}$		$\{W^T\}\{S_N\}$

Fig. 6.2 Multiattribute Evaluation with Weights and Scores

respect to each of the attributes. If there is a location which is superior to the other locations in all the attributes, it is the optimal choice. However, such locations rarely exist in reality. Usually, a location is better with respect to some set of attributes and some other location is better with respect to a different set of attributes. Hence the problem is to consolidate and synthesize all the information to rank the locations with respect to all the attributes.

Let there be  $N$  locations (alternatives) and  $M$  location factors (attributes). Let the required information about these  $N$  locations with respect to  $M$  factors be known. Now to evaluate the locations, two numerical entities are required:

- *Weights*:  $W = \{w_1, \dots, w_j, \dots, w_M\}$ .
- *Scores*:  $S_i = \{s_{i1}, \dots, s_{ij}, \dots, s_{iM}\}, i = 1, \dots, N$ .

The relative importance of the location attributes (as perceived by the DM based on the firm’s objectives and constraints) are denoted using the weights  $W$ . The scores, on the other hand, rates the performance of a location for each of the attributes. The total score for a location  $i$  is then obtained by combining the weights  $W$  and the scores  $S_i$  in some mathematically acceptable way, which depends on how the weights and scores are represented and obtained. Figure 6.2 illustrates the multicriteria analysis using scores and weights. In the figure, the total scoring function  $\{W^T\}\{S_i\}$  for location  $i$  is left unspecified and it can be any mathematically acceptable combination. The various multicriteria evaluation techniques differ by the way they *estimate* the weights and scores, and by the way they *combine* them. They can be formalized in two steps as arranging the criteria into a hierarchy (analysis) and then measuring how well the alternatives perform on each criterion (synthesis) [35].

### 6.4.2 Analysis

The analysis starts with the identification of *criteria* and *attributes*. We use the word *criteria* to refer to objectives or directions along which the DM seeks better performance from the alternatives. The performance is measured in terms of *attributes*. For example, the criterion economic factors can be measured using attributes income tax, property tax, and sales tax. There is a considerable interplay in the identification of criteria and attributes. This complex creative process is achieved

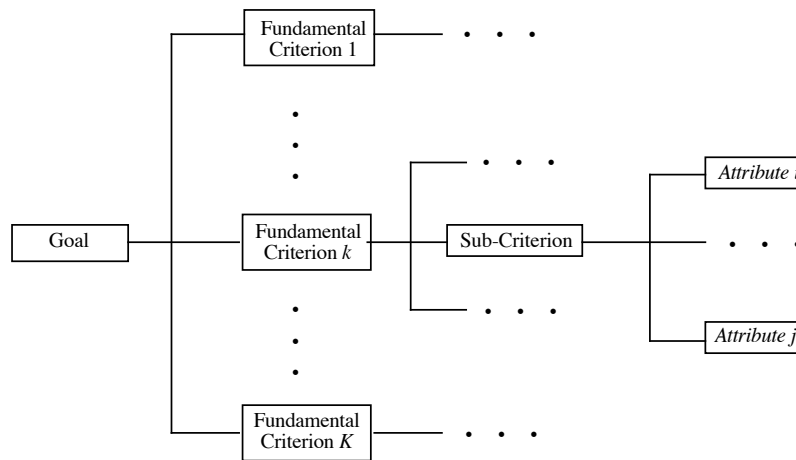


Fig. 6.3 Hierarchical Structuring of Criteria and Attributes

through hierarchically structuring homogeneous clusters of criteria and attributes [27, 26, 37]. The resulting multilevel hierarchy is shown in Figure 6.3. The fundamental criteria are next to the overall goal and can be further divided into sub-criteria, sub-sub-criteria, and so on, till they cannot be further subdivided. This last level contains measurable attributes, which in our case are the  $M$  location attributes. These are measurable in the sense that numerical scores can be given to the locations for each of these attributes. The hierarchy implies a one way dependence relationship from a parent node to its child node. There are models that can incorporate other kinds of dependence like feedback, by creating a network of criteria and attribute nodes [26, 38].

### 6.4.3 Synthesis

Given the hierarchy, the next step is the application of a multicriteria decision analysis technique, which determines the weights  $W$ , scores  $S$ , and combine them to give a final ranking. The hierarchical clustering of criteria and attributes is used to elicit the weights  $W$  from the decision maker. To be precise, the weights  $W$  are derived for all the criteria and sub-criteria, in addition to the attributes. The final score for a location is obtained through multilinear superposition of weights and scores. First the linear combination of scores with the corresponding weights is obtained for attributes that have the same parent criterion. This becomes the score for that criterion. This is repeated for all attributes and all criteria at each level, till the goal node is reached, which gives the final consolidated score for the location.

Two commonly used multi-attribute analysis techniques [5] for problems involving *few* alternatives and *many* attributes are: *analytic hierarchy process* (AHP) [37] and *multi-attribute utility theory* (MAUT) [27, 14]. The two approaches differ both in theory and in practice in the assessment of criteria weights and scores. Unlike AHP, there are many ways by which the weights and scores can be obtained in MAUT. MAUT allows the DM to directly state the  $W$  (values) or estimate it as a utility function identified through risk lotteries. AHP uses paired comparisons of hierarchical factors to derive  $W$  as ratio-scale measures. There have been long standing debates between these

two schools of thought over the mathematical authenticity of the techniques involved. Nevertheless, both have been successfully employed in practice. An insightful comparison of both the techniques is presented in [5]. For a comprehensive study of different multicriteria techniques the reader is referred to [35].

We use AHP for the multi-attribute evaluation of locations. AHP has been used to resolve multi-attribute decisions in many hundreds of diverse applications by cognizant decision makers. The applications include business and R&D decisions by Xerox, engineering decisions by NASA, resource allocation decisions by DoE, strategic planning by DoD, etc [17, 39]. It has also been proposed as a decision methodology for location choice problem [46] and for evaluating market attractiveness [39, Chapter 9].

## 6.5 Analysis: PERC based Hierarchical Structuring

The analysis stage consists of identifying fundamental criteria and sub-criteria therein, to homogeneously cluster the locations factors or attributes. This would, to large extent, depend on the industry and the nature of investment. Our aim is to develop a generic analysis framework, which would help in identifying and grouping the attributes for location selection in global supply chains. We propose here the **PERC** framework to identify the activities and factors along four dimensions that affect the business operations and output. Using the PERC framework, the decision maker (DM) can structure the list of seemingly unrelated and incomparable location factors hierarchically with suitable sub-categories as shown in Figure 6.4.

### 6.5.1 PERC Model

There is little work in any area of multiple criteria decision making to advise on how hierarchies should be constructed and what makes a good hierarchical representation [5]. However, there are broad guidelines on the hierarchy development process and the properties that a hierarchical structuring should possess [27, 26]. In general, this phase is entirely under the control of the DM. There are many different ways one can cluster and form a hierarchy of criteria and it is not possible to claim or prove the betterness of one over other. Table 6.3 presents different hierarchical clustering proposed in literature and being used in practice. The list is not exhaustive and it includes location selection problems studied from varying perspectives: locating in foreign countries [46, 2], locating manufacturing industries [45, 1, 2], locating R&D facilities [24], industry location consultants [23], and measuring market attractiveness of countries [39] and locations within a country [42]. There are two things that are evident from the Table 6.3. Firstly, the hierarchical structure depends on the particular industry and firm, and for the same type, one can arrive at different structures. The second observation is that there are some common features in these seemingly different location problems. To complement and extend these efforts, we propose here the PERC model, which is an abstract higher level model that consists of the following four fundamental criteria:

- Product/Process Value Chain
- Economic Integration
- Resources and Management

Fundamental Criteria	Sub-criteria
<i>Location of Japanese firms in European Commission [46]</i>	
1. Labour	labour force, costs, union;
2. Markets	product market, raw materials;
3. Transport	airways, railways, seaport, roadways;
4. Financial inducement	tax, country risk, loan availability;
5. Living conditions	firms from host country, educational facilities, crimes, consumer price index;
6. Environment for operations	electricity rate, water charge, sewage facilities, rules and regulations;
<i>International location decision for manufacturing plants [2]</i>	
1. Cost	direct costs, indirect costs;
2. Quality of products	labour, infrastructure;
3. Time to markets	markets, suppliers, macro-environment;
<i>Industrial location decision [1]</i>	
1. Environmental aspects	regulations, disposal, taxation;
2. Cost	operating, start-up;
3. Quality of living	climate, crime rate, traffic congestion, living expenses;
4. Local incentives	tax, union, laws, skilled labour;
5. Time reliability provided to customers	proximity to centers, suppliers, customers, waterway, rail, highway;
6. Response flexibility to customer demand	proximity to suppliers and customers, other company's complimentary facilities;
7. Integration with customers	post-sale service, co-makership, co-design;
<i>Facility location selection [45]</i>	
1. Market	growth potential, proximity to market, raw materials;
2. Transportation	land, water, air;
3. Labour	cost, availability of skilled and semi-skilled labour;
4. Community	housing, educational, business climate;
<i>Locating global R&amp;D operations [24]</i>	
1. Demand factors	proximity to the final market, growth potential, response to local variations
2. Supply factors	local scientific talent, local technology, know-how
3. General competitive factors	competitive environment
<i>Benchmarking of European locations by IBM PLI [23]</i>	
1. Cost	property costs, labour costs;
2. Quality	staff availability, language skills, labour laws, international accessibility, attractiveness for international staff;
<i>Market attractiveness of developing countries [39, Chapter 9]</i>	
1. Political factors	turmoil, strategic relevance;
2. Economic-financial factors	risk of direct investment, GDP, inflation rate, growth rate of GDP;
<i>Investment climate of India for manufacturing industry [42]</i>	
1. Business environment	regulation, corruption, infrastructure, factor markets;
2. Agglomeration economies	own industry concentration, economic diversity, spatial distribution;

**Table 6.3** Fundamental Criteria and Sub-Criteria of Various Hierarchical Structuring.

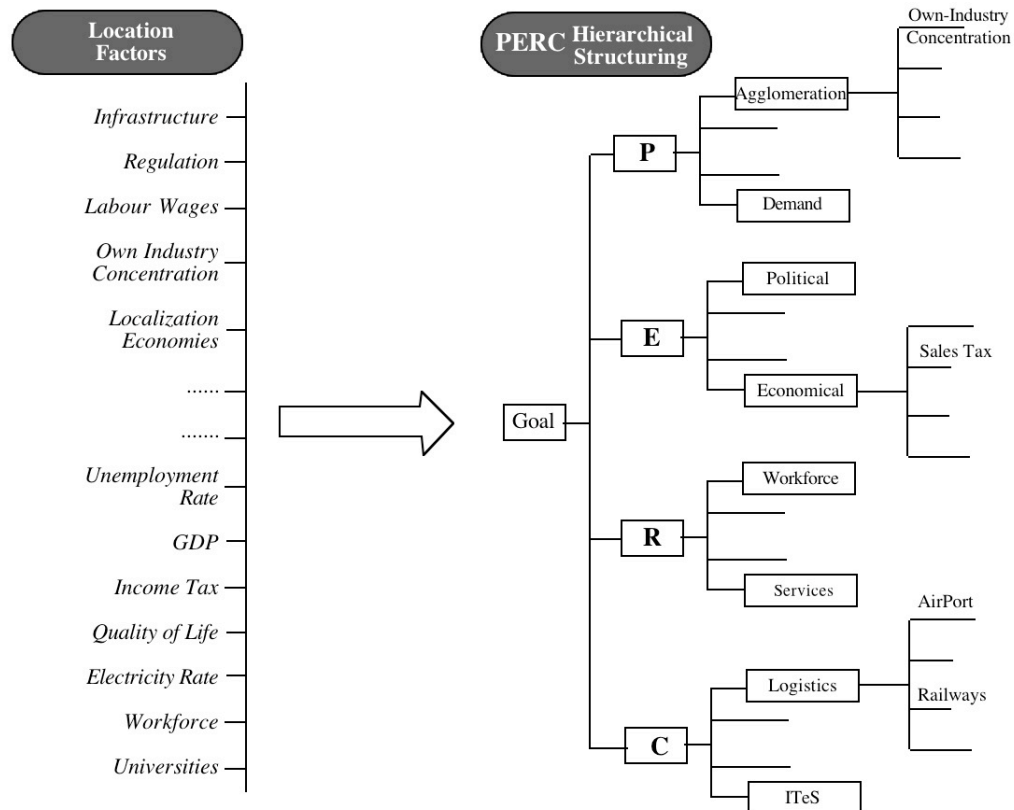


Fig. 6.4 PERC based Hierarchical Structuring

- Connecting Technologies

The above are the fundamental criteria in the hierarchical structuring. The sub-criteria under each of them are shown in Table 6.4. They are explained in detail in the following.

### 6.5.2 Product/Process Value Chain

The investment is intended for some business process like manufacturing a product or providing a service. This criterion is about the value chain dimension of the intended subsidiary. It is not about the entire global supply or value chain, but the part confined to the location. It is concerned about the forward and backward linkages, supply and demand (market conditions), agglomeration economies (competing and complementing businesses) and business process innovation (adapting to local markets, creating new business opportunities). The above aspects of the location are clustered under this criterion.

The important sub-criteria considered are the supply-demand and the agglomeration. The traditional supply-demand factors are enhanced in global supply chains in terms of cheap supplies, local demand, and potential for market growth. However, deviations and disruptions in demand

Fundamental Criteria	Sub-criteria
1. Product/Process value chain	suppliers, markets and demand, agglomeration economies and clusters, knowledge sharing and collaboration;
2. Economic integration	economic policies, trade facilitations, laws & regulations, financial inducements and incentives, political factors, living conditions;
3. Resources and management	human resources (skilled workforce), financial resources (loans, investors), utilities and industry inputs (land, water, power, educational and training institutes), management services (legal, marketing, business consulting, financial planning);
4. Connecting technologies	transport (rail, road, air, sea), information and communication technologies (Internet, wireless, landline, data);

**Table 6.4** Fundamental Criteria and Sub-Criteria of PERC Model.

and supply can result in costly discrepancies elsewhere in the global supply chain. Similarly, the stronger agglomeration economies and cluster effects provide many benefits and opportunities and also pose major risks. The presence of related businesses in the location reduces supply costs and provides huge demands. It also enables knowledge sharing and collaboration to make the business process efficient but knowledge spill-over could result in IP violations. Ignorance of domain knowledge will be an added advantage of the locals with added expertise due to knowledge spill-over. The agglomeration, on the other hand, can help in business process innovations by leveraging the global expertise to meet local demands. The DM, hence have to take into account the above conflicting factors to arrive at an optimal location decision.

### 6.5.3 Economic Integration

The economic and political factors play an important role in global supply chains. The interaction between the investing firm and the host government during the location decision has been modeled using game theory in the international business discipline [28, 10]. The host government attempts to elicit desired behavior from the investing firm using direct (through legislative and executive controls) and indirect (through incentives) stimuli. The firm is always assumed to choose amongst several alternative locations, greatly reducing the bargaining power and role of the host government [34]. However, the economic and political profile of the government plays a significant role in the location decision.

This criterion include taxes (income, sales, trade, import, export), regulatory framework (labor, environmental, legal), trade agreements, government incentives and subsidies, political stability, and living conditions. The obvious benefits of incentives, subsidies, and trade agreements also come with a great pool of risks like anti-dumping, voluntary export restrictions, and breach of promises. Once the investments are made, the bargaining powers of the firms are lost and are dependent on the functioning of the government. The exposure of the firm's information while applying for incentives is another risk encountered commonly in practice [31]. The indirect influences of the government like terrorism and crime are other sources of risk.

The regulatory framework is another major sub-criterion that is government dependent. Many studies [41, 16] based on surveys have indicated that rules and regulations (labor laws, licensing, environmental) are seen as an hinderance by firms. The bureaucratic framework results in

unproductive delays and non-transparent functioning leads to corruption. Finally, the intangible attributes living conditions and public attitude also have subtle effects on location selection.

The role of this criterion in location selection is evident at the national level, while choosing countries for investment. They also play an important role at the sub-national level for countries with federal system that is co-administered with several regional or state governments. Incentives, subsidies, and regulatory framework are generally the dominating factors while choosing a location within a country.

#### 6.5.4 Resources and Management

The third criterion covers the resources and the management of resources. The resources include human (skilled and unskilled), natural (raw materials, land, coast line), utilities (water, electricity), and also financial (loans, banks, venture capitalists). Management of resources is an important sub-criterion that is overlooked. Many global business operations largely depend on resource management skills like global sourcing, global marketing, research and training institutions, legal services, human resource training, and financial planning. The resource management complements with the resources and sometimes even substitutes when the resources are not available.

