

Exploring Integrated Supply Chain and its applicability in public sector

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Abstract: The Integrated Supply Chain Management (ISCM) is now not only a problem of integrated logistics (as a process) but also demands that the supply chain management (SCM) must look into the ramifications of these arrangements on the cost of transportation (including tariffs or duties) of products within a trade zone and outside it, besides, developing logistics strategies. The field has thus developed in the last few years for bridging the gap between demand and supply vis-à-vis efficiency and cost trade-offs. The SCM now not only involves the “management of logistic function”, as was done in the past (to achieve internal efficiency of operations) but, includes the management and co-ordination of activities, upstream and downstream linkage(s) in the supply chain. The integrated supply chain management, in particular includes:

Planning and Managing supply and demand; Warehouse Management; Optimal Inventory control; Transportation and Distribution, Delivery and customer’s delight following the basic principles of supply chain management viz. working together; Enhancing revenue; Cost control; Assets utilization besides, customer’s satisfaction.

The last two decade has seen the rise of a plethora of acronyms always used in conjunction with production, operational management and control. To name a few JIT (Just-In-Time); TQM (Total-Quality-Management); ZI (Zero-Inventory); ECR (Efficient Consumer Response); VMI (Vendor Managed Inventory). All these have now been integrated within the domain of Supply Chain Management Process.

With the growth in the Information Technology and easy accessibility of computing power, the development and implementation of objective based modelling system(s) have been changed to a new environment, for integrating quantitative and simulation models, as a backend system for both horizontally diversified and vertically integrated Supply Chain Management System(s).

Though, the SCM have found the versatility of applications, more so in the private sector enterprises (business environment) for cost cutting and for having a competitive advantage. In the government set-up though the basic objective, is not maximization of profit, but the social-economic development of people. Even, if the objectives of these two mutually exclusive categories of enterprises are different, they share some features:

- Satisfying the end-consumer(s) by providing the right product, in right condition at the right time to fulfil the social obligation towards society.
- The optimum allocation of limited resources.

Thus, the SCM has many applications in the government environment too. The paper highlights some of the typical applications in the government sector of the SCM paradigm. What is essential in the SCM is to establish operationally feasible link(s) between various key component for achieving overall efficiency and cost trade-off. The use of quantitative methods in SCM is evaluated, embedding of these models in Decision Support System (DSS) have been discussed. The major component of SCM is multi-objective transportation and distribution function for time and cost trade-off. The Multiple Criterion Decision Making (MCDM) model for the component of SCM viz. Transportation and Distribution, system as a DSS have been described in detail - a major backend system of Integrated Supply Chain Management process (ISCOMP).

Introduction: Supply Chain Management (SCM) can be best described as the natural extension of the downsizing (right-sizing) and re-engineering performed by the organization(s) in the past. Downsizing and re-engineering transformed the enterprises into “lean and mean competitive units”, by cost cutting and process simplifications. These operations (of downsizing and re-engineering) involved the “optimization” (in terms of the number of persons involved, the time taken, the complexity of the work etc.) of business “units” (functional and/or administrative domains) over which the organizations had full control. These strategies did lead to increased productivity and profitability of the organizations but as the benefits of these levelled off, it was realized that the approach to the way organizations work needed to be changed. The above changes were a by-product of the “isolationist” (closed system) world picture of the enterprises involved in the full value chain; with organizations (the system) trying to survive in an hostile environment; assuming that all other participants in the value chain were adversaries with whom the organization must compete, even though the operations performed by the separate organizations may be supplementary in nature rather than complementary. The realization that this world picture was an impediment to the growth of organizations prompted the enterprises to start seeking “strategic alliances” with other organizations. The formation of these alliances required a basis (a common ground) which would be acceptable to each and every partner in the alliance. This common basis is/was supplied by the participation of the organizations in the value chain (the demand-supply chain). The participants in the chain, suppliers, sub-contract suppliers, inhouse product processes, transportation, distribution, warehouses, and the end customer, generally, perform mutually exclusive tasks and thus do not compete directly with each other.

