Challenges of Supply Chain Management for the Indian Industries

* *Dr P Kameswara Rao*
** *Dr Rabi N Subudhi*

ABSTRACT

Supply chain management is focusing increasingly on value for the end consumer, and is also oriented towards consumer demand. This, in turn, requires flexibility and adaptability on the part of the components of the supply chain itself; traits not always compatible with those of the required elements of supply chains, efficiency and the balance between demand and efficiency. In this paper, authors have examined various decision propositions for Supply Chain, Supply Chain Modeling Approaches, designing of supply chain, Emerging Research Problems in manufacturing, logistics, and Supply Chain Management and various allied current issues. Industrial needs and the opportunities are discussed in the e-business context.

Introduction

Concept and evolution of Supply Chain Management

The supply chain of any business entity may consist of geographically dispersed facilities where raw materials, intermediate products, or finished products are acquired, transformed, stored, or sold, and also the transportation links connecting the facilities along which products flow. There is a distinction between plants, which are manufacturing facilities where physical product transformations take place and distribution centers, which are facilities where products are received, sorted, put away in inventory, picked from inventory and dispatched, but not physically transformed. The company's goal is usually to add value to its products as they pass through its supply chain and transport them to geographically dispersed markets, in correct quantities, with correct specifications, at correct time, and at a competitive cost. *Supply chain management* (SCM) is an emerging and evolving area. It crystallizes those concepts of integrated business planning that have been espoused for many years by logistics experts, strategists and operations research practitioners.

In the present scenario we have seen a wide range of interest in field of Supply Chains (SCs), under conditions of flexibility, dynamic control and decision synchronization, utilizing the techniques of Information Sharing (IS), Decision sharing and Knowledge Management (KM). Supply chains are a network which is composed of many firms (or nodes) in order to supply products responding to customer demands, where every individual node has an option flexibility to select the subsequent nodes, based on various alternatives. Supply chains are composed of many flows, which are guided by autonomous entities or nodes. Flexibility stands out as the most discussed and applied domain in manufacturing and supply chains. Flexibility implications on the SCs performance need to be

**Dr P Kameswara Rao*
Asst Professor VIT-Business School, Vellore Institute of Technology (Deemed University), Vellore- Tamil Nadu-632014 India; Email: kamesh_p2001@yahoo.com
***Dr Rabi N Subudhi, Professor, VIT-Business School, Vellore Institute of Technology (Deemed University), Vellore- Tamil Nadu-632014 India*

more closely studied, as most researchers have interpreted it differently. Flexibility can be defined "as the ability to deal with change by judiciously providing and exploiting controllable options dynamically" [Wadhwa and Rao (2000)]. We may define supply chain flexibility as the robustness of the buyer–suppliers relationship under varying supply conditions. The paper attempts to utilize the flexibility, from the standpoint of a dynamic supply chain management, by using the routing flexibility or node-based flexibility. Routing type flexibility refers to the availability of alternative resources of the same resource type. This type of flexibility refers to situations where more than one type of resource (i.e. nodes or supply chain members or partners) of a given type exists. Recent trends show that competition has vastly increased which has resulted in reduced profit margins. This has led to the development of dynamic control in supply chains to reduce total cost, lead time, inventory, backorders etc, by selecting the best suppliers (e.g. for customer, it could be selection of best retailer, for retailer it could be the selection of best wholesaler etc.). This problem is relatively new, since many SCs are integrated together and complexity is created to manage decisions at individual nodes.

As a recent trend, new supply chain strategies, such as Vendor Managed Inventory (VMI), Collaborative Planning, Forecasting and Replenishment and Efficient Consumer Response (ECR), have begun to exploit the new communication channels, like Internet.

The supply chain strategies, most commonly considered in the market now, can broadly be put under the following six categories:

i. *Traditional strategy*– in which there are four "serially linked" echelons in the supply chain.

ii. *e-Shopping strategy*– where the distribution network is by-passed

iii. *Direct Flow strategy*– between the end consumer and the product suppliers.

iv. *Reduced strategy*–where an echelon in the supply chain is removed.

v. *Vendor Managed Inventory (VMI) strategy*– It is simulated by developing a protocol, positioned between two businesses in the supply chain. It gives the necessary inventory and sales information, authority and responsibility to the supplier.

vi. *Electronic Point of Sales (EPOS) strategy* – where information from the market places is transmitted to all enterprises in the supply chain.