#### 6.5.5 Connecting Technologies

The final criteria is about how a firm connects to the external world using the transport and network infrastructure. The inbound and outbound flow of materials, manpower, information, and data are considered in this criterion. The obvious attributes include availability of sea ports, air posts, railways, road ways, freight forward costs, lead time, network readiness, IT connectivity, mobile networks, postal and courier system, IT enabled services, etc. The other network components due to globalization are customs clearance and quality tracking systems. International logistics flows are substantially more complex with more documentation like commercial invoices and customs paperwork. Hence, locations that employ automated trade documentation are advantageous.

The following characteristics of the PERC model are worth noting.

- The four fundamental criteria are integral to many global investments. Indeed, they can be interpreted as four forces whose interplay affect the evolution of a global supply chain. Their relative importance, however, depends on the industry and the investing firm. For example, in locating a large manufacturing plant, all the four criteria have almost equal significance, whereas in locating a call center, network connectivity and resources play a dominant role. Thus its widespread applicability lies in its genericness.
- The model is complete in the sense of covering all aspects and takes an end-to-end view of a global investment.
- It is a top-down approach by starting with the fundamental criteria first and then identifying the suitable sub-criteria and the attributes. It is not based on the importance of the attributes, perceived a priori by the DM. It is also not classified by the tangible or intangible nature of the attributes. It can aid the practitioners in identifying and grouping the attributes for new-age business processes, which are not yet well studied in literature.

- The number of fundamental criteria in the PERC model is optimal. As observed earlier, the main reason for an hierarchical structuring is to elicit the preferences of the DM for the attributes in terms of weights. It has been long observed in cognitive science that the comparative capability of human brain is limited to five distinct entities simultaneously. Thus too many fundamental criteria is undesirable and too few would result clustering of non-homogeneous attributes.
- The PERC model assumes that information about a location for the location factors is already known. For example, it is usual in production investments to forecast and project sales for period of five years. Similar to this are the risk evaluations. It is assumed that such calculations are already available to the DM.
- The PERC model only suggests what can be included under a criterion. Some of the attributes in the Table ?? are interrelated. For example, the benefit high labor availability is a mathematical inverse of labour cost. They can also be indirectly related like high taxes and poor infrastructure. The DM should make sure that such related attributes are not included to avoid double counting. The lack of a step-by-step cookbook procedure is an obvious outcome of its genericness, though the Tables 6.4 and ?? can be used as look-up tables by the practitioners.

## 6.6 Synthesis: Analytic Hierarchy Process

The second phase in the multi-criteria evaluation is to determine the scores for the locations for each of the attributes and weights for the attributes and criteria that reflect their relative significance. This multidimensional scale of measurements are then combined into a unidimensional scale of ranks. Out of the two commonly used methodologies, MAUT is preferred more by location consultants (Section 6.3.5), whereas AHP is advocated more by academicians (Section 6.3.4). To be more precise, location consultants use *value* function by directly assigning values to the criteria in some interval scale (say 1 to 10) and not *utility* function, which is elicited through risk lotteries. This direct assignment of values is subject to high degree of human subjective errors. On the other hand, use of utility functions, though mathematically infallible, is found to be difficult to understand and implement in practice for DMs. AHP is widely accepted as the best trade-off between mathematical accuracy and implementation in practice. It is also best suited to handle both tangible and intangible attributes along with objective and perception data, which is the norm in the location selection problem.

Given the problem in a hierarchical structure, AHP determines the scores and weights using pairwise comparisons of sibling nodes under each parent node. AHP ingeniously derives the weights and scores using *pairwise comparison*. Actually, it does not distinguish between scores and weights and they are called as *priorities*. The priorities are numbers on *ratio scales*.

The priorities are obtained for each set of siblings separately. The siblings are compared *pairwise* with respect to their parent and a numeric value is given, which represents the *ratio* of preference between the two factors. A matrix of pairwise comparisons is constructed by reference to the semantic scale and 1-9 numeric scale, shown in Table ?. Let  $A$  denote the matrix with scales assigned through pairwise comparisons.  $A$  is a positive, ratio matrix with  $a_{ij} = 1/a_{ji}$ . The priorities of the factors  $w$  is the normalized eigenvector associated with the largest eigenvalue of



Scale	Definition	Explanation
1	Equal importance	Two factors contribute equally to the objective
3	Moderate importance of one over another	Experience and judgment strongly favor one factor over another
5	Essential or strong importance	Experience and judgment strongly favor one factor over another
7	Very strong importance	An activity is strongly favored and its dominance demonstrated in practice
9	Extreme importance	The evidence favoring one factor over another is of the highest possible order of affirmation
2,4,6,8	Intermediate values between the two adjacent judgments	When compromise is needed
Reciprocals	If factor <b>F1</b> has one of the above numbers assigned to it when compared with factor <b>F2</b> , then <b>F2</b> has the reciprocal value when compared with <b>F1</b>	

**Table 6.5** The fundamental scale used in AHP for pairwise comparison

A. It is obtained by solving the following set of linear equations:

$$Aw = \lambda_{\max} w \quad (6.1)$$

The largest eigenvalue  $\lambda_{\max}$  will be greater than or equal to the size of matrix  $A$ . If it is equal to the size of  $A$ , then the judgement made from pairwise comparison is consistent. However, such consistency is rarely a reality in real world and AHP allows for such inconsistencies. Because each pairwise comparison is already a ratio, the resulting priorities will be ratio-scale measures as well. Once the priorities are obtained for all the nodes, the location is evaluated by *multi-linear superposition*.

## 6.7 Location of a Biotech R&D Centre

In this chapter, we illustrate the applicability of our proposed decision framework in modeling and solving the location selection problem faced by a global biotech firm. The problem is to locate a R&D facility in India. The following is not an in depth analysis, which is beyond the scope of this work. Further, the evaluation of locations in reality is ultimately made with subjective judgement (though objective and perception data are used) by the investing firm based on its objectives and characteristics [42].

India has long enjoyed a reputation as a destination for IT and business process outsourcing. Now, the country is fast emerging as a major center for cutting-edge research and development (R&D) projects for global multinationals. According to an UNCTAD survey, India has emerged as the third most attractive prospective destination for setting up research centres by the world's largest corporations looking to expand their R&D activities worldwide during 2005-09 [40]. The list of multinationals with R&D centres in India includes General Electric, Microsoft, IBM, Cisco, Intel,

General Motors, Astra Zeneca, Motorola, and Texas Instruments. The best-known Indian R&D companies are in pharmaceuticals: Ranbaxy, Dr. Reddy's Labs, Sun Pharma, Biocon, Reliance Life Sciences, and Shanta Biotech. Though many of these are Indian companies, there are new companies like Divi's labs, Vimta labs, and Matrix labs, which do contract R&D for multinationals. The location choice using our proposed approach consists of the following steps:

1. Identifying the potential locations
2. Determining the location factors
3. Hierarchical structuring of the location factors according to the PERC model
4. Assessment of scores and weights
5. Ranking the locations by synthesizing the scores and weights
6. Performance and sensitivity analysis

The last three steps are done according to the AHP methodology. We used the Expert Choice<sup>9</sup> software for implementing the AHP. We progressively explain our stylized case of locating a R&D centre in the remainder of this chapter.

### 6.7.1 Potential Locations

Given the natural resources and the skilled workforce, India has identified its potential in biotechnology nearly two decades ago. Department of Biotechnology<sup>10</sup> was setup under the Ministry of Science and Technology in 1986. With biotechnology industry registering over 35 percent growth in the last few years, this industry is seen as one of the key drivers that will contribute to the socio-economic growth. So several states are making conscious efforts to create a conducive environment to attract entrepreneurs to set up their units and leverage on the vast talent pool and rich biodiversities in the respective states. With the success in IT using the IT parks, the central and state governments are keen to replicate it in biotechnology. As a result, India will have at least 20 biotech parks in the next few years. With such a surplus of biotech parks with built-in facilities, it is relatively advantageous for many firms to locate in a biotech park. We assume that our hypothetical MNC is interested in locating its R&D in a biotech park. First, we have to short list the potential locations, which have to be evaluated.

Four cities, Chennai, Hyderabad, Lucknow and Pune have taken the lead in setting up dedicated parks. About 15 states have announced their intention to develop biotech parks. Table 6.6 lists the biotech parks, both currently under progress and completed, in India. Out of these we have selected the following five locations:

1. *ICICI Knowledge Park, Hyderabad, Andhra Pradesh*  
(<http://www.iciciknowledgepark.com/>)
2. *TICEL BioPark, Chennai, Tamil Nadu*  
(<http://www.ticelbiopark.com/>)

<sup>9</sup><http://www.expertchoice.com>

<sup>10</sup><http://www.dbtindia.nic.in>

State	Park	Location	Focus Area	Year
Andhra Pradesh	Shapoorji Pallonji Biotech Park	Hyderabad	Biopharma	2001
	Marine Biotech Park	Vishakapatnam	Marine	2001
	Agri Biotech Park	Hyderabad	Agriculture	2001
	ICICI Knowledge Park	Hyderabad	Pharma/biotech	2001
Tamil Nadu	TICEL BioPark	Chennai	Biotech	2001
	Golden Jubilee Biotech Park for Women Society	Chennai	Agri biotech	2001
Kerala	Kinfra Biotech Park	Kochi	Agri, pharma, industrial biotech	2003
	Kinfra Bio Park	Trivandrum	Agri, pharma, industrial biotech	2003
Karnataka	Bangalore Helix	Bangalore	Biotech	2001
Maharastra	International Biotech Park	Pune	Biopharma	2001
	Biotech Park	Aurangabad	Agri biotech	2001
Gujarat	Biotech Park	Vadodara	Biotech	2005
Madhya Pradesh	Herbal Pharma Park	Indore	Agri, biopharma	2003
Punjab	Biotech Park	Chandigarh	Agri, pharma, industrial biotech	2003
Himachal Pradesh	Biotech Park	Solan	Horti, agri, herbal, industrial	2001
Harayana	Biotech Park	Pantnagar	Agri, healthcare	2002
Uttaranchal	Biotech Park	Haldi	Agri, healthcare	2004
Uttar Pradesh	Biotech Park	Lucknow	Agri, healthcare	2004
Rajasthan	Biotech Park	Jaipur	Biotech	2004
	Biotech Park	Jodhpur	Biotech	2004
	Biotech Park	Bhwida	Biotech	2004
Orissa	Orissa Biotech Park Biotech park	Bhubaneshwar Chandrabhaga	Agri, healthcare Marine	

Source: *BioSpectrum*, August 16, 2005

<http://www.biospectrumindia.com/content/BioSpecial/10508162.asp>

**Table 6.6** Upcoming Biotech parks in India

3. *Bangalore Helix, Bangalore, Karnataka*  
(<http://www.bangalorebio.com/>)
4. *International Biotech Park, Pune, Maharashtra*  
(<http://www.ibpl.net/>)
5. *Biotech Park, Lucknow, Uttar Pradesh*  
(<http://www.biotechcitylucknow.org/>)

The above 5 locations were shortlisted as they are close to completion, except for ICICI knowledge park and TICEL, which are already completed and have several functioning labs. We assume that the above 5 are ready for starting the new R&D center. As R&D is a service industry, resources in terms of educational and research institutes are very crucial. Now we have to decide on the location determinants, which will be used to evaluate the locations.

### 6.7.2 Location Determinants

The literature identifies several distinct categories of factors that influence the location of foreign R&D centre. The factors can be broadly categorized as [24]:

- *Demand factors*
- *Supply factors*
- *General competitive factors*

A different categorization was used by:

- *Economic environment*
- *Institutional environment*
- *Science and telecommunications environment*
- *MNC competitive factors*

The above categorization were used, in general, to explain the R&D expansion of a MNC in foreign countries, along with the location decision. Table 6.7 presents the location factors in terms of importance for greenfield R&D according to Buck Consultants International, a location consultancy firm [9]. Firms choose for locations where highly qualified labour is available at reasonable costs, where universities and technological institutes conduct state-of-the-art research, and where travel to foreign destinations is easy.

The above factors are for national level and some of them are irrelevant to the subnational location choice. In particular, *corporate tax* and *income tax* are centrally administered, and do not vary across locations. For our particular case of locating in a biotech park, many more factors become redundant. Most of the regulatory frameworks are from the central government and the state government usually provides a single point interface, if located in a biotech park. The pollution control and treating of toxic and chemical wastes are taken care at the special facilities in the park. Likewise, the infrastructure needed for conducting research are also available at all parks and hence need not be considered. We identified 12 factors that are relevant to our subnational location choice of an R&D centre in a biotech park, which are shown in Table 6.8.

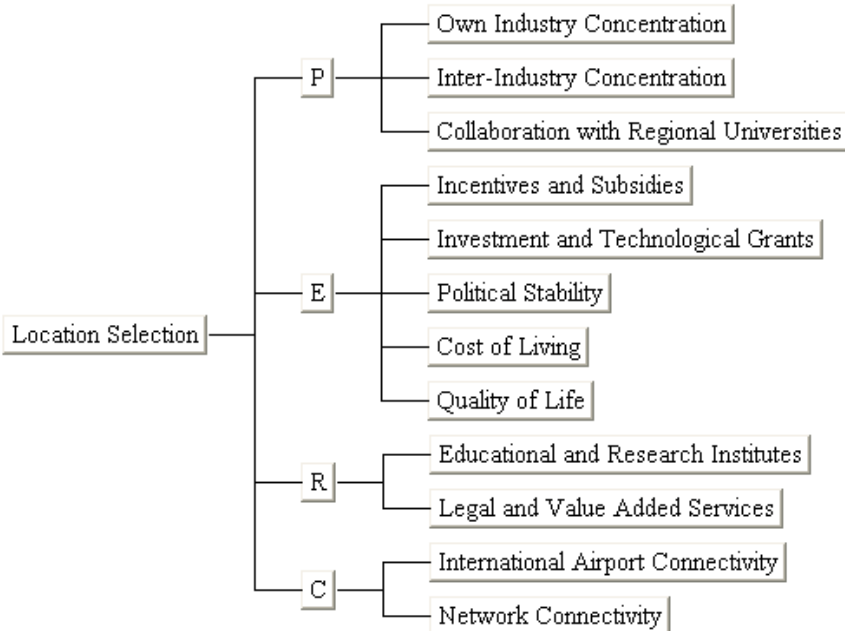


Fig. 6.5 Hierarchical structuring of the R&D location factors

Crucial	Very Important	Important	Less Important
availability and costs of highly qualified labour;	investment and technology grants;	quality of local suppliers, customers and competitors;	quality and costs of telecommunication and energy;
availability and quality of universities and technological institutes;	availability of technology/science parks;	corporate tax regime, income tax regime;	macro-economic profile and political stability;
proximity and quality of international airport;	quality of life, costs of living, and international schools;	regulatory framework;	

**Table 6.7** Location factors for greenfield R&D

Educational & research institutes;	International airport connectivity;	Cost of living;	Quality of life;
Own industry concentration;	Inter-industry concentration;	Collaboration with universities and research centers;	Investment and technological grants;
Incentives and subsidies;	Legal and value added services;	Network connectivity;	Political support

**Table 6.8** Location factors for subnational location choice of a Biotech R&D

### 6.7.3 Hierarchical Structuring using the PERC Model

The hierarchical structuring of the location parameters under the four dimensions is shown in Figure 6.5. The factors related to the value chain are:

- Own-industry concentration
- Inter-industry concentration
- Collaboration with regional universities and research centers

They capture the demand factors, supply factors, agglomeration economies, and cluster effects. The own-industry concentration reveals the cluster effect which is positively correlated with the suppliers, market demand, complementing firms, and competing firms. Biotech is a multidisciplinary industry with linkages to chemistry, biology, and IT. The inter-industry concentration is used to model these linkages. The above factors also capture the knowledge spill over across the firms and the industries. Collaboration with the local universities and research institutions is a very crucial activity in the value chain of and R&D industry and it is positively correlated with the growth of the organization.

Economic integration comprises of the following economic, political, and social factors:

- Incentives and subsidies
- Investment and technological grants

- Political support
- Cost of living
- Quality of life

The cost of living, quality of life, and political support influence the employees' living conditions in the city and hence affect the MNC's ability to employ highly skilled workforce. The government incentives and the availability of venture capital investments are very important for the establishment and the operations of the subsidiary.

Resources is *the* crucial factor for a service industry like R&D. The following two factors are considered, respectively, under *Resources & Management*:

- Educational and research institutes
- Legal and value added services

The educational and research institutes provide the required workforce for the centre. Further, an R&D centre will need several value added and management services like legal consulting (for patenting), financial planning, human resources management, etc.