The present paper explores the following issues:

- The need for supply chain management.
- Type of supply chain management model(s)
- Framework of the supply chain management model(s).
- Relevance of the supply chain management paradigm to the government sector/public-sector enterprises.

Issues in SCM

A supply chain encompasses all the activities, functions and facilities involved in producing and delivering a product and/or service, from suppliers (and their suppliers) to the customers. The supply chain management (SCM) paradigm is geared towards optimizing each component of what used to be called (Production and) Operations management (production, warehousing, inventory, transportation and distribution etc.) and the inter-links between these components synergistically [21]. In the 70's and the 80's, various models for production and operations control and management were developed: Just-In-Time (JIT) Inventory management model, Vendor Managed Inventory (VMI) model, Zero Inventory (ZI) model, Total Quality Management (TQM) etc [1]. These models focussed on the various components of the supply chain in isolation, this implies that these models were oriented towards the optimization of a sub-part of the system whereas the SCM paradigm aims at the optimization of the full chain. This leads to trade-offs among the different components of the supply chain. For example, JIT would require a factory to keep inventories low and produce and distribute products in a timely manner, however JIT ignores many other aspects which cannot be seen independently, e.g. if the availability of the input materials is uncertain and irregular, the factory may need to insure smooth and continuous production. Similarly, regional stocking may permit reductions in transportation costs through increased shipment consolidation, as well as expanded sales through better delivery performance. These improvements may be accomplished with only moderate increases in inventory and warehousing cost(s).

However, in an environment where different functional units manage the various logistics activities independently, an organization is less likely to properly analyze such important trade-offs.

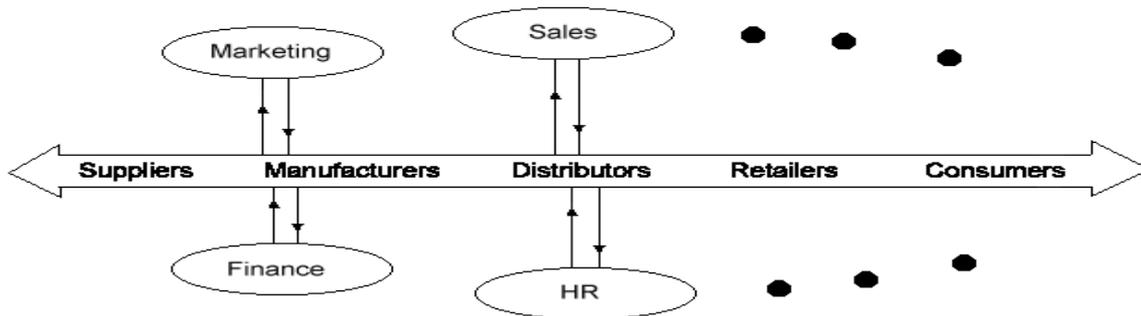


Fig. -1: Interdependence of supply chain with other functional domains in an enterprise.

Moreover, these models also ignore the interdependency of production and operations functions with other domains within an organization, such as marketing and finance. Marketing decisions have serious impact on logistics function and vice-versa. For example, a marketing promotion campaign should be coordinated with production planning, since a higher demand may be expected. On the other hand, when raw materials are cheap, or when the factory temporarily has an over-capacity, the marketing department may decide to cut prices and/or start other promotion campaigns during these periods to increase demands. Also, financial decisions are driven by production and logistics decisions. Productions of new products require the investment in raw materials and consume other change-over costs. Financial managers have to be aware of the increased demand for capital to finance the production plan. Likewise, the delivery of finished products generates financial income, so the forecast demand can be used to calculate/forecast the accounts payable and receivable in the future. The above description means that production, finance and marketing decisions cannot be made independently (fig.1). All these decisions are driven by the activities in the supply chain of a manufacturing company [1]. Fig.-1 shows a simple representation of the interdependence of the supply chain and the other functional domains in the organization. The links between the (other) functional domains - marketing, sales, human resources etc. - are not shown. The linkage between the supply chain components and the other functional domains relies heavily on information sharing to have an effective impact.