Empirical studies

A number of authors have studied the impact of IT on the supply chain [Holmström (1998), Fransoo and Wouters (2000), Kaipia et al. (2000)]. Unfortunately, it is not always possible to compare the IT implementation strategies directly due to the varying nature of the environments, where they have been implemented in.

Against this backdrop, it is pertinent enough to take stock of the following issues:

a) Various Decisions for Supply Chain

b) E-Business and Supply Chain Management

c) Designing the supply chain

d) Supply chain structural dynamics

e) Emerging Research Problems

f) Current Needs of the Industry

g) India-centric Issues and Solutions

h) Opportunities for micro-level research in Manufacturing, Logistics and SCM

Decisions For Supply Chain Management

The decisions, relating to supply chain management can be classified into two broad categories: viz. *strategic decisions and operational decisions*. Strategic decisions are made typically over a longer time horizon. These are closely linked to

the corporate strategy and guide supply chain policies from a design perspective. On the other hand, operational decisions are short term, and focus on activities over a day-to-day basis. The effort in these types of decisions is to efficiently manage the product flow in the "strategically" planned supply chain.

There are four major decision areas in supply chain management:

1) *location- decisions,*

2) *production- decisions,*

3) *inventory- decisions, and*

4) *Transportation (distribution)- decisions,*

There are, as discussed earlier, both strategic and operational elements in each of these decision areas. Let us have a critical look on each of the above points.

Location Decisions

The geographic placement of production facilities, stocking points, and sourcing points is the natural first step in creating a supply chain. The location of facilities involves a commitment of resources to a long-term plan. Once the size, number and location of these are determined, so are the possible paths by which the product flows through to the final customer. These decisions are of great significance to a firm since they represent the basic strategy for accessing customer markets. It can have a considerable impact on revenue, cost, and level of service. These decisions should be determined by an optimization routine that considers production costs, taxes, duties, tariffs, local content, distribution costs, production limitations, etc. (Arntzen et al. 1995). Although location decisions are primarily strategic, they also have implications on an operational level.

Production Decisions

The strategic decisions include what products to produce, and which plants to produce them in, allocation of suppliers to plants, plants to DCs, and DCs to customer markets. As before, these decisions have a big impact on the revenues, costs and customer service levels of the firm. These decisions assume the existence of the facilities, but determine the exact path(s) through which a product flows to and from these facilities. The capacity of the manufacturing facilities depends largely on the degree of vertical integration within the firm. Operational decisions focus on detailed production scheduling. These decisions include the construction of the master production schedules, scheduling production on machines, and equipment maintenance. Other considerations include workload balancing, and quality control measures at a production facility.

Inventory Decisions

It refers to the means, by which inventories are managed. Inventories exist at every stage of the supply chain as either raw material or semi-finished or finished goods. They can also be in-process between locations. Their primary purpose is to buffer against any uncertainty that might exist in the supply chain. Since holding of inventories can cost anywhere between 20 to 40 per cent of their value, their efficient management is critical in supply chain operations. It is strategic in the sense that top management sets goals. However, most researchers have approached the management of inventory from an operational perspective. These include deployment strategies (push versus pull), control policies –the determination of the optimal levels of order quantities, reorder points and setting safety stock levels at each stocking location. These levels are critical, since they are primary determinants of customer service levels.

Transportation Decisions

The mode of transport or the choice aspect of these decisions is more of the strategic one. These are closely linked to the inventory decisions. Because the best choice of the mode is often found by trading-off the cost of using the particular mode of transport with the indirect cost of inventory associated with that mode. While air shipments may be fast, reliable and warrant lesser safety stocks, they

are expensive. Meanwhile shipping by sea or rail may be much cheaper, but they necessitate holding relatively large amounts of inventory to buffer against the inherent uncertainty associated with them. Therefore customer service levels and geographic location play vital roles in such decisions. Since transportation is more than 30 per cent of the logistics costs, operating efficiently makes good economic sense. Shipment sizes (consolidated bulk shipments versus lot-for-lot), routing and scheduling of equipment are key to the effective management of the firm's transport strategy.