Finally, the *Connecting Technologies* consists of the following obvious factors:

- International airport connectivity
- Network readiness

The network readiness refers to the connectivity with respect to IT, ITeS, and telecommunication, including wired and mobile communication.

Following observations about the PERC based hierarchical structuring can be immediately made by referring to Figure 6.5:

1. Firstly, from the practical perspective, there is a quantum leap in the understanding and representation of the problem from the list of factors in tables 6.7 and 6.8 to Figure 6.5. The PERC based structuring provides the decision maker with a holistic view of how information about various location factors will be synthesized to evaluate a location.
2. Secondly, from the theoretical perspective, the PERC structuring enables the decision maker to compare and judge the factors with respect to a common feature or objective. This makes the methodology theoretically, and as well as practically, implementable.

The model could be further expanded by including more factors at the last level of hierarchy, thus making it more fine. The *own industry concentration* is a measure of localization economies of agglomeration economies. Biotechnology industry can be further subdivided as *bio pharma*, *bio industrial*, *bio services*, *bio agri*, *bioinformatics*, and *bio suppliers*. The priorities of these will be measured using pairwise judgement and the preferences will depend on the intended R&D industry. Similarly, one can split inter-industry concentration into IT, auto, chemicals, leather, etc. The incentives and subsidies offered by the state governments include waiver on sales tax, tax on capital investment, tax on captive energy, stamp duties, and registration fees for locating in the biotech park. The total subsidy, thus, should be calculated using judicious combination of all these values. The influence of the *educational and research institutes* can be further subdivided. Services

	High	M. High	Medium	M. Low	Low	Priorities
High	1	2	3	5	7	1.000
M. High		1	2	3	5	0.589
Medium			1	2	3	0.343
M. Low				1	2	0.199
Low				1	2	0.118

Table 6.9 Pairwise comparison matrix for the intensity ratings

	Own Industry Concentration	Inter-Industry Concentration	Collaboration with Univs
Bangalore	MH	M	H
Lucknow	MH	M	MH
Pune	M	MH	M
Chennai	M	H	ML
Hyderabad	M	MH	MH

Table 6.10 Scores for factors of *Product/Process Value Chain*

like legal and business consulting are very important for start-ups and R&D establishments for filing patents and like. The overall contribution of *value added services* can be obtained from combining individual availability of services. For the sake of simplicity, we have confined our model to just two levels of hierarchies as shown in the Figure 6.5. Given the hierarchical structuring, the first step in AHP is to evaluate the scores for the locations.

#### 6.7.4 Scores for the Locations

The scores for the 12 location factors in the second level of hierarchy can be measured in two ways in AHP:

- *Pairwise Comparison*: Make a pairwise judgement for the five alternatives with respect to each of the 12 location factors.
- *Intensity Ratings*: Define different level of intensities and rate each alternative using an intensity for each of the factors.

We have used the *intensity ratings* approach. We define five intensities: *High*, *Medium High*, *Medium*, *Medium Low*, and *Low*. For each of the location factors, the alternatives are given one of the above intensities. The priorities of the intensities are calculated using pairwise comparison. We have used the pairwise comparison shown in Table 6.9 for all the 12 factors.

The scores for the five locations with respect to each of the 12 location factors are shown in tables 6.10 to 6.13. The ratings were given based on the information available from the following sources:

- **Websites of the five BioTech Parks**  
<http://www.iciciknowledgepark.com/>  
<http://www.ticelbiopark.com/>  
<http://www.bangalorebio.com/>



	Incentives & Subsidies	Investment & Tech. Grants	Political Support	Cost of Living	Quality of Life
<b>Bangalore</b>	ML	H	MH	ML	MH
<b>Lucknow</b>	L	MH	ML	MH	L
<b>Pune</b>	MH	M	M	MH	MH
<b>Chennai</b>	H	MH	MH	MH	MH
<b>Hyderabad</b>	M	H	MH	MH	MH

Table 6.11 Scores for factors of *Economic Integration*

	Educational & Res. Institutes	Legal & Value Added Services
<b>Bangalore</b>	H	MH
<b>Lucknow</b>	MH	H
<b>Pune</b>	M	M
<b>Chennai</b>	ML	MH
<b>Hyderabad</b>	MH	MH

Table 6.12 Scores for factors of *Resources & Management*

	Intl. Airport Connectivity	Network & Readiness
<b>Bangalore</b>	H	MH
<b>Lucknow</b>	ML	M
<b>Pune</b>	ML	M
<b>Chennai</b>	H	H
<b>Hyderabad</b>	M	H

Table 6.13 Scores for factors of *Connecting Technologies*

	Own Industry Concentration	Inter-Industry Concentration	Collaboration with Univs	Priorities
Own Industry Concentration	1	1/3	3	0.243
Inter-Industry Concentration		1	1/7	0.088
Collaboration with Univs.			1	0.669

**Table 6.14** Pairwise comparison matrix for factors of *Product/Process Value Chain*

<http://www.ibpl.net/>  
<http://www.biotechcitylucknow.org/>

- **Indian Investment Centre**  
<http://iic.nic.in/>
- **FICCI: India in Business**  
<http://www.indiaainbusiness.nic.in/>
- **Gartner Report on City Rankings for IT Outsourcing** (for the *cost of living, quality of living, and political support*)
- **National Council of Applied Economic Research** reports on incentive packages and e-readiness  
<http://www.ncaer.org/>

Our intention here is to illustrate the practical applicability of the proposed methodology for location choice. Hence we have confined ourselves to the use of conventional wisdom in rating the alternatives using the information from the above mentioned sources. As mentioned earlier, a thorough evaluation would include a finer representation of the problem with more levels of hierarchies, more information, and judicious combination technique of the information.

### 6.7.5 Priorities for the Location Factors

The AHP methodology requires priorities to be assigned to each of the criteria or factor in the model. These are basically the *weights* for these factors, which are derived using pairwise comparison of the siblings with respect to the parent criterion. The priorities have to be derived for factors under each of the PERC structure and for the PERC itself under the overall goal of locating the R&D centre. The pairwise comparisons and the priorities are shown in tables 6.14 to 6.16. For the *Resources & Management*, the educational institutes were assessed as 5 times more important than the services. The priorities were respectively 0.833 and 0.167. For the *Connecting technologies*, the international airport connectivity was 5 times more important than the network connectivity.

### 6.7.6 Ranking of Locations

Figure 6.6 shows the ranking of the locations with respect to the overall goal.

	Incent. & Subsid.	Invst. & Grants	Political Support	Cost of Living	Quality of Life	Priorities
Incent. & Subsid.	1	4	6	3	3	0.479
Invest. & Grants		1	2	2	2	0.190
Political & Support			1	1/2	1/2	0.074
Cost of Living				1	1	0.129
Quality of & Life					1	0.129

Table 6.15 Pairwise comparison matrix for factors of *Economic Integration*

	P	E	R	C	Priorities
P	1	3	1/4	4	0.236
E		1	1/4	3	0.125
R			1	7	0.581
C				1	0.058

Table 6.16 Pairwise comparison matrix of PERC



Fig. 6.6 Ranking of locations with respect to the overall goal

## 6.8 Final Notes and Proposals

Evaluating and ranking locations for investment based on a multitude of factors was the central theme of this report. A decision framework was proposed for location evaluation from the perspective of an MNC that is searching for a location to invest in its subsidiary.

The decision framework consists of two stages: *analysis* and *synthesis*. The analysis stage is an important stage where the location attributes are identified and homogeneously clustered under hierarchies of criteria or objectives. There exists no formal and generic framework for this hierarchical structuring. Our structuring is based on PERC model which consists of four fundamental criteria that are integral to global business supply chains. We identified different sub-criteria under these four criteria in terms of benefits, opportunities, costs, and risks that can aid the decision maker in structuring the location factors hierarchically.

The second stage is the synthesis where the the information about the locations are used with the attributes in the hierarchy to obtain a ranking of the locations. We used the analytic hierarchy process for this stage, which is useful in handling both tangible and intangible attributes. An example of an MNC locating its Biotech R&D facility in India was described in detail. The location evaluation was solved from the perspective of an investing MNC. However, this problem is encountered as the core or sub-problems in many scenarios. First we will see two direct applications of this methodology, followed by scenarios that require possible modifications.

### 6.8.1 Measuring Investment Climate

Private firms invest in new ideas and new facilities that strengthen the foundation of economic growth. They include farmers and micro-entrepreneurs to MNCs and their investment in a region is mainly determined by the *investment climate*. Investment climate reflects the location-specific factors that shape the opportunities and incentives for firms to invest productively, create jobs, and expand. More specifically it is the *policy, institutional, and behavioral environment, both present and expected, that influences the returns, and risks, associated with investment*. Three main features of the investment climate are:

- Macro-economic factors (including political stability)
- Governance
- Infrastructure

Our proposed methodology can be used to measure investment climate. The PERC model, in addition to the above features, includes the *Product/Process value chain* dimension. This is essential for measuring the investment climate for specific industries like automobiles. The **P** dimension provides the forward and backward linkages like supply, demand, and markets, which are essential in measuring industry specific investment climates. To be precise, the proposed methodology in this report is firm-specific. If the attributes and weights are derived with industry-specific characteristics, then the methodology can be used to evaluate investment climates at international, national, regional or city level.

### 6.8.2 Market Attractiveness of Tier II Cities

With the sustained FDI inflows in various sectors, the tier I cities like Bangalore, Chennai, Hyderabad, Mumbai, and Delhi are saturated and the infrastructure is overwhelmed. The city limits have expanded considerably and many development agencies are targeting tier II cities for development. The proposed decision framework can be applied to evaluate and rank the potential tier II cities. The evaluation can also be used to measure the time and cost involved in preparing the cities to be future centers of economic activities. The planning commission and economic development agencies can leverage the proposed methodology to systematically identify, plan, and develop potential tier II locations.

### 6.8.3 Location of Retail Stores

India's retail sector is wearing new clothes and with a three-year compounded annual growth rate of 46.64%, retail is the fastest growing sector in the Indian economy. Traditional markets are making way for new formats such as departmental stores, hypermarkets, supermarkets and specialty stores. India's vast middle class and its almost untapped retail industry are key attractions for global retail giants wanting to enter newer markets. While organised retail in India is only two per cent of the total US\$ 215 billion retail industry, it is expected to grow 25 per cent annually, driven by changing lifestyles, strong income growth and favourable demographic patterns.

The process of determining optimal locations for new retail stores, franchise locations, restaurants, and financial institutions is a related but different location selection problem. It includes profiling customers, understanding competitors, and analyzing demographic, census, and market data to determine how one can reach and service both new and existing customers most profitably. Specifically, following issues need to be addressed:

- Where are the customers, best prospects, current stores, and competitors?
- How many suitable markets exist in a given geographic area for the products/services being offered?
- How many locations are necessary to optimally cover a given market area and which locations offer the greatest potential?

The decision problem is similar to the traditional facility location problem, but with a large number of tangible and intangible factors. The proposed decision framework could be used adapted to first list down the possible locations. However, one has to take into account the interaction effects of locations and create an optimization model to optimally choose the set of locations for the stores.

### 6.8.4 Design of SEZ

India over the past decade has progressively opened up its economy to effectively face new challenges and opportunities of the 21st Century. To compete in the global market, the Government of India has liberalised export policies and licensing of technology and implemented tax reforms providing various incentives. The tangible fruition of these efforts is the introduction of *special economic zones* (SEZs) in the Exports-Imports policy of March 2000.

SEZs are geographical regions that have economic laws different from a country's typical economic laws. The goal is usually an increase in FDI in the country. Traditionally SEZs are created as open markets within an economy that is dominated by distortionary trade, macro and exchange regulation and other regulatory governmental controls. SEZs are believed to create a conducive environment to promote investment and exports. And hence, many developing countries are developing the SEZs with the expectation that they will provide the engines of growth for their economies to achieve industrialisation.

There are many design issues regarding the SEZs. First is the location of SEZ or rather which location is to be declared as an SEZ. This decision problem, faced by the government, should take into account location and region specific factors like availability of labor, utilities, resources, connection to highways and ports, infrastructure, incentives, and governance. Usually the incentive and concession packages are uniform for all the SEZs in the country, but there are certain regulatory framework that depends on the state governments like the labour laws. One can easily see that above factors can be analyzed using the PERC model and can be used to evaluate and rank locations that can be potential SEZs. Moreover, this can aid the governments in planning and developing the locations of interest to be conducive to be an SEZ. It is worth noting here that the location problem of Biotech R&D center in the previous chapter is the problem solved from the *firm's* perspective of locating in a Biotech park.

The second decision problem faced by the government is to decide on which project(s) to accept for developing an SEZ. More specifically, an optimal portfolio of projects is to be decided based on the SEZ specific characteristics. For example, the proposed industry segments in Navi Mumbai SEZ consists of 18 industries including biotech, gems and jewellery, ITeE, and leather products. Here again, the PERC model can be used to analysis the location specific factors and industry needs, and AHP can be used to select a portfolio of projects.

The third is the design of SEZ from the *developer* perspective to determine the composition of companies in the SEZ. This includes determining the companies that care of logistics, MRO, information and communication infrastructure, venture capital and investments, human resource training, global marketing, etc. One can see that the PERC model can be applicable in this scenario, probably in combination with AHP and optimization techniques.

## References

1. Petroni Alberto. The logistics of industrial location decisions: An application of the analytic hierarchy process methodology. *International Journal of Logistics: Research and Applications*, 3(3):273–289, 2000.
2. W. Atthirawong. *A Framework for International Location Decision-Making in Manufacturing using the Analytical Hierarchy Process Approach*. PhD thesis, School of Mechanical, Materials, Manufacturing Engineering and Management, University of Nottingham, UK, 2002.
3. M. A. Badri. Combining the analytic hierarchic process and goal programming for global facility location-allocation problem. *International Journal of Production Economics*, 62(3):237–248, 1999.
4. Salvador Barrios, Holger Gorg, and Eric Strobl. Multinationals' location choice, agglomeration economies, and public incentives. *International Regional Science Review*, 29:81–107, 2006.

5. Valerie Belton. A comparison of the analytic hierarchy process and a simple multi-attribute value function. *European journal of Operational Research*, 26:7–21, 1986.
6. Fabienne Boudier-Bensebaa. Agglomeration economies and location choice: Foreign direct investment in Hungary. *Economics of Transition*, 13(4):605–628, 2005.
7. Lance Eliot Brouthers, Keith D. Brouthers, and Steve Werner. Is Dunning's eclectic framework descriptive of normative? *Journal of International Business Studies*, 30(4):831–844, 1999.
8. John A. Cantwell and Lucia Piscitello. The recent location of foreign R&D activities by large MNCs in the European regions: The role of different sources of spillovers. In *ERSA Congress*, Finland, 2003.
9. Maarten Cornet and Marieke Rensman. The location of r&d in the netherlands: Trends, determinants and policy. CPB Documents 14, CPB Netherlands Bureau for Economic Policy Analysis, 2001. available at <http://ideas.repec.org/p/cpb/docmnt/14.html>.
10. P. Dicken. Seducing foreign investors - the competitive bidding strategies of local and regional agencies in the UK. In M. Hebbert and J. C. Hansen, editors, *Unfamiliar territory: The re-shaping of European geography*. Aldershot, Hants: Gower, 1990.
11. Zvi Drezner and Horst W. Hamacher, editors. *Facility Location: Applications and theory*. Springer-Verlag, Berlin, 2002.
12. J. H. Dunning. Trade, location of economic activity and the MNE: a search for an eclectic approach. In B. Ohlin, P.O. Hesselborn, and P.M. Wijkman, editors, *The International Allocation of economic Activity*. Macmillan, London, 1977.
13. J. H. Dunning. *Explaining International Production*. Unwin Hyman, London, 1988.
14. W. Edwards and J. R. Newman. *Multiattribute Evaluation*. Sage Beverly Hills, CA, London, 1982.
15. E. Erkut and S. R. Morgan. Locating obnoxious facilities in the public sector: an application of the analytic hierarchy process to municipal landfill siting decisions. *Socio-Economic Planning Science*, 25(2):89–102, 1991.
16. FICCI. FICCI handbook on foreign direct investment. Report, Federation of Indian Chambers of Commerce and Industry, FICCI, New Delhi, October 2005.
17. Ernest H. Forman and Saul I. Gass. The analytic hierarchy process - an exposition. *Operations Research*, 49(4):469–486, 2001.
18. M. Fujita, P. Krugman, and A. Venables. *The Spatial Economy: Cities, Regions, and International Trade*. MIT Press, Cambridge, MA, 1999.
19. Rachel Griffith, Michael P. Devereux, and Helen Simpson. Firm location decisions, regional grants, and agglomeration externalities. AIM Research Working Paper Series 038-May-2006, Advance Institute of Management Research, May 2006.
20. Roger Hayter. *The Dynamics of Industrial Location: The Factory, the Firm and the Production System*. John Wiley and Sons, Chichester, 1997.