One other major factor in the current scenario is the globalization of the supply chain. With the fall of the East-European socialist bloc and the opening of the Asian market, the trade barriers began falling in the 1980's and the 90's. This led to organizations having a supply chain that criss-crossed the globe the proliferation of trade agreements - EC, ASEAN, NAFTA, APEC, etc. - has changed the global market. SCM now has become not only a problem of logistics but also demands that supply chain management must look into the ramifications of these agreements on the cost of transportation (including tariffs or duties) of products within a trade zone and outside it[1].

Furthermore, organizations now acknowledge that efficient consumer response (ECR) can lead to competitive edge. SCM is tantamount to coordinating all the operations of an organization with the operations of the suppliers and customers. Effective SCM strategies are essential for successful implementation of ECR programmes [22]. Thus, a production planning and control model that focuses on all the aspects of the operations and distribution activities and links with other functional domains such as finance and marketing is needed. The supply chain management model should also perform the task of managing and coordinating activities upstream and downstream in the supply chain.

Of course, such a model in its entirety becomes very complex and can not be used without a sufficient computational infrastructure.

Supply-Demand Nexus: To have an effective supply chain management framework; organizations must have a clear understanding of the supply - demand nexus and its implications for strategy and implementation. There is an interdependent relationship between supply and demand; organizations need to understand customer demand so that they can manage it, create future demand and, of course, meet the level of desired customer satisfaction. Demand defines the supply chain target, while supply side capabilities support, shape and sustain demand [1].

The basis of such a holistic strategy framework is the integrated supply and demand model (Fig.-2). The model is designed around two key principles. First, in the present scenario where vertically integrated supply chains (VISC) are a rarity, if not non-existent; organizations must bring a multi-enterprise view to their supply chains. They must be capable of working co-operatively with other organizations in the chain rather than seeking to outdo them. Secondly, they must recognize the distinct supply and demand processes that must be integrated in order to gain the greatest value.

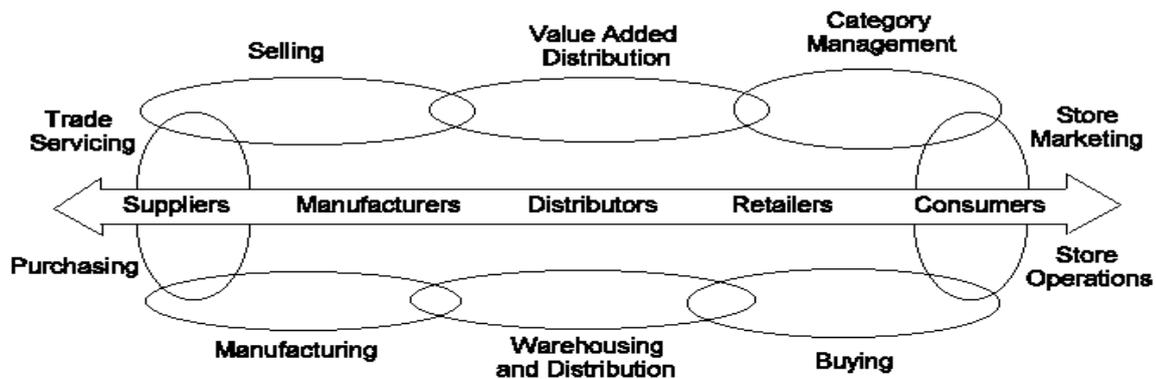


Fig. -2: The Integrated Demand-Supply Model

Source: This model is based on the work done by Bill Copacino.[5]

Thus involving three key elements:

- The core process of the supply and demand chains viewed from a broad cross-enterprise vantage point rather than as discrete function. To gain the maximum benefits, organizations need to identify the core processes across the demand and supply chain, as well as exploring the impact of each of these processes on the different functions.