E-Business and Supply Chain Management

E-business largely refers to Internet-based and ICT-supported business models. It has now become a part of the modern management practice, especially for data mining, reporting, communication, storage and retrieval of information. The full scope and contribution of e-business models to the field of decision-making, is still being assessed. Across firms, e-business technologies are being applied more and more, in the e-commerce mode in a variety of ways. Models of e-business have substantial potential to improve decision-making.

The term Supply Chain Management, on the other hand, has already become too large a concept for comprehensive analysis. Some of the main modeling implications are that we are moving from single actor to multiple actor models, and that we need to be careful on customer satisfaction. While keeping costs under control, we also need to look for its effectiveness and responsiveness. An important part of Supply Chain analysis is the identification of a supply chain driver, which would provide an unambiguous perspective on sequential decision-making in the supply chain.

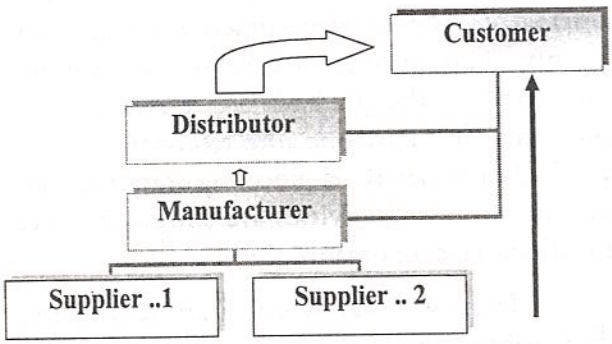
Some conundrums are inherent in the terminology and application of the principles of supply chain management. We list a few of them below:

- The term "chain" implies that there are different entities, but the term "manage" refers to a single entity, as far as span of control is concerned.
- There is debate about whether a supply chain is really a value chain, or a demand chain.
- Most industries begin with economies of scale upstream and end with economies of scope down-stream.

Designing Of Supply Chain

The supply chains are not just as happened, but as designed, as the operational component of the value chain. They must be organized using techniques and methods similar to those of business process re-engineering (BPR). Extending the concept further, the processes which were accepted till now as *re-engineered*, are now 're-told / rectified' as *re-invented* by subject experts [Dixit (2006); Ramanarayan & Nilakant (2006)]. Processes and activities go hand in hand. Functional activities are the tasks necessary to mobilize resources and bring products and services to the customer. What makes the supply chain unique is that these activities are coordinated through processes to become an integral operating unit. Activities, which can be best illustrated by the following figure [Figure 1], are the building blocks for product flow, linked by processes across organizations.

Figure-1: Structure of Activity-Flow in a Supply Chain



This discussion begins with *activities*. We then move to the implications of *process* and finally the influence of final *demand* on supply chain structure. Structure involves a now-familiar term,

"outsourcing", whereby in-house activities are performed by external organisations. Demand makes itself felt through real-time order fulfillment, mass customization and postponement. Real-time fulfillment connects demand directly with production. Mass customization adapts the supply chain to individual customer product and service requirements. Postponement enables both by delaying final stages of supply until the last possible moment.

Activities

Activities, here, are sets of operations that add value or reduce costs. Those can be a set of operations performed by a corporate partner, or a single step in a production/ distribution process. The important element worth considering here is their contribution to the value of the final product. Activities as building blocks can be moved among organisations to be performed where they are most efficient. IT companies such as Dell, or the shoe manufacturer Nike, around the world rely on contract manufacturers, rather than to produce their own products.

Companies may even outsource the entire supply chain process. Bajaj Electricals Ltd. can be a good example, in this regard, which outsources all its products.

Processes

Processes, on the other hand, connect activities. Internal processes cut across functional boundaries; supply chain processes cross-organizational boundaries. Although both create management problems, they have one aim: to create value for the final customer. Re-engineering or re-invention occurs whenever activities are shifted between functional areas or organizations.