21. Keith Head, John Ries, and Deborah Swenson. Agglomeration benefits and location choice: Evidence from Japanese manufacturing investment in the United States. *Journal of International Economics*, 38:223–247, May 1995.
22. G. G. Hedge and P. R. Tadikamalla. Site selection for a 'sure service terminal. *European Journal of Operational Research*, 48:77–80, 1990.
23. IBM. Investment strategies and location benchmarking study. Location benchmarking analysis, Oxford Intelligence, February 2004.
24. G. Jones and H. Davis. National culture and innovation: implications for locating global R&D operations. *Management International Review*, 40(1):11–39, 2000.
25. C. Jungthirapanich and C. O. Benjamin. A knowledge-based decision support system for locating a manufacturing facility. *IIE Transactions*, 27:789–799, 1995.
26. R. Keeney. *Value-Focused Thinking: A Path to Creative Decisionmaking*. Harvard University Press, Cambridge, Massachusetts, 1992.
27. R. Keeney and H. Raiffa. *Decisions with Multiple Objectives: Preference and Value Tradeoffs*. Wiley, New York, 1976.
28. D. W. Loree and S. E. Guisinger. Policy and non-policy determinants of US equity foreign direct investment. *Journal of International Business Studies*, 26(2):281–299, 1995.
29. Philip McCann. Classical and neoclassical location-production models. In Philip McCann, editor, *Industrial Location Economics*. Edward Elgar, Cheltenham, UK, 2002.
30. Philip McCann and Ram Mudambi. The location behavior of the multinational enterprise: Some analytical issues. *Growth and Change*, 35(4):491–524, 2004.
31. Marcel de Meirler. *Location Location Location: A Plant Location and Site Selection Guide*. Wiley, New York, 2006.
32. H. Min. Location analysis of international consolidation terminals using the analytic hierarchy process. *Journal of Business Logistics*, 15(2):25–44, 1994.
33. Ram Mudambi. The MNE investment location decision: Some empirical evidence. *Managerial and Decision Economics*, 16:249–257, 1995.
34. Ram Mudambi. The location decision of the multinational firm: A survey. In Philip McCann, editor, *Industrial Location Economics*. Edward Elgar, Cheltenham, UK, 2002.
35. David L. Olson. *Decision Aids for Selection Problems*. Springer, New York, 1996.
36. Michael E. Porter. Clusters and the new economics of competition. *Harvard Business Review*, pages 77–90, November-December 1998.
37. Thomas L. Saaty. *The analytic hierarchy process*. McGraw-Hill, New York, 1980.
38. Thomas L. Saaty. *The Analytic Network Process: Decision Making with Dependence and Feedback*. RWS Publications, Pittsburgh, PA, 1996.



39. Thomas L. Saaty and Luis G. Vargas. *Models, methods, concepts and applications of the analytic hierarchy process*. Kluwer International, Massachusetts, USA, 2001.
40. UNCTAD. Transnational corporations and internalization of R&D. World investment report, UNCTAD, 2005.
41. World Bank. A better investment for everyone. World development report, World Bank, 2005.
42. World Bank. India: Investment climate and manufacturing industry. Investment climate assessment report, World Bank and International Finance Corporation, November 2005.
43. J. A. Wu and N. L. Wu. Analysing multi-dimensional attribute for the single plant location problem via adaptation of the analytic hierarchy process. *International Journal of Operations and Production Management*, 4(3):13–21, 1984.
44. C. H. Yang. *Identifying and testing the decision making factors related to key industries choice of location*. PhD thesis, Faculty of Commerce and Management, Griffith University, Brisbane, 2004.
45. Jiaquin Yang and Huei Lee. An AHP decision model for facility location selection. *Facilities*, 15(9/10):241–254, 1997.
46. Shigeru Yurimoto and Tadayuki Masui. Design of a decision support system for overseas plant location in the EC. *International Journal of Production Economics*, 41:411–418, 1995.
47. M. Zeleny. *Multiple criteria decision making*. McGraw-Hill, New York, 1982.



# 7 Indian Construction Supply Chains: An Approach To Competitive Advantage

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## 7.1 Introduction

Construction industry is the second largest economic activity in India. According to the latest CRISINFAC report, construction investments in the country account for nearly 11% of the GDP and around 50% of the Gross Fixed Capital Formation. During the period 2002-05, investments in the construction industry grew at a CAGR of 11% and are expected to grow at a CAGR of 8% during the period 2006-08. Over this period construction investments will grow to a level of Rs 8300 billion. Also the construction industry is the second largest employment provider. There are around 3 million small, medium and large contractors in India.

Indian Construction Industry can be divided into three market segments: Infrastructure, Industrial and Real Estate. Infrastructure constitutes of roads, ports, airports, irrigation, railway, and power projects etc. Infrastructure investment has a share of 25% in the total construction investments and is expected to rise at a CAGR of 9% over the period 2006-08. Especially government's focus on roads, water supply and sanitation, and irrigation would be the key drivers. Industrial construction includes both public and private industries in steel, textiles, refineries, petrochemicals etc. Investment in this segment is around 10% of the total construction investment and is expected to rise at a CAGR of 33% during the period 2006-2008. With the globalization effect and increasing local demand, this segment is expected to grow with the investments in oil, gas and metals being the key drivers. Real estate investment is around 60% of the total construction investment and is expected to grow at a CAGR of 5% during the period 2006-2008. It constitutes residential, commercial and retail construction. Commercial construction includes hotels, office space, hospitals, schools etc. while retail sector includes malls and multiplexes. 90% of real estate developed is from residential sector. The persistent demand-supply gap in residential sector, rising affordability levels, attractive financing options, fiscal benefits on availing the home, and favorable demographics are the key drivers supporting the real estate segment.

Looking at the ubiquitous construction activity in the country and strong future prospects, it is important to devise the strategies to enhance the productivity in construction activity which seems to lag far behind in comparison to other manufacturing and service industries. While auto and

other manufacturing industries in India are using advance technologies to manage their supply chains, construction industry has not yet adopted the change. Other construction firms like that of UK and Australia are far more efficient than Indian firms. With the change in government foreign investment policies (effective from February, 2005) in the country which allowed 100 percent FDI in construction, Indian construction firms are under global pressure and need operational reforms to match international standards.

Delays, cost overruns and material wastage are commonplace in construction projects. These consequences are resulted mainly by the temporal characteristic of construction supply chains and the short-term project mentality of construction firms. In comparison to other industries, construction firms have been slow in using Information Technology and Supply Chain Management principles in their operations which have transformed the manufacturing sector during last fifty years. While it is important to identify the reasons which are preventing construction firms from stimulating this innovation, finding the effective and feasible solutions to increase the productivity is a key issue today.

*In the lack of construction firms' initiative for higher productivity and better quality, construction industry has seen commoditization; where contracts are awarded on the basis of minimum bid. This in turn has reduced the profit margins and industry players have been averse of making investments for productivity enhancement. Current firm-specific cost reduction doesn't confer any sustainable advantage in the global market. With the increasing global competition, Indian firms need to involve all the stakeholders of the construction supply chain who influence the productivity of the project. This is possible only through greater coordination among various players. Firms need to follow a supply chain approach to achieve global standards. Rising revenues of construction industry and strong future prospects would encourage construction firms to make investments to achieve higher productivity.*

There is a lot which can be learnt from other manufacturing and service industries but it can not be done with the ignorance towards the characteristics of construction operations which differentiates it from other industries. The issue of delays, cost over-runs and quality non-conformance is closely related to the Supply Chain Management (SCM) and we believe that applying SCM principles, Use of Information Technology (IT) and supply chain integration can bring significant increase in the productivity in construction projects. Cases from other countries show that the savings with the application of Supply Chain Management tools can be as significant as 35%.

This report suggests strategies for Indian construction firms to manage their supply chains better. Our analysis of Indian construction is based on our interviews with industry people, the information available in the company web-sites and a literature survey covering the research in construction operations.

## 7.2 Construction Supply Chains: Characteristics

The temporal characteristic of construction supply chains and demand driven nature of industry makes it very different from other manufacturing and service industry. In order to devise the feasible and effective Supply Chain Management strategies, it is important to understand the characteristics of construction supply chains which may limit the scope of implementation. This chapter illustrates the characteristics of construction supply chains.

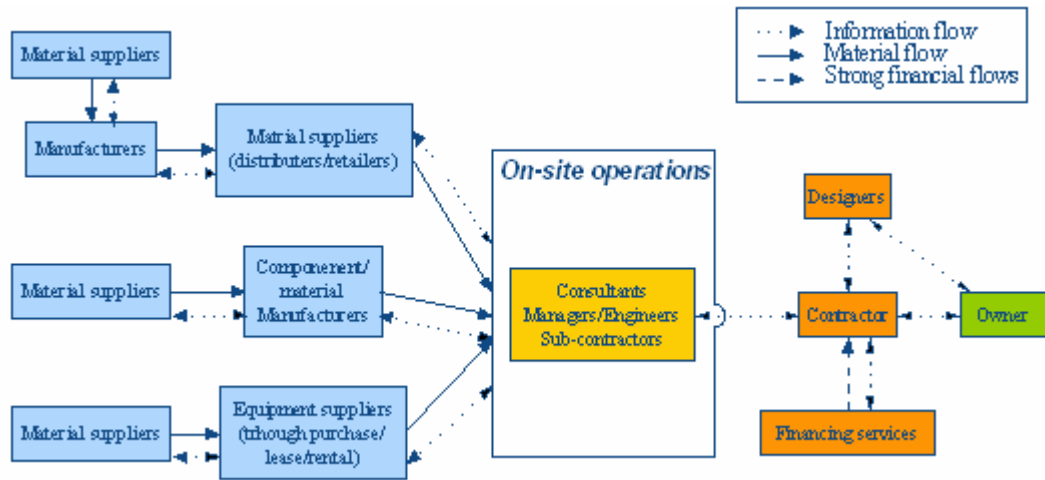


Fig. 7.1 Construction supply chain

*Construction service can be defined as “work on construction projects and installations by a construction enterprise in locations outside the economic territory of the enterprise. This includes all goods and services that form an integral part of the construction contract.”*

Construction supply chain involves stakeholders who are individual service providers such as subcontractors, designers, engineering consultants, transporters etc. and manufacturers of materials and equipments. On an average material cost contributes 50% to the project cost and hundreds of material and equipment suppliers take part in the supply chain. Apart from these suppliers, activities of the construction projects are subcontracted to specialty contractors such as designers, electrical, engineering, plumbing etc. Being a demand driven industry owner’s involvement in the project remains crucial and continuous information flow from client is essential. Figure 7.1 shows the highly non-linear characteristic of construction supply chains where strong supply chain information and material linkages are shown.

Construction can be viewed as a complex of manufacturing and services. In this sense, many of the operations involved in manufacturing have similarity with construction projects in their characteristics. As an example, procuring materials and assembling them to make a product is common in both manufacturing and construction. This is the reason why Toyota, the leading Japanese auto manufacturer, has entered into housing construction and applying mass production and lean manufacturing techniques there. Likewise some characteristics of services can be seen in construction. For example, construction involves project management techniques as do many of the software services firms. Satyam Computer Services, the lead software services firm in India entered into construction business with their core competency in Project Management. Basic characteristics of construction supply chains are as follows.

- **Temporal supply chains:** With each new project, the location of project changes and a new supply chain network has to be designed. Project planning incorporates scheduling, logistics planning, and strategic decisions pertaining to the supplier and subcontractor selection. The

life of the temporal supply chain ends with the contract. This temporal characteristic of construction supply chains causes aversion of construction firms towards investments in Supply Chain Management as Return On Investments (ROI) remains a concern.

- **Demand driven industry:** Unlike many product-based firms, construction projects are demand driven. Construction firms are awarded the contract to finish a project on the basis of a contract model (cash contract, BOT, BOO, BOOT etc.). Based on the type of contract, firms are responsible for activities like designing, material procurement, construction and other supporting activities like project management, waste management etc. Each project is customized and hence the structure of supply chain changes.
- **Long and short-term relationships:** For a construction project short-term relationships last for the project life cycle. For example local suppliers, workers, transportation services for a project usually end with the project life cycle. Long-term relationships can be with large material manufacturers, infrastructure and technical support organizations such as research institutes, insurance agencies, and financing firms etc (refer Appendix 2).
- **Fragmented industry:** Construction industry is highly fragmented. In 2004, there were a total of three million small, medium and large contractors in India and only 28,000 of them were registered. Especially Real Estate segment, which requires comparatively low technical skills, has many small and medium-sized players.
- **Capacity is not a constraint:** Construction is working capital intensive, and fixed capital requirement is quite less as compared to other manufacturing industries. This behavior has a parallelism with other service-based businesses. As a result capacity is not a constraint. Supply can be increased by mobilizing the skilled labor.
- **Financing constraints:** Most of the firms are not listed and credit profiles of contractors are not available. These firms could receive a short-term asset-based financing from banks, but, as fixed capital is not sufficient with most of the firms, it is hard for them to get an asset-based loan. The problem is very severe in India because records of contractors are not available. Construction Industry Development Council (CIDC) has taken up this issue and they are categorizing the contractors in grades, but these grades are meant for a different purpose (qualification criteria for a contract bidding), and we would need a credit rating for these firms for financing purpose. High risk and shrinking profit margins are other issues in financing.

### 7.3 Indian Construction Supply Chains: Status, Issues & Scope

Current status of Supply Chain Management (SCM) in the construction industry shows that the pace of innovation has really been slow and firms still have a lot to learn from the tools available in SCM literature. While talking to industry people, we realized that most of the industry people are ignorant about SCM approach and follow traditional project management tools. As illustrated in the subsequent part of this section, current industry practices are highly ineffective and lead to delays, cost overrun and wastage. Apart from this, various characteristics of construction supply chains make it difficult for construction firms to invest in SCM practices. This section gives an insight into the status of supply chain management practices and the related issues. We cover three important dimensions here: Project planning, Logistics, and use of IT.

### 7.3.1 Project Planning

Project planning consists of mainly three activities: scheduling, resource allocation, and risk management.

#### *Scheduling*

*Status* Current industry practices for scheduling use precedence relationships of various processes and use tools such as Program Evaluation and Reviewing Techniques (PERT) charts, Gantt Charts and Critical Path Method (CPM). Most of the large and medium sized firms use some software based on the above mentioned tools. Leading construction firm Larsen & Toubro uses software PRIMAVERA which incorporates planning or scheduling activities using CPM, Gantt charts, and risk management tools. These planning tools take process constraints into account based on the previously available data on the time consumed in each process but ignore resource and information constraints.

#### *Issues*

- Scheduling modules don't consider resource and information constraints (such as what information is required before an activity can be started) into account.
- As many important causes of uncertainties remain unconsidered during scheduling, project schedules remain unrealistic.
- Planning modules don't consider risk and uncertainty involved in delays of material and service procurement which lead to project delays.
- With unrealistic scheduling and hence frequent changes in project schedule, proper allocation of resources remains much below the optimal level and causes waste of material and underutilization of machines and human resources.

#### *Resource Allocation*

*Status* Most of the lead firms in India have a resource allocation unit, where the resources are allocated to various projects. The asset base includes Heavy Duty Cranes, Heavy Earthmovers, Asphalt, Batching & Crushing Plants, Asphalt & Concrete Pavers, Vibratory Compactors, Concrete Pumps, Boom Placers, Drilling Jumbos, Rock bolting machines, On / Offshore Hydraulic Drilling Rigs, Core Drilling Machines, Winders, Compressors, D.G. Sets and Mobile Crushing units etc. Apart from machineries and equipments, human resources like engineers, managers, subcontractors and labors etc. have also to be mobilized to various sites to maximize productivity by maintaining a balance between the availability, requirement and utilization of resources. Lead players like L&T, Gammon, and HCC etc. undertake several projects at a time in the Indian as well as overseas markets. For them resource identification and allocation becomes highly complex. As the leasing of equipments often cuts into the margins of the companies, more and more firms are trying to increase their asset base. Nagarjuna Construction's Operating Profit Margins (OPM) was as low as 5 per cent in 2004. Since then, with a ramp-up in asset base by over 80 per cent and an ability to undertake more projects, the company's OPM is close to 9 per cent. With the increasing complexity of resource allocation process and increasing order book, firms need to adopt new

resource allocation strategies. This task remains more crucial for small and medium sized firms who try to take variety of projects and don't have enough resources.