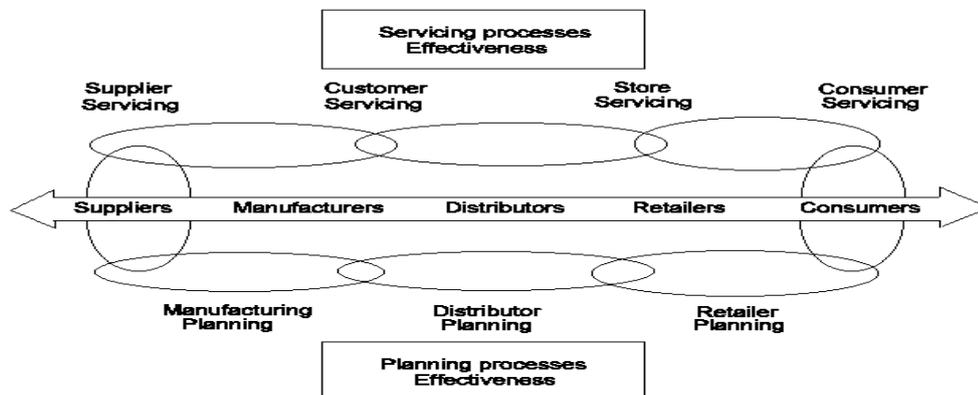


Fig. -3: Integrating processes in the supply and demand chains

Source: This model is based on the work done by Jeff Beech[1]

- The integrating processes that create the links between the supply and demand chains (fig - 3). This implies that the planning processes (which involves development of channel strategies, planning of manufacturing, inventory, distribution and transportation, demand planning and forecasting; and marketing and promotional planning) and service processes (which includes functions such as credit, order management, load planning, billing and collection, etc.) must be integrated. This integration must be done across the boundaries of the enterprises. If each participating organization in the chain formulates its own plans on the basis of its own private information, then there is no way to integrate the supply and demand chain processes that they share.

- The supporting information technology (IT) infrastructure that makes such integration possible. While information technology is needed to handle routine transactions in an efficient manner, it can also play the a critical role in facilitating the timely sharing of planning, production and purchasing information; capturing and analyzing production, distribution and sales data at new levels of detail and complexity. Information technology provides an integrating tools that makes it possible to convert data into meaningful pictures of business processes, markets and consumers that are needed to feed company strategies in order to develop competitive advantage.

On the administrative side, such elements as flow path economics, which help organizations understand the real drivers of costs, and new performance and measurement standards that align functions in accordance with total process goals that are critical to achieving integration.

SCM Framework

A framework to understand the various issues involved in SCM is provided by the pyramid structure for the SCM paradigm (fig. 4) the pyramid allows issues to be analysed on four levels:

- **Strategic:** On the strategic, level it is important to know how SCM can contribute to the enterprises' basic "value proposition" to the customers. Important questions that are addressed at this level include: What are the basic and distinctive service needs of the customers? What can SCM do to meet these needs? Can the SCM capabilities be used to provide unique services to the customers? Etc.

- **Structural:** After the strategic issues are dealt with, the next level question(s) that should be asked are: Should the organization market directly or should it use distributors or other intermediaries to reach the customers? What should the SCM network look like? What products should be sourced from which manufacturing locations? How many warehouses should the company have and where should the be located? What is the mission of each facility (full stocking, fast moving items only, cross-docking etc.)? etc.

- **Functional:** This is the level where operational details are decided upon. Functional excellence requires that the optimal operating practices for transportation management, warehouse operations, and materials management (which includes forecasting, inventory management, production scheduling, and purchasing) are designed. These strategies should keep in view the trade-offs that may need to be made for the overall efficiency of the system. Achieving functional excellence also entails development of a process-oriented perspective on replenishment and order fulfillment so that all activities involved in these functions can be well integrated.