Here we may keep in mind the two dimensions, which determine the location of activities: cost and value. Cost savings arise from three factors: economies of scale from combining with other supply chains, specialization and physical location. Value added is the revenue from that activity less the value from the preceding stage. Revenue can be estimated by the price of alternatives to provide the intermediate output. Net value added subtracts the costs of performing the activity. Low net values would indicate competitive markets where activities can be efficiently performed by outside organizations. High values indicate unique competitive advantage and usually the original basis for the organizing company. Activity assignments are not necessarily static. The information technology industries, called the "fruit flies' of industry" have evolved rapidly; individual suppliers have been acquired or separated in response to rapidly changing industry conditions. Structure evolves to fit the changing dynamics of the supply chain and its environment. In some cases, the supply chain can be created with short tenure for a single project, connected electronically as a *virtual supply chain.*

Demand

Demand plays an important role in designing the chain by shaping both products and service. Delivery time is important to customer preference and may force inventories to be located close to the market for rapid response. Orders may enter a production schedule as they are generated, reducing inventory and distribution. Mass customization responds to individual customer requests by adapting the supply chain through modular product design or even changes in organisation and activities. Postponement may delay final product assembly until orders arrive. There is an important link between mass customization and the supply chain information system.

Ultimately, the order penetration point, the point of balance between individual and standard products determines the structure. Adaptation requires carrying order information into the supply chain, perhaps even to suppliers, while orders for standard products may stop with distribution.

Structure and process are fundamental to supply chain strategy. Efficiency requires careful placement and co-ordination of functional activities,

while advantage comes from the ability to meet changing demands.

Structural Dynamics of Supply Chain

The structure of the computer industry was vertical in the 1970s and the early 1980s. Such insights from the computer industry help us to understand the patterns of evolution in supply chain structures.

For example, the three largest computer hardware companies, viz., IBM, Digital Equipment Corporation (DEC), and Hewlett Packard (HP) were highly integrated. These companies tended to provide most of the key elements of their own computer systems, from the operating system and applications software to the peripherals and electronic hardware, rather than sourcing bundles of subsystem modules acquired from third parties. In this era, products and systems typically exhibited closed, integral architectures.

By holding to its closed product architecture, these companies kept the existing customers hostage. Any competing machine they bought would be incompatible with their IBMs. At the same time, Big Blue emphasized the value of its overall systems and service package, determined to stave off competitors who might offer better performance on one or another piece of the package. Then in the late 1970s, IBM faced a challenge from Apple Computer. IBM quickly moved from a vertical to a horizontal structure, as the competitive response and the result was the PC, which catalyzed a dramatic change throughout the industry.

The dominant product was no longer the IBM computer, but the IBM compatible computer. The modular architecture encouraged companies large and small to enter the fray and supply subsystems for the industry: semiconductors, circuit boards, applications software, peripherals, network services, PC design and assembly. The modular (mix and match) architecture created significant competition within each segment of the horizontally structured industry. Within each of the categories, new businesses emerged, making it easier for a computer maker to shop around for just the right combination of subsystems. Some observers have speculated that this model of horizontal/modular competition, which also evolved in telecommunications during the 1990s, might be the new (and permanent) industrial structure for many industries.

The computer industry of the 1980s and 1990s therefore illustrates an entire cycle of supply chain structure evolution. We should consider here the dynamic forces at work which first disintegrates the industry structure for a vertical integration (of the product architecture), then push towards a horizontal and modular configuration.

These forces may include:

- entry of niche competitors;
- challenges of keeping ahead of the competition, across the many dimensions of technology and markets;
- bureaucratic and organizational rigidities, that often settle upon large, established companies.

These forces typically weaken the vertical giant and create pressure toward disintegration to a more horizontal, modular structure. It is equally interesting to note that, when an industry supply chain has a horizontal/modular structure, another set of forces push toward more vertical integration and integral product architectures. We can relate this to an interesting post Mittal–Arcellor merger scenario.

Such parallel forces may include:

- Technical advances in one subsystem can make that the scarce commodity in the chain, giving market power to its owner.
- Market power in one subsystem encourages bundling with other subsystems to increase control and add more value.