#### *Issues*

- With the increasing demand in construction industry, resource allocation is becoming more and more difficult.
- Firms with a low resource base need to devise strategies to acquire required resources to complete a project, either through purchase or lease, which can give them a balance of OPM and order-book. Financing remains a major concern especially for small firms which hinder the purchase of resources.
- Resource allocation is done in suboptimal levels. Resources remain underutilized and the problem of shortage of resources still persists to a great extent.

*Project managers can often be seen as complaining about lack of resources but even with additional resources the resource problem persists.*

#### *Risk Management*

*Status* Risk management in construction projects still seems a formality. Indian construction is fraught with various kinds of risks which are described in [1]. These risks include construction, Operating, Market, Interest rate, foreign exchange, payment, regulatory and political risks. Risk mitigation involves the allocation of various risks to the supply chain stakeholder who can manage them best. While this risk allocation helps in removing the burden from a single party, it never ensures the effective interceptive and preventive risk management actions that have to be taken in order to handle these risks. Current industry practices of documenting various risks and calculating risk exposure values and impact on the cost over-runs & delays; along with brain storming sessions don't provide an effective solution to manage risks. As risk management is highly experience intensive, many a times critical risk factors remain untouched and degenerate into huge losses during the project life.

#### *Issues*

- Through out the industry, focus is on risk allocation and risk management practices are still ineffective which cause delays and cost over-run. Firm level focus of risk management is important at this juncture.
- Firms ignore the importance of Knowledge Management and various supply chain risk events occurred during projects remain undocumented.
- As the risk management activity is highly experience and information intensive industry needs to build Decision Support Systems which can be used in the risk management.
- Risk management activity restricted in the planning stage where many critical uncertainties can not be realized. Firms need to develop interceptive risk management tools which can



support managers in the decision making on the appropriate actions that have to be taken subsequent to a risk event.

*Scope of improvement* It is not difficult to realize that resource management and scheduling practices can not ignore the uncertainties involved in projects. Also scheduling should incorporate resource and information constraints not only the process constraints. Big firms who undertake multiple projects at a time should take a multi-project planning approach so as to make resource allocation effective. Decisions taken in such a way will allow the decision makers to arrive at optimal solutions and can bring enormous savings.

Risk management should be an integral part through out the project life. Presently most of the small and medium-sized players in the industry do not incorporate risk management in their planning stage. While some of the large firms use a methodical approach for risk management, the process is limited to planning phase only. Because of these practices many risks remain unconsidered and degenerate into huge losses. Risk management is domain dependent and experience intensive and there is a need for the industry people to codify the knowledge and maintain a useful database of successful experiences which can be used to handle various risks. Following points serve the purpose of illustrating the scope of improvement in the project planning and the techniques which can be used by the industry people.

- Scheduling should incorporate resource and information constraints. We find constraint programming a useful tool to solve such problems
- Risk allocation should be on the multi-project basis and should incorporate uncertainties involved.
- As the work in construction projects is experience intensive and domain dependent. Codification of knowledge would be useful in decision making. For this purpose Decision Support Systems based on the Knowledge Engineering tools should be used.
- With the use of IT-enabled services, construction firms should look for customized softwares which are pertinent to their domain of construction projects. These softwares can integrate the Scheduling, resource allocation, and risk management processes which have to be treated together as mentioned above. In the next section we propose one such integrated module.
- Industry should start using real-time information transfer systems which make the visibility of resource usage clear. These systems would certainly help firms to increase the resource utility and remove uncertainties involved.

### 7.3.2 Logistics

*Logistics is the service that ensures the efficient flow of goods, services and human resources between supply chain facilities, using transportation means and intermediate storage facilities*

We spend 13% percent of our GDP on logistics. Transportation and inventory costs constitute over 50% of the value added in India. This includes all industries. Scenario in construction seems no different. According to Construction Industry Development Council (CIDC), breakup of construction cost is as shown in Table 7.1. There is no mention of logistics cost in this table. Material and

**Table 7.1** Break-up of construction costs

	Materials %	Construction Equipment %	Labour %	Finance %	Enabling Expenses %	Admin. Expenses %	Surplus %
Building	58-60	4.5	11-13	7-8	5.5-6.5	3.5-4.5	5-6
Roads	42-45	21-23	10-12	7-8	5.5-6.5	3.5-4.5	5-6
Bridges	46-48	16-18	11-13	7-8	5.5-6.5	3.5-4.5	5-6
Dams, etc	42-46	21-23	10-12	7-8	5.5-6.5	3.5-4.5	5-6
Power	41-43	21-24	10-12	7-8	5.5-6.5	3.5-4.5	5-6
Railway	51-53	6-8	16-18	7-8	5.5-6.5	3.5-4.5	5-6
Mineral Plant	41-44	20-22	12-14	7-8	5.5-6.5	3.5-4.5	5-6
Medium Industry	50-52	7-9	16-18	7-8	5.5-6.5	3.5-4.5	5-6
Transmission	49-51	5-7	19-21	7-8	5.5-6.5	3.5-4.5	5-6

**Source :** Construction Industry Development Council Survey

equipment costs include the cost associated with logistics, which is a common practice in costing. Our industry interviews suggest that 50% of the cost of a project is considered as material cost and there is almost no effort to minimize this cost. With the integrated supply chains (discussed in the next chapter), material cost can be reduced by controlling the logistics cost.

Function of logistics service is to ensure the availability of right resource at the right place, in the right quantities and right condition at the right time and right cost for right customer. To achieve this objective of logistics a high level of coordination among various supply chain stake-holders is needed. For effective logistics, integration and synchronization of material, information and financial flows across the organization is required. Due to the temporal nature of construction supply chains this coordination is often difficult. With the lack of incentives and conflicting interests, stakeholders of the supply chain are unable to share information effectively. While in manufacturing and service industries, supply chain stakeholders of successful industries are ready to share destiny, construction industry lacks various long-term relationships. Poor logistics practices are conspicuous in the industry. Lack of cooperation among stakeholders and lack of will for change makes it very difficult for Indian construction firms to look for the profits that can be achieved through proper logistics.

*Status* Indian construction industry lags far behind the manufacturing industries in proper logistics management. Following evidence shows this status.

- A high proportion of lorries can be seen moving on the roads, either empty or with part-loads while manufacturing industries are using various ordering models and consolidating delivery loads to maximize vehicle fill and hence reduce transportation cost.
- Many lorries have to wait for unloading. There are hardly any delivery time slots assigned to suppliers.

- Use of equipments for loading and unloading of materials is limited and mostly done for delicate and heavy components. The use of skilled labor for unloading and movement of material on site can be seen frequently.
- Inventory management is not given importance as compared to other manufacturing and retail industries. Materials have to wait for a long time before they are used. Also material storage location is not assigned prior to unloading which results in waste of time and resources for movement to appropriate location.
- While manufacturing and other services (retail etc.) use real-time information sharing tools today, information flow in construction supply chains is extremely poor. Supplies before the schedule, arrival of subcontractor with its resources when he is not needed etc. are common in construction industry.
- As compared to manufacturing industries, wastage of material and material damage in construction is huge.
- There is apparently little effort on material tracking in construction, as a result visibility is lost, which causes cost over-run and material wastage.

Above mentioned evidences are conspicuous. Industry still seems reluctant to agree upon the importance of Logistics Management. Given the deadlines for the project, most projects are completed in a rush with the prime focus being the dead-lines. Industry people are either unaware of the expected savings that the proper logistics may bring or are ignorant.

#### *Issues*

- Logistics and Supply Chain Management techniques are still abstract concepts in the construction industry. Even the lead firms of the industry are not using these techniques to transform their business processes. The main reason is the short-term project thinking of the industry people and temporal nature of supply chains.
- Construction firms are not giving attention to collaborations and proper information sharing with the supply chain stakeholders. To enable Supply Chain Management cooperation of all the stakeholders is mandatory.
- Most firms are benefited with the methods available in Project Management literature, which is slowly incorporating the SCM techniques in it.
- Low entry barriers in the industry have given entrance to many small contractors who are not aware of current technology and have poor Project Management skills. These small firms have to be educated.
- Fragmented nature of the industry and heterogeneous culture of supply chain stakeholders make it difficult for construction firms to align the work culture and practices.

There are hurdles in implementing the SCM concepts in the construction industry: conflicting interests, lack of trust due to short-term relationships, improper scheduling requiring flexibility in operations, short-term project thinking, and difference in work cultures of stakeholders etc. Also it is very much unclear who gets benefited. Any feasible solution for the betterment of the

logistics in construction should take these hurdles into account. Presently the industry needs to handle some strategic issues and hence we focus on strategic issues more than technological opportunities. The scope of improvement in this context is as follows.

#### *Scope of Improvement*

- The gains that can be achieved by proper logistics are impossible without supply chain integration. Proper match of demand and supply has to be followed by integrating the supply chain stakeholders.
- Use of supply hubs can allow firms to utilize the expertise of logistics firms. As mentioned later in this report, this strategy is feasible for Indian construction firms and would be a key in controlling project costs and removing delays.
- An industry wide collaboration can be used for pooled procurement. Procurement exchanges can be helpful, especially in reducing the cost and time of procurement of imported materials.
- Main hurdle in the management of on-site operations is that all the materials have to be assembled on site which makes the process complex. As has been seen in the case of manufacturing and service sectors, outsourcing would help in the management of logistics easier in construction.
- Material tracking and visibility, being the key to logistics holds a prominent position in this context. In the wake of favorable government policies for the use of Radio Frequency Identification (RFID) technology, construction firms should exploit this technology for improving the visibility in their projects.

### 7.3.3 Use of Information Technology (IT)

IT has changed the way information is stored and transferred from one place to the other and construction is no exception; but the use of IT in construction is limited in firm level operations, such as accounting, project control, drafting, wireless communication etc. Conflicting interests beget lack of cooperation and firms are averse of sharing information with other supply chain stakeholders. The real exploitation of IT is possible only if it is used for proper information flow across the supply chain. One just has to observe the success of the firms in other industries that have used IT to achieve radical transformation in growth. Examples include Wal-Mart who realized overwhelming cost advantages in supply chain optimization, and Dell Computer who cut out intermediaries in retail computer sales. To really exploit the IT in an effective manner one needs a strategy that provides incentives to stakeholders for sharing information. For small and medium sized firms the use IT is hindered by lack of scales and huge set-up costs involved for some of the latest technologies.

*Status* In each of the sectors, IT systems and tools are used today which directly assist in the specialist tasks. These systems and tools have allowed firms to automate various error-prone and time consuming tasks and gain benefits in cycle-time, productivity, and accuracy. As an example, the use of CAD for drafting has allowed firms to reduce cycle-time, productivity and accuracy when any design changes are required. Automation of manual tasks is the first phase of IT adoption.

Some firms have started to leverage the information in their business processes. The process of storing the information and exchanging it within the boundaries of the firm and, to a limited extent, outside has started. IT has been used to add value beyond its role in reducing the cost. E-transactions, e-tendering etc. are the examples of this phase and a fraction of lead firms are using some other e-commerce applications as well. Use of IT to transform firms' internal processes is the second phase of IT adoption in India. Generic benefits from the use of IT are productivity gains, shorter cycle time, capacity to manage larger and more complex projects, and improved accuracy and consistency of documentation.

The third phase of IT adoption in India will come when the firms will start transforming their core business processes using IT. This will include integrating the supply chain through IT, and use of stored information in critical decision making.

While large firms are investing in various IT solutions, medium and small-sized firms are still avoiding the change in their working practices. Since most of the infrastructure projects have high upfront cost and long payback periods, there are real cost savings to be gained by reducing project cycle time. Even a small time overrun can mean a loss of crores of rupees. This is the reason why construction firms want to capture the expenditure incurred at every stage of the project, and are demanding software to integrate construction design with material, equipment, capital and human resources. Lead players use productivity and cost reduction software applications like PRIMAVERA, CAD design tools, Enterprise Information Portals (EIP) for multi-project visibility, and other costing and scheduling modules.

Industry leaders in public as well as private sectors are investing heavily on Enterprise Application Software (EAS) for tracking expenditure incurred on infrastructure projects across sectors such as power, highways, shipping, railways and telecom. The software integrates project management and budgeting of projects. Industry heavyweights such as L&T, ABB, BHEL, Reliance, ONGC, Indian Oil and Tata power are investing in EAS.

Up to 80% of inputs into buildings are repeated. Therefore a Enterprise Application System is required to keep track of the past information, which in turn will require codification of knowledge. Such a system uses the knowledge from past in future projects and reduces project costs.

Many IT firms in India have already launched their software packages for different purposes. But it seems that most of the firms are hesitant to use these software solutions especially in Real Estate segment. It is found that lead players of the industry are investing in these solutions and their experience has been really good. It is expected that, in future small and medium sized firms will learn from these success stories and start investing in IT solutions for their projects.

#### *Issues*

- Construction firms are not IT savvy and only lead firms are trying to exploit the benefits.
- Lead players are using IT for project management and the use of IT is mostly at the firm level. Proper information flow across the supply chain is absent.
- Planning and productivity modules such as PRIMAVERA, are helping only a few individuals as these applications require a significant amount of investment with lack of scales for small & medium-sized firms and hence the current practices don't tend to optimize the whole system.

**CASE STUDY: L&T, Managing multi project operations with the use of IT, 2003*****Challenges***

One of the biggest challenges faced by L&T's ECC division was the Indian construction industry itself, which was not very IT savvy. There was no established IT product or solution to meet the specific requirements of managing information and projects on a large scale, spread over a wide geographical network. Typically, the length of projects lasted from six months to a year. And the ERP solutions that were available were rigid and catered to a limited number of people and projects. This proved to be an obstacle when it came to customization or flexibility in working within the requirements and processes in the construction industry.

The company had a huge task at hand with 210 work sites, and 350 of its turnkey projects spread over a vast geographical area. With no clear system to track job status or generate relevant MIS reports and optimise resources, the implementation of crucial corrective actions was delayed in several projects.

This resulted in increased costs. Apart from this, with over 6,000 vendors spread across 350 locations, the ECC division procured construction and equipment material and services worth \$1 billion and generated over 70,000 purchase orders in a year. However, the absence of an efficient Supply Chain Management (SCM) system limited the company's ability to leverage its huge purchasing power.

***Solution***

EIP provides a solid backbone to project execution of L&T through digital pictures of progress across all sites. Using Microsoft Project 2000 and Visual FoxPro-based CeMA (Construction Enterprise Management) at the back-end, complete job details from concept to implementation and completion are automatically uploaded onto the portal. This has helped speed-up access to all information, including financial status, seamlessly across business processes. EIP has brought together different phases of construction cycles—design, development, tendering/bidding, budgets, planning/scheduling, etc. By collaborating and bringing together the different stakeholders—architects, designers, vendors, sub-contractors, clients and L&T—on a single platform, EIP has emerged as a powerful ERP solution for L&T's construction division

Apart from this, the company also decided to implement a Web-based SCM solution built on SQL Server 2000 and Windows 2000 Server. This solution not only enabled the company to streamline its entire vendor network but also help build an effective system for the RFQ (request for quotes) process. Today, all a vendor has to do is log on to the vendor registration window and put in a request to place an order. The entire process from request to payments (except for delivery of products and construction equipment) is conducted online. The SCM solution is also integrated with the financial and back-end systems, thus streamlining the accounts and purchase processes too.

*Source: Express Computer, magazine*

**Fig. 7.2** L&T Case Study

- With the lack of a clear strategy for incentive allocation among the supply chain stakeholders and the presence of conflicting interests, IT solutions which can improve the information flow across the supply chain remain unsuccessful.

#### *Scope of improvement*

- A successful IT strategy for Indian construction industry should try to provide the solutions which are feasible to not only big players but small and medium sized players as well.
- It can be achieved in the leadership of lead players who can aggregate the supply chain stakeholders and ensure the incentives for information sharing.
- The effort of the lead firms along with the favorable government policies would homogenize the IT infrastructure in the industry which, in turn, would facilitate the supply chain integration and use of IT in critical decision making.

## 7.4 Indian Construction Supply Chains: Strategies

This section aims to provide strategies for construction industry in three areas: project planning, Logistics, and Use of IT. As mentioned earlier, any feasible and potential strategy would take the characteristics of construction supply chains into account. The technologies which can be used are also suggested to complement the strategies with appropriate solutions.