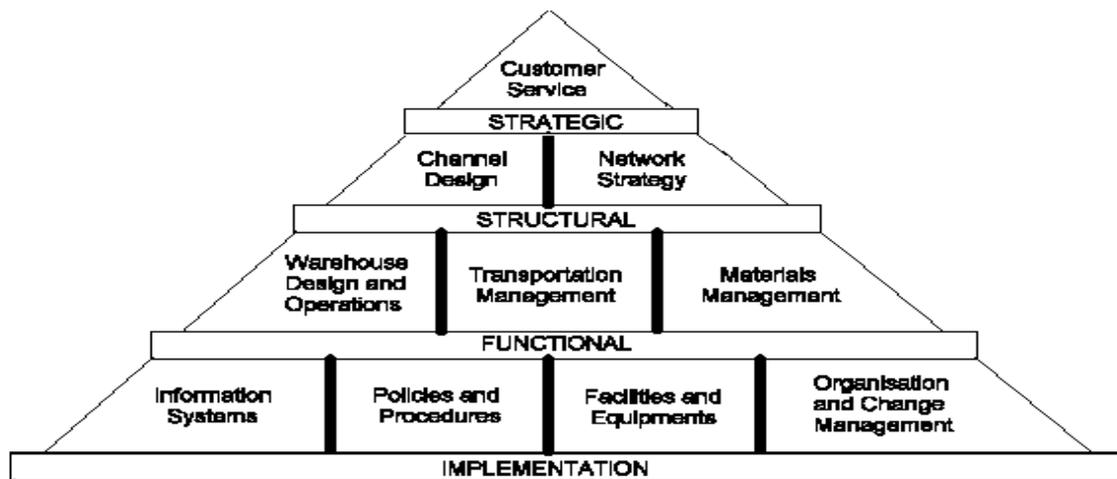


Fig.-4: SCM Framework Pyramid Source: Based on work done by William C. Copacino [5]

- Implementation:** Without successful implementation, the development of SCM strategies and plans is meaningless. Of particular importance are the organizational and information systems issues. Organizational issues centers on the overall structure, individual roles and responsibilities, and measurement systems needed to build an integrated operation. Information systems are “enablers” for supply chain management operations and therefore must be carefully designed to support the SCM strategy. Supply chain managers must consider their information needs relative to decision support tools, application software’s, data capture, and the system’s overall structure.

It is important to note that the decisions made within the SCM strategy pyramid are interdependent. That is, it must be understood what capabilities and limitations affect the functional and implementation decisions and consider those factors while developing a supply chain management strategy and structure.

The SCM models used in practice lie in a continuum between two extreme models : on one end of the spectrum lies the vertically integrated supply chain model in which the organization has direct control over each and every component of the supply chain, while on the other end of the spectrum lies the horizontally diversified supply chain model (ideally) in which the number of participant is as large as the number of distinct parts of the supply chain. In an vertically integrated supply chain system, the organization can control every component of the chain and can make various changes to the system to optimize the chain very easily. But in a horizontally diversified supply chain the tendency will be to optimize only the functions that the organization is involved in, thus conscious efforts must be made by the various participants in the supply chain for the integration of their respective components in the supply chain. If an organization can be identified as the major/dominant partner in the supply chain, then this organization has to take an initiative in seeking the co-operation of the other participants in the supply chain.

The type and structure of the supply chain that is established depends on many factors, some of the major factors are:

- Geographical:** If the supply chain is stretched across the globe then it may not be possible to incorporate some of the principles of lean production like JIT delivery, flexible manufacturing, and co-ordination among suppliers and customers. It can lead to uncertain transportation schedules, unpredictable lead time and may need larger inventory carriage.

- **Cultural:** The difference in the “culture” of the participants in the chain (the difference can be due to geographical factors or corporate practices) can lead to friction and distrust. This may hamper the development of close ties.
- **Government Legislation:** The laws of the country may prohibit the sharing of information about some facet of the supply chain and thus, may lead to a restrictive participation by one or more participant in the supply chain.