- Market power in one subsystem encourages engineering integration with other subsystems to develop proprietary integral solutions.

Emerging Research Issues

The researchers in SCM tend to focus more on the operational issues for modeling and optimization. In the process, they undermine the critical issues of linking financial performance of the supply chain stakeholders with the operational metrics, building integrated models, studying the informational component of SCM and risk management, applied to SCM.

Now, in e-business markets, design of procurement auctions, design of algorithms for improving efficiency of e-business processes, use of machine learning in e-CRM and dynamic pricing, etc. are a few such emerging, critical issues. Tools such as algorithmic game theory, combinatorial optimization, stochastic approximations, reinforcement learning, and duality theory are in the process of being applied in e-business modeling and optimization.

The other topic that was of interest was investigating what the industry needs as on date, with regard to SCM. Assuming that the stakeholders of the supply chain have all implemented IT solutions to handle business processes, it becomes even more important to pursue integration of information systems with decision-making. Benefits of following SCM practices will not accrue unless this integration is done. Thus software companies should emphasize working in this area. Of immediate interest in this connection is the security of information systems. One could conduct a comprehensive Risk Analysis to determine which information can be shared with which stakeholders. Also, there is a burning requirement to implement standards ways of handling information exchange. Standards need to be industry specific and hence calls for collaboration among academia and relevant companies in that industry.

It was also observed that a crucial capability that an SCM should have is the ability to build personalized on-demand products which gets well along with automotive and PC companies. This calls for tight supply chain integration and the possessing systems that monitor and trigger the service activities.

With respect to core SCM decision-making needs, it was felt that filtering out the right information from a heap of data is of utmost importance. That led to the development of OLAP and data mining engines, specific to SCM requirements.

If the modeling and optimization are to succeed, it is then extremely important to educate the industry on O.R. tools, mathematical techniques, and their usefulness. This is one area that academia can help industry which will eventually help develop trust in modeling. Industry participants hence felt the need to promote closer relevance of academic research to industry.

Researchers in India are encouraged to focus attention on India-centric problems to drive home their research. This serves the dual purpose of helping the Indian industry and also in providing better visibility for India-oriented problems. We discuss below some issues, in SCM, relating to India.

India Focused SCM Issues

Opportunities

Several Indian companies have now a global clientele in the area of auto components and other industries like healthcare and tele-medicine. These companies present an immense potential for India to contribute in SCM issues.

There also exists phenomenal opportunities in the area of optimizing distribution networks and solutions especially for rural India. A case in point is the milk unions and associated cooperative societies. Though academic institutes in India have the capability of transforming the theoretical models

into solutions, most of the researchers do not focus on such issues. This is a definite opportunity for them.

There is an opportunity for Indian IT companies as well. They could leverage on the large Indian market to test their solutions thoroughly first, before going global. This has the dual advantage that they can improve the quality of solutions through local customer feedback in a low cost way and also improve the state of Indian companies through deployment of IT solutions.

Problems

Opportunities seldom occur without the impending problems. Such problems are also found in plenty in the Indian scenario. The market for solution providers is now getting overcrowded, making it a 'million rupee problem of identifying the right solution provider for manufacturing and services enterprises'. On the other hand, prices of products are dropping dramatically making it far more challenging for the companies to cut costs and maintain profit levels. It may also be noted that the productivity paradox is present in India's case. That is, an improvement in capabilities does not translate into orders. This calls for investigating the missing links. One observation would be that the manufacturing support activities are not up to the mark. Also, the infrastructure requirements for seamless supply chain integration are not present. For instance, an efficient road/rail network, or, 24x7 available high-speed networks for enabling online transactions is yet to materialize. It is also important to observe that India has a low manufacturing share in her GDP. Similar problems, worth exploring, also lie in the agricultural and service sectors of our economy.

Conclusion

Research should focus on building integrated models for supply chains and service networks. From the IT perspective, it is worthwhile studying the informational component of SCM. One could look at quantifying the benefits and loss of using the web, or build systems that will effectively utilize real-time information for operational planning. One might focus on mitigating risk through proper demand management, where demand sensing and planning are well connected. Academic researchers need to pick their problems from the industry.