### 7.4.1 Integrated Supply Chains

Any Supply Chain Management initiatives would fail unless and until the stakeholders are willing to share information and cooperate in an integrated manner. This can be done if and only if there are incentives for individual supply chain stakeholders for cooperation and there are mechanisms to control risks associated with information sharing.

Dell, Wal-Mart and some Indian manufacturing firms have been successful in achieving supply chain integration because they could propagate the incentives through out the supply chains. The key difference in any construction firm and the above mentioned firms is *Relationship Management*. Changing the industry attitude from adversarial to cooperative is a challenge before construction industry. There are four main strategic steps that have to be taken to form integrated supply chains. Figure 7.3 shows these steps and benefits which would follow from integrated supply chains.

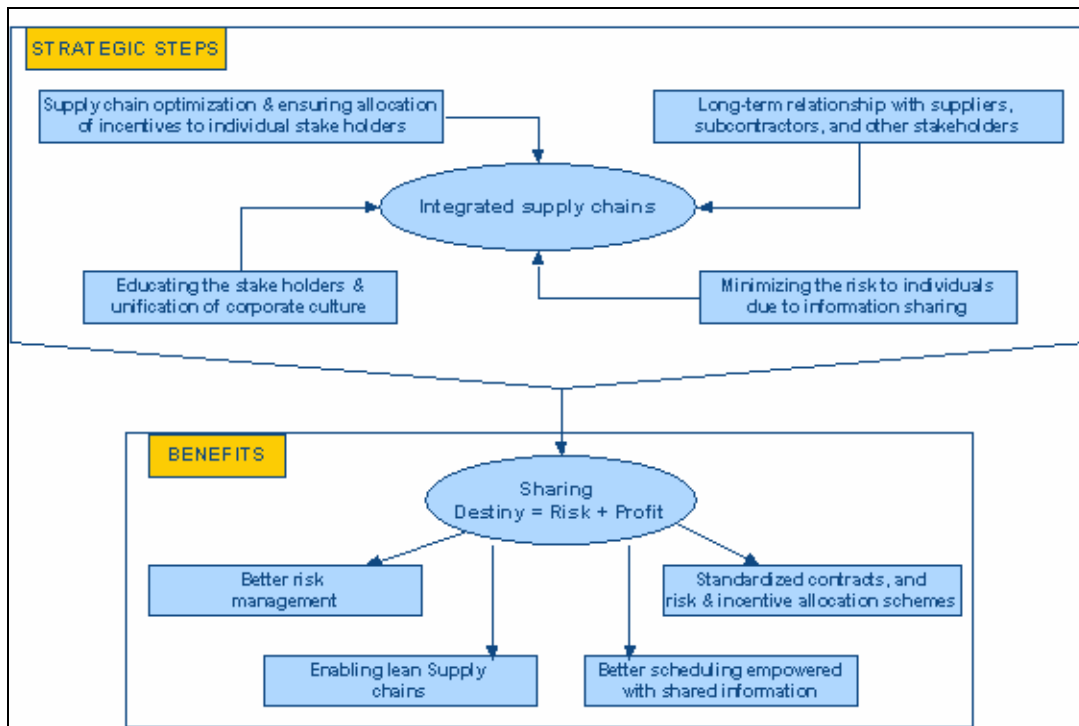


Fig. 7.3 Integrated supply chains: Approach and benefits



*To form integrated project supply chains means building long-term relationships with suppliers, subcontractors and other service providers and employing them for various different projects with proper risk and profit sharing. An integrated project supply chain is focused on the reduction of the total cost of the project. With the proper risk and profit sharing, all the stakeholders co-operate to reduce redundancies and waste in various processes (design, scheduling, material procurement, installation etc) of the construction project. Proper information sharing enables main contractor in realistic scheduling, timely procurement of material with inventory controls at various levels of supply chain network. Long-term partnership with suppliers, subcontractors and other service providers helps in standardizing contracts with risk and profit allocations. Better Supply Chain Management empowered with lean principals is followed by cost reduction and greater customer satisfaction*

**7.4.1.1 Forming Integrated Supply Chains** Lead construction firms (L&T, Gammon India, HCC, Nagarjuna Construction, Punj Lloyd, IVRCL etc) presently have a strong order book. It would be easy for these firms to create integrated supply chains by forming long-term relationships. These firms can ensure the participating suppliers and subcontractor of long-term orders and contracts. In the view of *bargaining power of lead firms*, they can integrate the supply chain and apply above mentioned strategic steps for better Supply Chain Management. Sharing of information should not be an issue for other supply chain stakeholders if the proper profit sharing schemes are applied.

Small and medium-sized enterprises (SMEs) have to see their core competencies and join an appropriate supply chain. They should be a part of the policy-making process for information and profit sharing.

Under the relationship-based approach, suggested strategies are as follows.

**A. Strategic Alliances** Firms from different sectors who act as stakeholders in construction supply chains need to collaborate in order to coordinate for their mutual benefits. These strategic alliances, having partners with their individual knowledge and expertise, can contribute in achieving a higher productivity in construction projects. This inter-sectoral cooperation would help all the partners in making better decisions through knowledge-sharing and will bring systemic developments in the industry. With this model the benefits of specialization are fully retained and there are economic incentives to individual partners.

Current practices in the industry maintain project contracts for a particular project. As mentioned earlier, these short-term relations have to be converted into long-term partnerships. In that sense, selection of a new supplier or subcontractor should be based on the benefits that can be achieved through the long-term relationship with the stakeholder. The idea of integrated supply chain relies on long-term strategic alliances, where the stakeholders can perceive their incentives for cooperation and knowledge-sharing. *The lack of common technological infrastructure and inter-operability standards can be maintained if the long-term relationships are maintained.*

**B. Performance-driven supply chains** Present industry practices are based on the competitive bidding process. Construction industry has seen the commoditization because for a long time innovation for higher productivity has been absent and product differentiation was absent in the Indian market. As a result the bidder with minimum bid gets the contract even today. This contractor selection approach has worsened the situation and with the reducing

margins it has been difficult for firms to invest on new technologies. "How can we bring a culture of innovation in the construction?" is a critical question.

The motivation for innovation to achieve higher standards of productivity and quality can come only if the incentives are ensured to individual players. The supply chain optimization, which has been used in some manufacturing industries, should be applied to construction. Government has taken this initiative to increase the private partnership in construction. Many projects: most of the projects under the National Highway Development Program (3rd phase) are on Build-Own-Transfer (BOT) basis, Hyderabad & Bangalore international airport projects were awarded on the Built-Own-Operate (BOO) basis etc. The use of such contracts is a sign of performance-driven approach. These contracts have been designed to shift the principal contractor's focus to the performance of the asset. Similar incentive allocation schemes should be devised for other supply chain stakeholders to promote innovation for better productivity.

The firms who would be able to motivate the critical players involved in the project for greater cooperation and innovation would be able to reduce the project cost to a great extent and compete in global markets. This can not be done without a performance-driven approach with proper incentives allocated to individual players.

**C. Effective inter-organizational processes** Once the cooperative culture of integrated supply chain is developed, the effectiveness and efficiency of inter-organizational processes has to be ensured. Following approaches should be followed for the same.

- Firms need to ensure that an integrated database of design and other construction information is provided appropriately to each of the critical supply chain members. This can be done using internet with the password protection. The information should be shared in real-time by individual members of the supply chain: suppliers, consultants, design professionals, and contractors etc. It ensures the consistency in collaborating effort by sharing and managing data.
- Before maintaining the databases it is important to find out information linkages between supply chain members. Which means that "what information is required, at what time, in what format, and by whom" should be clear.
- Standard formats and practices would help in homogenizing the practices in the supply chain and would be easy to use as well.
- Information sharing process has to be supported with proper IT infrastructure. A proper IT strategy needs to be worked out to handle various challenges related to the fragmented structure of the construction supply chains. We will take this issue later in this report.

#### 7.4.2 Improving Project Planning

Reliable planning improves project coordination and reduces disruptions and delays. Status and issues related to current industry practices for project planning were discussed in Section 7.3.1. Current industry planning procedures include scheduling based on process constraints (PERT, CPM etc.), risk management, and resource allocation in separation. It is widely accepted that the schedules which don't consider resource and information constraints, and don't take into account the possible risk events are unrealistic and the Indian industry is full of such examples where

**CASE STUDY: Planning deficiencies**

The Durand Centre is a £100 mn (\$150 mn) shopping mall built in the London area in the early 1990's. It followed a traditional contractual form where the general contractor held contracts with each of the subcontractors and did not self-perform work. Standard penalty clauses for liquidated damages were in place. The project completed on time and placed second in a national project manager competition. On the Durand Centre project there was a delay to steel fabrication that resulted in a six-week delay to steel erection on-site. This delay was not anticipated and did not become apparent until it occurred on-site. To avoid liquidated damages and complete the project on time, the contractor directed an acceleration of following trades at a cost of £231 thousand. Subsequent investigation found that an alternative acceleration may have been possible at a savings of ~£70 thousand. This analysis came from investigation with the affected subcontractors and suppliers. Conditions that affected cost and capability were both site conditions that affect productivity and resource availability given the demands of other projects under changing schedule.

*Source: O'Brien (1998)*

**Fig. 7.4** Planning deficiencies

firms had to bear huge losses and delays because of poor planning. Though the case studies which can highlight the causes of delays are not easily available for Indian industry, improper planning and ignorance of critical risks can easily be seen. Several NHPC projects, Narmada Dam, Pradhan Mantri Gram Sadak Yojana (PMGSY), and the latest delay in Bangalore-Mysore highway are a few examples. Although many of these delays can be associated with political and legal risk events, poor feasibility study, financial delays, climatic problems, scarcity of materials and labor and change in work culture are prevalent causes of delays (refer Appendix 1).

Case study in Figure 7.4 shows that resource, and information constraints should be included in scheduling. And output of risk analysis should be used in project planning.

We make the following recommendations for the improvement of project planning modules.

- A firm needs to consider the resource constraints (equipments, machines, labor etc.) while scheduling the project to make the schedules realistic. For the firms who are involved in multiple projects, it is mandatory to find out which resources can be allocated to the scheduled project. In that sense, resource allocation should be a part of project scheduling.
- The Scheduling module should also consider the information constraints. Information constraints include the equations which consider the critical information that must be available before a process can start. As an example if the information regarding inventory for a material is not available, the process using that material can be hindered and may cause delays. With the integrated supply chains it would be easier to find out real constraints regarding material lead times.
- Risk analysis should be paralleled by scheduling and appropriate risk management schemes should be devised to avoid the future changes in the schedule. [21] describes how a CBR-based Decision Support System can be used for construction supply chain risk management.

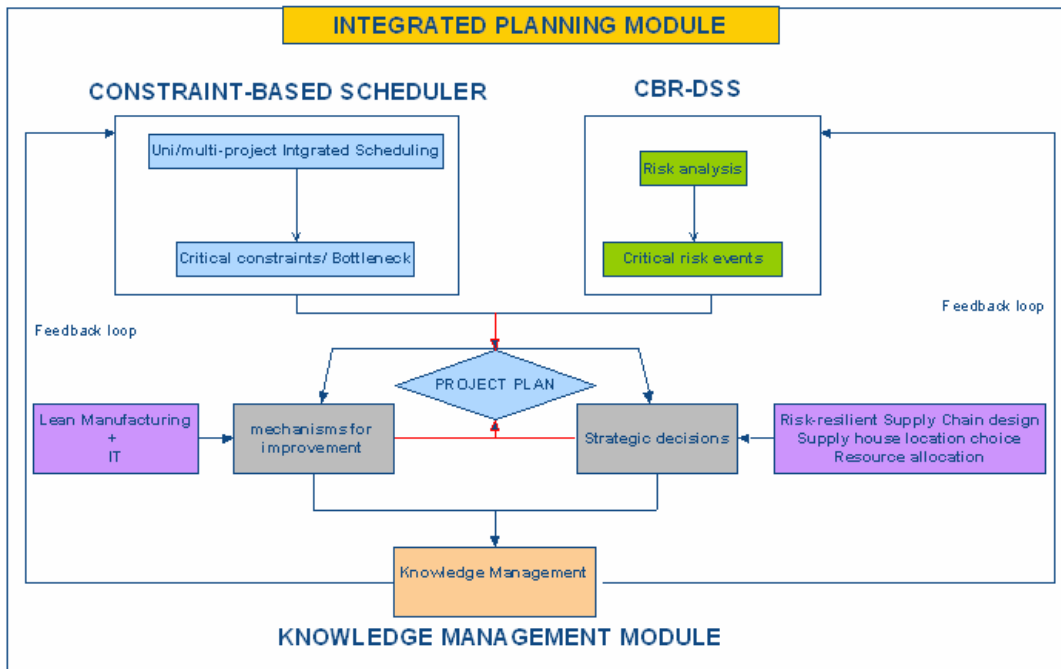


Fig. 7.5 An integrated planning module for construction firms

- With the scheduling and risk management module, a Knowledge Management module which can store the knowledge and experiences of on-site operations, would help project planners to identify and manage critical risks in planning.

Figure 7.5 illustrates the framework of the proposed planning module. Constraint-based programming is a good choice for handling various constraints (process, resource and information) in scheduling. Constraint-based programming also helps identifying critical bottlenecks (critical constraints) in the project. These bottlenecks can be dealt with, using Lean principals (in case of resource constraints) and Information Technology (in case of information constraints). Also the CBR-based Decision Support System for risk management [21] can be used to take strategic decisions on the supply chain design and resource allocation.

### 7.4.3 Focus on Logistics

As mentioned earlier, no one part of the construction supply chain can improve logistics on its own. All the stakeholders have their roles to play and a collective effort of information sharing would be required. Currently the industry is ignorant about the logistics and evidences illustrated in the previous section support that.

With the integrated supply chains, logistics focus can be easily achieved. The focus on logistics should start right at the designing phase of the project.

**7.4.3.1 Design for Logistics** Design professionals need to be more aware of logistics costs. This can be done by involving logistics managers in the design phase. Design for logistics would mean

that a process map for packing, transportation, order quantity etc. is specified during the design phase itself. Design for logistics would help in reducing material wastage and cost in the following way.

- Design professionals would include the *packing and lot size instructions* to ensure the optimal loading of transport vehicles. This would reduce the material wastage and save transportation cost. Packaging instructions should also ensure ease of *packaging* and *site storage* constraints to save storage space.
- *Kitting* is a useful tool for construction industry. Kitting opportunity can best be seen at designing level. Using the bill of materials and drawings, design professionals should see which components/materials should arrive at the site at the same time and can be supplied together. As an example, a modular door assembly can arrive with all the components arriving at the site as a kit. Such a kitting would help synchronization of material procurement and reduce the chances of delays.
- It would be easier to decide about the *site layout* and *location of store house/s* during the design phase. Design professionals should work together with project managers and work on the site layout. This would help in double handling of materials.
- *Standardization of logistics processes* would help in applying the design for logistics for the products of similar nature which are used in separate locations and purposes. This would reduce the cost of "design for logistics" itself.

**7.4.3.2 Pooled Procurement through Supply Hubs** According to overall industry estimates transportation (35%), inventory (25%) costs contribute a total of 60% of the total logistics cost. A few Indian lead firms have started using e-commerce applications for online material procurement. These solutions rely on firms' supplier networks and reduce process and transaction costs to some level. Also only a few firms are benefited through these e-commerce solutions. Following two observations are keys in developing the strategy which reduces the above mentioned costs.

- As is well known, transportation cost can be reduced by increasing the scales, i.e. by more and more material supplied from the same supplier, cost of transportation per unit comes down. But for individual firms optimal lot size remains fixed. An individual firm can not afford to order more than required as it would cause high inventory levels and material wastage in many cases.
- Inventory costs and delay in material procurement are the result of information gap between the suppliers and the contractor. In construction projects, many a times subcontractors are responsible for their own material procurement and the quality of information flow, back and forth, from the supplier and to the supplier remains in the hands of subcontractors, who have a variety of work cultures. Due to these reasons, demand distortion (as known as bull-whip effect in Supply Chain Management literature) remains a challenge for construction industry.