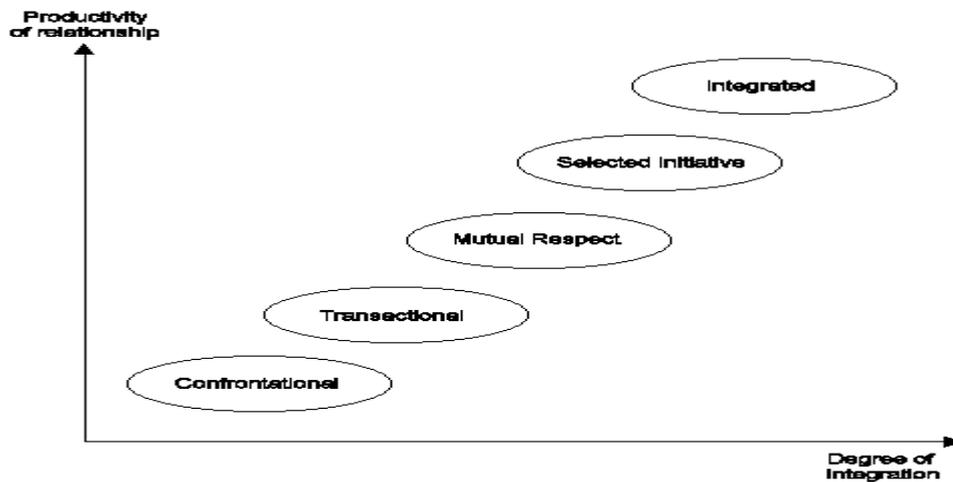


Fig. -5: Spectrum of alliances in the supply chain.

- **Time:** Just as among individuals, organizations require time before trust can be built up. The first phase in any relationship is manifest as confrontation that essentially means that participants in the chain try to win at the cost of other participants. And, the last phase is exemplified by total trust and working together of organizations. The information sharing behaviour in the first phase is almost zero, while in the integrated relationship the information sharing is mutual and free about the common concerns. In between the two phases lies a continuum of phases (see fig. 5).

SCM in the Public sector

To understand the relevance of ‘SCM’ to the government sector, one must understand the difference between the objective of a government/public sector enterprise and that of a private sector enterprise. A government/public sector enterprise objective is not maximization of profit solely, but also economic development of the nation (as a long term goal) and the welfare of the society; whereas a private sector enterprise is oriented towards the sole objective of maximization of profit. But, even if the objectives, of these two exclusive categories of enterprises, are entirely different, they share some features:

- The satisfaction of their respective consumers by providing the consumer with the right product, in the right condition and at the right time, at the least cost.
- The allocation of limited resources (of the nation and/or enterprise) for this purpose.

In the government sector (in India) the SCM paradigm can be used by the public sector organizations involved in:

(a) Petroleum Products : the bulk of the major petroleum product(s) required in the country are indigenously produced, but at the same time significant proportion of crude and finished products are being imported to meet the national demand. This requires the construction of a global supply chain that should withstand the vagaries of the “petroleum politics”. Petroleum products are needed through out the country on a priority basis. This requires a well designed and feasible transportation and distribution network, integrated with the production plan(s); distribution network; pricing policy; national and regional demand policies etc.

(b) Fertilizer production industry: for the procurement of raw materials, manufacturing and transportation and distribution to the demand centers through out the country, using the predicted demand (as the need for fertilizers by consumers is bound to have a regional and seasonal effect due to the very nature of the product and its use). The SCM methodology can be used to decide the location of new warehouse(s), the design of the raw material procurement policy, and the design of the optimal distribution plan/channel etc. This industry generally follows a single sourcing policy for raw material procurement,

(c) Coal and other minerals: These are primary sector industries, supplying to other industries in “core manufacturing “ (the type of manufacturing that is essential for the development of the nation like steel, electricity etc.) The consumers of the product of these industries can be any where in the country, therefore a well designed SCM strategy is an important activity.