The Indian universities should do research more now on Indian issues/problems. This will not only provide a window for the global community to appreciate India-specific issues, but also make the research more pragmatic and practical. Higher education programs, too, need a fine-tuning and customization, in the context of present day's need of e-business.

Supply chain design needs to be recognized as a strategic activity that can determine the fates of companies and industries.

References:

A. McMullan, *Supply Chain Management Practices in Asia Pacific Today,* International Journal of Physical Distribution & Logistics Management, *26:79-95, 1996.*

A. M. Geoffrion and G. W. Graves, *Multi-Commodity Distribution Design by Benders Decomposition,* Management Science *20:822-844, 1974.*

A. M. Geoffrion and R. F. Powers, *Twenty years of strategic distribution system design: An evolutionary perspective, Interfaces 25:105-127, 1995.*

Arntzen, B. C. Brown, G. G. Harrison, T. P. Trafton, L. L., *Global Supply Chain Management at Digital Equipment Corporation,* Interfaces –Providence, 1995, Vol. 25; Number 1, p69.

D. R. Towill, N. M. Naim and J. Wikner, *Industrial Dynamics Simulation Models in the Design of Supply Chains,* International

Journal of Physical Distribution & Logistics Management, *22:3-13, 1992.*

Fransoo, J.C. and Wouters, M.J.F., *Measuring the Bullwhip Effect in the supply chain*, Supply Chain Management: An International Journal, *Vol. 5, No. 2, 2000, pp78-89.*

Holmström, J., *Business process innovation in the supply chain: a case study of implementing Vendor Managed Inventory*, European Journal of Purchasing and Supply Management, *Vol. 4, 1998, pp127-131.*

J. Fuller, J. O'Connor and R. Rawlinson, *Tailored Logistics: The Next Advantage*, Harvard Business Review *71:87-93, 1993.*

J. L. Heskett, *Logistics-Essential to Strategy,* Harvard Business Review *55:85-96, 1977.*

J.M. Swaminathan, S.F. Smith, N.M. Sadeh, *Modeling Supply Chain Dynamics: A Multi-agent Approach,* Decision Sciences, Volume 29 Number 3, Summer 1998.

J. W. Forrester, *Industrial Dynamics: A Major Breakthrough for Decision Makers,* Harvard Business Review *36:37-66.*

Kaipia, R., Holmström, J. and Tanskanen, K., *VMI: what are you losing if you let your customer place orders*, Working Paper, Dept. of Industrial Management, Helsinki University of Technology, Finland, 2000.

M. L. Fisher, *What is the right supply chain for your product? Effective Supply Chains,* Harvard Business Review *75:105-116, 1997.*

M. Mourits and J. J. Evans, *Distribution network design,* International Journal of Physical Distribution & Logistics Management, *25:43-57, 1995.*

M.R. Dixit, *Taking charge and leading re-invention: some insights*, Vikalpa, Vol. 31(1), 2006.

Philip B. Schary & Tage S. Larsen, *Managing the Global Supply Chain (2nd ed),* Copenhagen Business School Press, 2001

Ramanarayan and Nilakant, *Dynamics of re-invention*, Vikalpa, Vol. 31(1), 2006.

R. D. Shapiro, *Get leverage from logistics,* Harvard Business Review *62:119-126, 1984.*

R. Lamming, *Squaring Lean Supply with Supply Chain Management,* International Journal of Operations & Production Management, *16(2):183-196, 1996.*

R. Roy and S. Pofter, *Managing engineering design in complex supply chains,* International Journal of Technology Management, *12:403-420, 1996.*

R. Satterfield and E. P. Robinson, *Designing Distribution Systems to Support Vendor Strategies in Supply Chain Management,* Presented at Supply Chain Linkages Symposium, *Indian University, 1996.*

Subhash Wadhwa and K. Srinivasa Rao, *Flexibility: an emerging meta-competence for managing high technology,* International Journal of Technology Management, 2000, Vol. 19 Issue 7/8, p820.

S. Wadhwa and K. S. Rao, Proactive Knowledge Management: Developing a Novel View on Manufacturing Flexibility