**IT- ENABLED POOLED PROCUREMENT**

*IT-enabled pooled procurement is a material procurement arrangement in which demands for the materials/equipments are placed for multiple projects and by multiple customers (contractors) through a third party, called supply hub. Supply hubs maintain long-term relations with construction material suppliers around the world and place the aggregate demand for materials which arrives from various customers. With the increased scales, transportation and transaction cost per unit decreases and hence reduces material cost.*

*Being a third party, supply hubs act as an intermediary maintaining the confidentiality of information from various suppliers as well as clients. With a supply hub connecting various stakeholders of supply chain, it is easier for firms to share the information. Supply hubs act as a safe channel for proper information flow and hence reduce the demand distortion. A supply hub for material procurement would reduce the inventory holding cost and procurement delays by maintaining a smooth information flow enabled by IT.*

Pooled procurement is a strategy that can handle both the issues mentioned above. Typically the pooled procurement arrangements work in fragmented industries where the end-customers don't have a bargaining power and the demand is uncertain. Healthcare industry is one such example where this kind of arrangement has gained a huge success. There are over 550 group purchasing organizations in healthcare in US, which account for 80% of the total annual spending by hospitals and nursing homes. Construction industry has both the characteristics mentioned above and we think that pooled procurement strategy enabled by internet can bring huge cost reductions.

Strategic suggestions for pooled procurement are as follows.

- Small and medium sized firms who lack the bargaining power can join together to form a supply hub, which with the increased scales would have the bargaining power. This will reduce not only the logistics cost but also the material cost as a whole.
- A supply hub can be shared by contractors as well as suppliers if the long-term relationships are maintained. As happens in supply hubs of manufacturing, suppliers would take the responsibility of contract fulfillment and inventory levels until the material arrives at the site.
- Lead firms dealing with multiple projects at a time, can create their private supply hub and get benefited but the information confidentiality can be an issue. They are suggested to contact a third party who can act as an intermediary and maintains the confidentiality of suppliers' information. Also, none of the lead firms in India seems to have a core competency in Supply Chain Management. It should be best for these firms to outsource the material procurement to a third party.
- An IT-enabled procurement with real-time information sharing at supply hub would minimize the demand distortion to a great extent and hence would reduce the procurement delays.
- Supplier-side investment on the required IT infrastructure is not high and hence several small and medium-sized players are expected to participate.
- The selection of a third party for supply hubs should be based on Supply chain Management skills, breadth of network and market credibility.

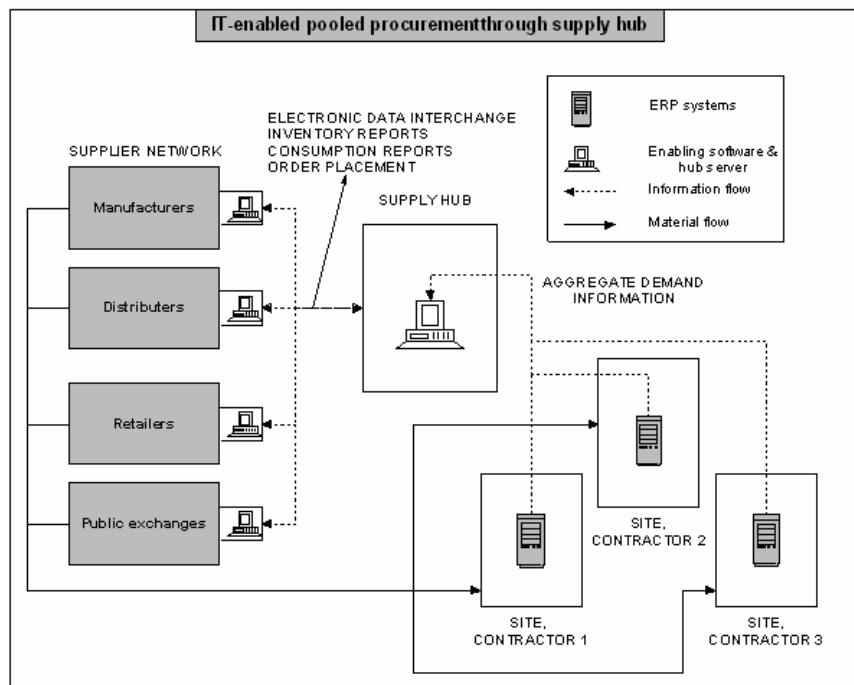


Fig. 7.6 A supply hub model for construction firms

Many areas of India are attracting firms for commercial activities. Examples include Hyderabad, Gurgaon, and Hariyana. A lot of real estate construction is expected in these areas in coming years. A supply hub in these areas would reduce the construction costs of the projects. As building materials for residential and commercial complexes are almost common, such a supply hub can provide a total solution for materials if planned properly.

Software firms like i2 technologies, IBM and Oracle etc. are capable of providing the required IT infrastructure for such a pooled procurement arrangement.

*Limitations & challenges*

- Such an arrangement for pooled procurement requires the use of Information Technology in construction industry. Although firms are gearing up in this area, it will take time to grow the supplier-customer network.
- As construction industry requires a huge number of various different goods for various different projects, it is hard to believe that supply hubs can provide a total solution for material procurement.
- Some contractors might be unwilling to share the information necessary for the great impact of such an arrangement.

7.4.3.3 *Goods' Tracking & Visibility* Visibility of goods in construction is not given importance. Material visibility is scarce on site and negligible off site. Material visibility in various stages of supply chain and its importance is as follows.

- Visibility in warehouses enables labor cost minimization and warehouse management.
- Transportation visibility enables in-transit inventory management and trailer/asset management.
- Supplier visibility enables vendor managed inventory and supplier collaborative replenishment.
- On-site visibility enables work-in-process material management and replenishment planning.
- Demand visibility enables order fulfillment, vendor drop-ship, and direct to store delivery.

Material tracking is of fundamental importance for critical materials and components. Critical goods include materials such as cement; concrete; asphalt; bricks etc. which need to be supplied continuously, High value components such as baggage handling systems; industrial turbine; and equipments (earthmovers, machines etc.), and imported materials which have risk of damage and/or stealing in procurement etc.

Radio Frequency Identification (RFID) technology provides a wireless means of communication between objects and readers. It involves the use of tags, or transponders, that collect data and manage it in a portable, changeable database. Unlike bar codes, RFID has the ability to identify and track products and equipments in real-time without contact or line-of-sight and the tags can withstand harsh, rugged environments.

The materials in construction are used in a rough environment, where dirt, dust and other contaminations are present. Sensing and reading of labels in such environments is not possible through optical sensing. RFID is a tracking technology that can be used in construction. A lot of research is going on in this area around the world [7, 8] and there are some success stories outside India [29, 30], where RFID has been used for the tracking of materials in construction projects.

Construction materials (ex. steel beams) can have RFID tags so that manufacturing, transporting, storing, and installation of materials are monitored by construction engineers. This will have a great benefit in reducing field overhead costs which accounts for the major portion of project expenses.

Indian government's Wireless Planning and Development Authority has released radio frequency in the UHF 865 - 867 MHz band. This move is expected to encourage the use of RFID in the supply chains. A number of manufacturing firms: Mahindra & Mahindra, Honda SIEL, and Abhishek Industries etc. are using RFID for various logistics operations. Similar implementations are under way in Ashok Leyland, Pantaloons, Arvind Mills and other firms. A group of public and private professionals joined together and formed RFID Association of India (RFIDAI), a not-for-profit organization to promote rapid and responsible adaptation of RFID in India. Conditions for the use of RFID are favorable in India and construction firms should adopt this technology for better goods' tracking.

**7.4.3.4 Lean Construction** Lean Production is the generic version of the Toyota Production System, recognized as the most efficient production system in the world today. Lean Thinking describes the core principles underlying this system that can also be applied to every other business activity - from designing new products and working with suppliers to processing orders from customers.



**CASE STUDY: Use of RFID in Automated Asset Control System, UK**

Select Plant Hire Company Limited – a subsidiary of Laing O’Rourke – is one of the largest operators of specialist construction plant and equipment in the UK. Costs of order processing were spiralling due to the growing number of customer queries about plant dispatch and delivery status and a high volume of billing queries. Select Plant Hire recognised that it would need to radically transform its systems and processes and began the search for a technology-based solution.

The system chosen as part of the overall solution utilizes leading edge radio frequency identification (RFID) technology. Ruggedised identification tags are attached to some 10,000 items of plant to provide each with a unique identity. Fixed scanners – called RFID readers – are sited at depots’ entry and exit points. The resultant data is securely transmitted over the internet and processed by a hosted Auto-ID platform to provide an auditable log and record of equipment dispatch and receipt.

The new solution has radically improved the Select Plant Hire business model, supporting growth and increasing output. Efficiency has improved and re-keying errors have been reduced. Invoice accuracy has been improved and, with the increased data visibility, the number of queries and billing disputes has been reduced – providing a significant boost to customer satisfaction.

Select Plant Hire is very satisfied with the return on investment (ROI) of the solution. Independent analysis conducted by Forrester Consulting has calculated a non-risk adjusted ROI of 53 per cent and a risk adjusted ROI of over 25 per cent over a three-year period with payback achieved within less than 24 months. In fact such has been the success of the project that it has been entered into the ‘Quality in Construction Awards 2006’ under the ‘Innovation through the use of IT’ category. It has reached a final shortlist of four candidates.

*Source: www.networked.bt.com*

**CASE STUDY: Use of RFID in Dubai International Airport expansion project**

Thermo, MEP contractor of Dubai International Airport expansion project is using RFID to track their crew of 10,000 workers in a 1.25 km<sup>2</sup> site. Manpower of 10,000 workers was creating a lot of logistical problems with the earlier system of gate pass, which was not that effective as well. With the automatic RFID system for staff tracking, the firm has saved the staff of 100 people for time-keeping and security, and the tracking of staff is error-free now.

Previously, labor would leave site early to board the buses for the journey back to camp. On arrival for their shift, they had to queue for up to half an hour at the gates to sign in using the manual timekeeping system. With the RFID tag, they simply walk into the site. The savings of half an hour per worker resulted in a cumulative saving of 10,000 man-hours per month on site.

RFID was easy to adapt on the airport expansion project as it does not interfere with aircraft systems either. In fact, RFID-tagged goods are routinely transported by air, and the technology is also used to find lost luggage.

The RFID system at Dubai airport cost US\$250,000 to implement, a cost that Thermo hopes to recover by next July through the savings on labor, increased productivity and efficient use of resources.

**Fig. 7.7** RFID case studies in construction

**CASE STUDY: LEAN THINKING IN CONSTRUCTION**

**Pacific Contracting** of San Francisco, a specialist cladding and roofing contractor, have used the principles of lean thinking to increase their annual turnover by 20% in 18 months with the same member of staff. The key to this success was improvement of the design and procurement process in order to facilitate construction on site, investing in the front end of projects to reduce costs and construction times. They identified two major problems to achieving flow in the whole construction process – inefficient supply of materials which prevented site operations from flowing smoothly, and poor design information from the prime contractor which frequently resulted in a large amount of redesign work.

To tackle these problems Pacific Contracting combined more efficient use of technology with tools for improving planning of construction processes. They use a computerized 3D design system to provide a better, faster method of redesign that leads to better construction information. Their design system provides a range of benefits, including isometric drawings of components and interfaces, fit co-ordination, planning of construction methods, motivation of work crews through visualisation, first run tests of construction sequences and virtual walk-throughs of the product.

*Source: Rethinking construction, the report of the construction task force, UK, 2002*

**Fig. 7.8** Case study of lean thinking in construction

The starting point is to recognize that only a small fraction of the total time and effort in any organization actually adds value for the end customer. By clearly defining value for a specific product or service from the end customer's perspective all the non value activities, often as much as 95% of the total, can be targeted for removal step by step.

Few products or services are provided by one organization alone, so that waste removal has to be pursued throughout the whole value stream - the entire set of activities across all firms involved in jointly delivering the product or service. New relationships are required to eliminate inter-firm waste and to manage the value stream as a whole.

Instead of managing the workload through successive departments, process are reorganized so that the product design flows through all the value adding steps without interruption, using the toolbox of lean techniques to successively remove the obstacle to flow. Activities across each firm are synchronized by pulling the product or design from upstream steps just when required in time to meet the demand from the end customer.

Removing wasted time and effort represents the biggest opportunity for performance improvement. Creating flow and pull starts with radically reorganizing individual process steps, but the gains become truly significant as all the steps link together. As this happens more and more layers of waste become visible and the process continues towards the theoretical end point of perfection, where every asset and every action adds value for the end customer. Lean Thinking represents a path of sustained performance improvement and not a one-off programme.

A lean construction approach would be similar to lean manufacturing where, value-adding processes would be clearly defined and a continuous effort to remove the waste would be made. This can reduce material wastage and project cycle time, and allow proper utilization of resources.

### MOTIVATION FOR THE IT STRATEGY

*Government's policy towards foreign investment which allowed 100% FDI in construction (2005), has put a pressure on the Indian construction firms to maintain global standards in productivity and quality. So far most of the government infrastructure projects have been awarded to foreign construction firms as a form of consortium with Indian firms. There are a number of private projects which have been awarded to foreign firms independently. This is a sign of increased global competition in Indian market. On the other hand, this is the time for Indian firms to achieve global standards by transforming their business processes using advanced technologies and greater supply chain coordination. As most of the lead firms have a strong order book and rising profits today, appropriate investment decisions will give them competitive advantage in the years to come.*

*As a project involves players from various different sectors: manufacturers, specialty consultants etc., who influence the productivity of the project, the real competitive advantage can not come without exploring cross-sectoral potential. Information Technology would be the key in integration of construction supply chains by involving all the stakeholders in the project in better information sharing and exploiting the information with better coordination.*

Fig. 7.9 Motivation for IT strategy

#### 7.4.4 IT Strategy

We discussed the status of Information Technology application in construction industry in the previous section 7.3.3). Use of IT applications gained the attention nearly five years back when lead firms started adopting various IT-enabled solutions for their internal operations (as mentioned in Section 7.3.3). As the industry is not that IT-savvy and requires investments which many small and medium-sized contractors can't make, the Indian construction industry still needs to go a long way in the IT applications.

As mentioned in Section 7.3.3, it is because of the fragmented structure of the industry that IT capabilities of Indian firms are heterogeneous. The real exploitation of the benefits of IT will come through industry-wide homogenized use of IT; where suppliers, subcontractors and other stakeholders of supply chain will have a common IT infrastructure to speed up the information flow and use the stored information in critical decision making processes of business.

Our approach in this report is towards the use of IT in *integration of construction supply chains* and *critical decision making*. We believe that this approach would be responsible for Indian firms to derive systemic radical changes and greater benefits.

In Section 7.4.1.1 we discussed the concept of Integrated Supply Chains. This section takes this idea further and introduces a strategic path which would lead to greater cross-sectoral coordination in the construction industry using IT.

**7.4.4.1 Developing Awareness, Skills, and IT Infrastructure** IT skill base in construction industry is quite low. While big suppliers, consultants, contractors are gaining the benefits of IT, many small players are not even aware of these benefits. First step towards the supply chain integration should be increasing the awareness of IT applications and its benefits.

Many manufacturing firms have a regular education and awareness programs for their vendors and suppliers. Construction firms need to start similar programs for their supply chain partners. It should be mentioned here that it is possible only if long-term relationships are expected and the intention is to form an integrated supply chain for multiple projects. The status of IT and computer education in India is in a good shape. If the awareness of the IT benefits is spread in the industry, it is expected that various small and medium-sized players can adopt the IT-enabled practices. Construction Industry Development Council (CIDC) and other public organizations are expected to take initiative in this direction, who can publicize industry best practices as case studies on their web-sites, organize educational conferences for SMEs, and assist them in forming the right IT strategy. Government's favorable policies for the use of IT in construction would help SMEs in bringing up the change in this work culture.

In the integrated supply chain approach, lead contractors would educate the firms to develop the required IT infrastructure. The tools which are to be used and the systems which are required can be suggested by lead firms' IT consultants so that a common IT infrastructure, maintaining inter-operability standards, can be built.

*7.4.4.2 Standardized Database* Once the required IT infrastructure and skill has been acquired by the supply chain stakeholders, the next step would be to find the information linkages between various players and creating standard systems and procedures for storing and sharing the information. These systems should be able to provide real-time information sharing. As an example, a material supplier should be aware of delivery dates; inventory levels of the customer; customer schedule; lot size information; design changes etc. on the real-time basis, and the customer of that supplier should be aware of capacity constraints; failures and disruptions; quality constraints etc. of the supplier. For the security concerns best solution is to use password protected web-based systems.

Standardized databases would help individual supply chain members to plan their production and services in an effective manner. Inter-organizational processes would become a standard practice and can be used if any change in the supply chain is introduced. For example it would be easy for a new firm to join an integrated supply chain and become a part of it.

*7.4.4.3 Decision Support Systems* Construction Management is experience intensive. The knowledge gained on site is hardly stored and used for the future decision making. Also individuals in the supply chain do not have the information which is critical in the decision making. In an integrated supply chain, individual firms will have an opportunity to gather the information relevant to them and this information can then be used in making critical business decisions.

A Decision Support Systems (DSS) provides a standard way of storing the information and using this information in various decision making processes. As an example: a contractor can use a DSS for risk management in construction projects, which uses the chances of occurrence of various supply chain risks and knowledge stored from the previously handled risk management cases, to make a risk management plan for new projects. Individual firms need to identify critical decision making processes of their business: supplier selection, material selection, waste management etc. and build Decision Support Systems to use the information gathered from other players in making better decisions.

## 7.5 Conclusions

- We found that efforts in the construction industry to achieve higher levels of productivity have been much slower as compared to other manufacturing and service industries. This slow pace in innovation can be attributed to work culture in Indian construction industry and characteristics (temporal nature, short-term thinking, fragmented structure etc.) of construction supply chains.
- While lead firms are trying to leverage IT and other technologies to increase the productivity at firm-level, small and medium-sized firms are still following traditional approach in project execution.
- We believe that it is not possible for construction firms to achieve long-term benefits without managing the entire supply chain (rather than focusing on firm-level operations). Devising the workable strategies for supply chain integration is the issue that construction firms need to consider today.
- Lack of cooperation among supply chain stakeholders (suppliers, subcontractors, and other service providers) limits the scope of rise in productivity.
- Industry is unable to ensure *incentives* for supply chain stakeholders which are mandatory for the development of a cooperative attitude.
- The key in developing a cooperative attitude among various team players is to maintain *long-term relationships* and allocate share of profits, gained through higher productivity, to individuals in the supply chain.
- Forming *Integrated Supply Chains* is a strategy that construction industry should follow by forming long-term relationships with suppliers; subcontractors and other supply chain players, sharing information for mutual benefits; and using IT to make it more efficient and effective.
- We found some serious flaws in the current project planning practices, which ignore information and resource constraints. Also the *Risk Management* should be more effective, in lack of which firms cant avoid delays and cost over-runs.
- We suggest a planning module which integrates risk management, scheduling and resource allocation for better planning. We also highlight the crucial role that Knowledge Management can play in project planning.
- Importance of *logistics cost* can not be ignored as it is a significant part of the project cost. There is a huge potential for the reduction of logistics cost in construction.
- Effective logistics and strategies like *IT-enabled pooled procurement* are expected to compress project cycle times and to reduce chances of project delays.
- Construction firms should learn Lean Principles from other manufacturing industries and apply them in construction. *Lean construction* would reduce resource wastage and project costs in construction.
- As the construction industry is not IT-savvy and there are issues related to investments and work culture, a proper IT strategy is needed to be worked on. The approach should

incorporate developing *awareness of IT benefits* in the industry, building *IT infrastructure*; ensuring inter-operability standards; and effective *information flow*, and using this information in *decision making*.

## Appendix: Cases of Government Infrastructure Projects & Causes of Delays

### CASE 1: Hydro Power Projects of NHPC

In 2003, Government of India proposed to double the current electricity generation, proposing 162 new hydroelectric projects. National Hydro Power Corporation (NHPC) plans to install 100,000 MW of generating capacity till March 2012 (i.e. during 10th and 11th five year plan period).

Of the eight operational NHPC projects, three were completed much behind the schedule. Baira Siul, which was completed in 1981, had a time overrun of 75 months, Loktak, which started to generate energy in 1983, had time overruns of 110 months and Tanakpur, completed in 1992, was 40 months behind schedule.

Of the announced addition of 4622 MW during the Tenth Plan period (2002-2007), so far, only 300 MW (Chamera II) have been added. Many NHPC projects have been categorized as *in the pipeline* or *under construction* for many years. All NHPC projects that experience delays during the construction phase also experience massive cost escalations.

Report highlights following causes behind these delays and cost overruns.

- Land acquisition problem
- Projects do not follow government policy and regulation
- Change of government
- Wrong cost estimation
- Slow decision making from owner (Government)
- The impact of climatic change
- Financial difficulties (World Bank and many private Banks have stopped financing dams in India)

### CASE 2: Pradhan Mantri Gram Sadak Yojna (PMGSY)

The central government formalized the PMGSY in December 2000. As per estimations, the project would cost government a sum of Rs 582 billion. The project was targeted to get finished by 2007.

Since (2004) the Congress-led UPA government took charge at the center, the plan was changed and now government is facing financial constraints. As per estimations, available funds (Rs 396 billion) are far less than the planned expenditure (Rs 600 billion).

Apart from fund constraints [28] mentions the following causes of delays.

- Change in bureaucratic procedures
- New work culture under PMGSY

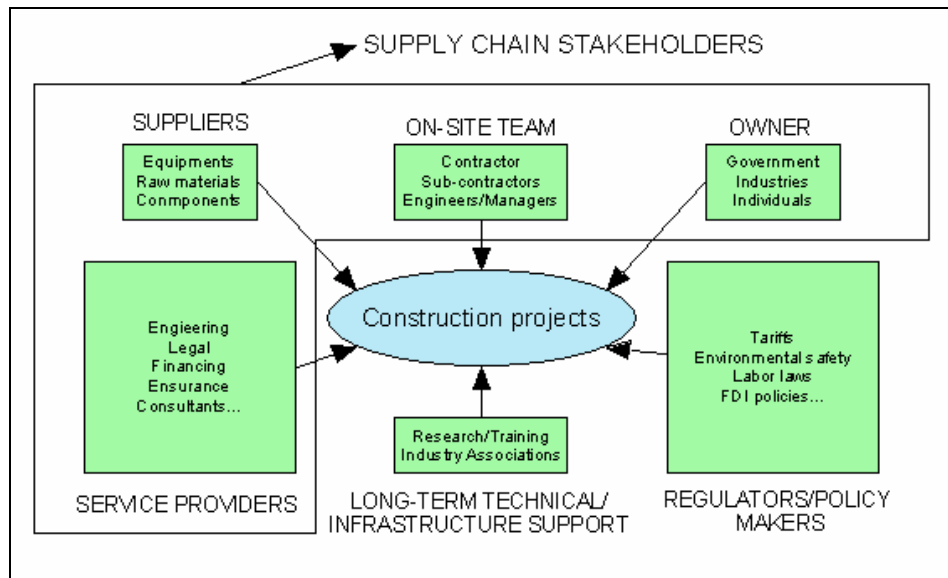


Fig. B.1 Indian construction system

- Land acquisition problem
- Delays on account of monsoon
- Poor feasibility study
- Scarcity of skilled labor and materials

## Appendix: Indian Construction System

A description of some of the key supply chain stakeholders is as follows.

*Suppliers* The main raw materials used in construction are cement, steel, bricks, tiles, sand/aggregates, fixtures/fittings, paints and chemicals etc. are easily available as India is self sufficient in these resources. Most project contracts (excluding lump sum turnkey contracts) are currently structured as fixed price contracts, with a cost escalation clause on direct inputs only. Indirect costs arising due to the delays are not covered under the clause.

Construction equipments broadly comprise earthmoving, lifting, paving and trucking equipments. Nearly 20 to 25 percent construction machinery is imported and contractors are exposed to foreign exchange fluctuations and customs tariffs on imported equipments. BHEL, L&T, ABB, Elgi Equipments and HMT are among the major Machinery manufacturers of India.

*Contractors* Responsibility of contractors is to take a project from design to completion. Qualification criteria include experience in the execution of the similar projects, technical expertise and

financial strength. Contractors mobilize their resources (Machinery, engineers, managers, skilled and unskilled workers etc.), procure materials and execute the project.

Major construction firms in India are Larsen and Toubro, Gammon India, Hindustan Construction, Nagarjuna Construction, Jaiprakash Associates, Simplex infrastructures, IVRCL Infrastructures and Projects, and ITD Cementation.

*Consultants* The role of consultant is to provide detailed project design and supervise the project during pre- project, execution and post-project phases. Consultants are highly specialized and are available for architecture, structure designs, preparing contract documents, and soil investigation etc. There are around 5000 consulting organizations are operating in India. Until the early 1990s, government- owned consulting companies controlled a large share of the market, as most large projects were executed by the public sector. Since economic liberalization in 1991, several foreign consulting companies have set up their offices in India. However public sector consultants continue to play a dominant role in project execution.

Some of the major consultants in public sector are Rail India Tec and Eco Services Ltd. (RITES), Telecommunication Consultants India Ltd.(TCIL), Project and Development India Ltd. (PDIL), Engineers India Ltd.(EIL) for oil and petrochemical projects, and Fact Engineering and Design Organization (FEDO) for fertilizer projects.

*Owner* An owner (public or private) is a project implementer, who is responsible for the project execution by liaising with financial institution, contractors, and consultants Project sponsors include municipalities for urban infrastructure projects, National Highway Authority of India for NHAI and Road Development Corporations for executing road projects, National Hydro Power Corporation for hydel projects etc. Owners in Real Estate sector are individuals and public and private companies. Owners in industrial sector are private firms and public corporations such as NTPC and IOCL etc.

*Industry associations and research institutes* With the combined efforts of government and industry, several industry associations and educational institutes have been developed. These associations solve various different purposes to support the industry in activities such as material and management research, training and education, building and maintaining common databases (suppliers and materials etc.) for the construction industry, assisting in project exports etc. A list of such organizations is provided below.

- Builders Association of India (BAI): <http://www.bainet.org/>
- Building Materials And Construction Technologies (BMCT): <http://www.bmctexhib.com/>
- Construction Federation of India (CFI): <http://www.cfionline.org/>
- Construction Industry Development Council (CIDC): <http://www.cidc.in/>
- Indian Building Congress: <http://www.indianbuildingscongress.com/>
- Indian construction industry primary portal: <http://www.constnindia.com/>
- Indian Federation of Asian And Western Pacific Contractors Associations (IFAWPCA): <http://www.ifawpca.org/>
- Project Exports Promotion Council of India (PEPCI): <http://www.projectexports.com/>



- National Council for Cement and Building Materials (NCB): <http://www.ncbindia.com/>
- National Institute of Construction Management And Research (NICMAR): <http://www.nicmar.org/>

## References

1. Montek S. Ahluwalia, *Financing Private Infrastructure: Lessons from India*, Choices for Efficient Private Provision of Infrastructure in East Asia, World Bank (1997).
2. A. N. Baldwin, A. Thorpe, C. Carter, The Use of Electronic Information Exchange on Construction Alliance Projects, *Automation in Construction*, 8: 651-662 (1999)
3. R. Barker, M. M. Naim, Housebuilding Supply Chains: Remove Waste Improve Value, *The International Journal of Logistics Management*, , 15(2) : 51-64 (2004)
4. G. Briscoe, A. R. J. Dainty, and S. Millett, Construction Supply Chain Partnerships: Skills Knowledge and Attitudinal Requirements, *European Journal of Purchasing and Supply Management*, 7 (4) : 243-255 (December 2001)
5. A. R. J. Dainty., S. J. Millett and G. H. Briscoe, New Perspectives On Construction Supply Chain Integration, *Supply Chain Management: An international Journal*, 6 (4) : 163-173 (2001).
6. V. N. Haggade, IT-propelled Value Engineering In Construction, *The Indian Concrete Journal*, 222-226 (April 2002).
7. E. J. Jaselskis, M. R. Anderson, C. T. Jahren, Y. Rodriguez, and S. Njos, Radio-Frequency Identification Applications in Construction Industry, *Journal of Construction Engineering and Management*, American Society of Civil Engineers, 189-196 (June 1995).
8. J. Song, C. Haas, C. Caldas, and K. Liapi., *Locating Materials on Construction Sites Using Proximity Techniques*, Construction Research Congress (2005).
9. A. Koerckel, G. Ballard, "Return on Investment in Construction Innovation-A Lean Construction Case Study", Proceedings IGLC-13, Sydney, Australia (July 2005).
10. Bing Li, A. Akintoye, C. Hardcastle, "VFM and Risk Allocation Models in Construction PPP Project", Working paper *School of Built and Natural Environment, Glasgow Caledonian University*, [www.arcom.ac.uk/workshops/04-Edinburgh/06-Li.pdf](http://www.arcom.ac.uk/workshops/04-Edinburgh/06-Li.pdf)
11. N. D. Long, S. Ogunlana, T. Quang and K. C. Lam, "Large Construction Projects in Developing Countries: A Case Study From Vietnam", *International Journal of Project Management*, 22 ( 7) : 553-561 (Octpber 2004).
12. B. Mulholland and J. Christian, "Risk assessment in construction schedules", *Journal of Construction Engineering and Management*, ASCE, 125 (1) : 8-15 (1999).
13. W. J. O' Brien, "Construction Supply-chains: Case Study And Integrated Cost And Performance Analysis", In Proceedings of the 3rd Annual Conference, *International Group for Lean Construction*, Albuquerque, New Mexico (1997).

14. W. J. O' Brien, *Capacity Costing Approaches for Construction Supply-Chain Management*, Ph.D. dissertation, Stanford University (1998).
15. W. J. O' Brien, "Construction Supply Chain Management: A Vision For Advanced Co-ordination, Costing And Control", Proceedings of the *Berkeley-Stanford Construction Engineering and Management Workshop: Defining a Research Agenda for AEC Process/Product Development in 2000 and Beyond*, University of California, Berkeley, CA (1999).
16. W. J. O' Brien, "Enabling Technologies for Project Supply Chain Collaboration", *NSF/ICIS Infrastructure and Information Technology Workshop*, Arlington VA (2000)
17. W. J. O' Brien, R. R. A. Issa, J. Hammer, M. S. Schmalz, J. Geunes, and S. X. Bai, "SEEK: Accomplishing Enterprise Information Integration Across Heterogeneous Source", *ITcon*, 7 : 101-124 (2002).
18. G. Ofori, "Challenges of Construction Industries in Developing Countries: Lessons From Various Countries", *Construction in Developing Countries* (2000), <http://buildnet.csir.co.za/cdcproc/docs/2nd/ofori.g.pdf>
19. J. H. M. Tah, and V. Carr, "Towards A Framework For Project Risk Knowledge Management In The Construction Supply Chain", *Advances in Engineering Software*, 32 (10) : 835-846 (October 2001).
20. J. Taylor, and H. Bjornsson , Construction supply chain improvements through internet pooled procurement, *Proceedings of IGLC-7* , Berkeley, CA, 207-217 (July 1999).
21. N. Viswanadham, V. Kumar, "A CBR-Based Decision Support System Framework For Construction Supply Chain Risk Management", Working Paper, *Indian School of Business, Hyderabad* (2006).
22. R. Vrijhoef, L. Koskela, Roles of Supply Chain Management in Construction, *Proceedings of the 7th Annual Conference, International Group for Lean Construction*, University of California, Berkeley (July 1999).
23. P. X. W. Zou, Y. Seo, Effective Applications of E. commerce Technologies in Construction Supply Chain: Current Practice & Future Improvement, *ITcon*, 11 : 127-147 (2006).
24. *Accelerating Change* A report by Strategic Forum for construction, UK (2002), [http://akseli.tekes.fi/opencms/opencms/OhjelmaPortaali/ohjelmat/Sara/fi/Dokumenttiarkisto/Viestinta\\_ja\\_aktivointi/Muu\\_viestinta\\_ja\\_aktivointi/AccChange.pdf](http://akseli.tekes.fi/opencms/opencms/OhjelmaPortaali/ohjelmat/Sara/fi/Dokumenttiarkisto/Viestinta_ja_aktivointi/Muu_viestinta_ja_aktivointi/AccChange.pdf)
25. *Financing Dams in India: Risks and Challenges*, Report, Published by International Rivers Network, Delhi Forum (February-2005)
26. *Rethinking Construction*, Report, UK (1998), [http://www.constructingexcellence.org.uk/pdf/rethinking%20construction/rethinking\\_construction\\_report.pdf](http://www.constructingexcellence.org.uk/pdf/rethinking%20construction/rethinking_construction_report.pdf)
27. *Rethinking Construction*, Report, UK (2002), [http://130.227.54.203/db/files/rethinking\\_construction\\_2002.pdf](http://130.227.54.203/db/files/rethinking_construction_2002.pdf)
28. *Summary of a quick Concurrent Evaluation of Pradhan Mantri Gram Sadak Yojna-2005*, Report (2005), [http://planningcommission.nic.in/reports/peoreport/peoevalu/peo\\_pmgysy.pdf](http://planningcommission.nic.in/reports/peoreport/peoevalu/peo_pmgysy.pdf)

29. "RFID tracks assets, prevents shipping errors", Case Study, [http://www.nje.ca/Index\\_CaseStudy\\_Construction.htm](http://www.nje.ca/Index_CaseStudy_Construction.htm)
30. "Case Builds for RFID in Construction", *RFID Journal*(January 2004).



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