(d) Steel industry: This industry depends on three major categories of supplies for the procurement of raw materials: (1) Coal/coke, (2) Minerals (iron ore, limestone etc) and (3) electricity. This industry needs a well designed a methodology for SCM, wherein it may be controlling the production of the raw materials to an extent, and depending on demand, supplementing with externally supplied raw material. The supply chain in this case needs to be totally integrated, as a shortfall in this case can lead to closing of the furnaces that can lead to their closure, leading to substantial economic and material loss.

(e) The Electricity generating industry: This industry in India faces a situation of demand exceeding the supply. This demands a rationing system. It must be decided, and planning must be done for distribution of the “load shedding” time, so that the basic needs of the consumers are satisfied in the region under consideration. SCM and more specifically optimal scheduling methodologies need to be applied.

(f) Food Grain Procurement and Distributions: There are public sector enterprises involved in the procurement of food grains and their storage in different parts of the country, As agriculture is an “industry” where the type of product produced depends on the geo-physical characteristic of the region; the grain that is produced in one region of the country may need to be transported to another region to meet the food requirements in other parts of the country. Therefore, a policy for the location of warehouses in different parts of the country, a plan for optimal distribution of the procured foods grains among these warehouses and to the retail shops under the Public Distribution Scheme (PDS) and for open market transaction is required. A failure in any of the links of this procurement - transportation - storage - transportation - retail can lead to large scale famine in the affected part of the country. The organization must also be involved in food grain distribution under exceptional conditions of famine, flood or earthquake. The SCM concept can be used to manage the routine and extra-ordinary situations before this industry.

(g) Postal clearance and delivery system: The Post and Telegraph (P&T) department of the government of India is the organization that handles the major portion of the postal volume generated in the country (a small fraction of the net postal volume is carried through the private courier services). Thus, the transportation and distribution planning is a major requirement of the organizations involved in the system. A well designed ‘SCM’ strategy will go a long way in improving the services for postal clearance and thus increasing efficiency.

(h) Public Health Services: The public health services through the government run hospitals and dispensaries forms the backbone of the health services offered by the government of India. The functioning of these organizations needs to be strengthened. Unavailability of essential drugs and other medical supplies leads to crisis. As the

pharmaceutical industry has major players from the public sector undertakings, the hospitals can have a full-fledged integrated supply chain involving these PSU's. The SCM paradigm can be applied for the procurement and distribution of the life saving medical drugs and other medical items.

(i) Import and Export : The government sector is involved in the Import of essential items needed for the development of the nation, be that petroleum products, steel, coal, food grains, essential drugs, defense stores etc, and export of products that the public sector enterprises produce as a surplus, prime examples of these being mineral products like iron ore, mica etc. This involves the negotiation with the other parties/government organization for avoiding double taxation and charting an optimal delivery system.

(j) Banking and financial services: With the globalization of the world economy and the liberalization policies pursued by the government of India, the banking sector was the first to recognize the need for offering better facilities to the customers. Also, they were the first to realize the benefits of the use of IT for this purpose. But, the use of IT for integration of the different branches of the banks was not offered to the customers as to provide a location independent real-time banking facility. It was primarily used only to automate the routine working of the banks and for internal administrative purposes. EDI can also be used for electronic clearance of inter-bank transactions leading to faster and better transfer of funds. All links in the system needs to be addressed adequately in the design of 'SCM', to meet the end objective of providing efficient services.

The above description is based on the assumption that the government enterprises work in isolation. But, generally in the supply chain of these enterprises, the main players are the government agencies. Thus, the implementation of SCM paradigm in the case of these enterprises can be effective if one takes care of : **a)** Trust :- as all the organization involved belong to the same umbrella organization, the building of trust among these enterprises can be fast and more easy. **b)** Sharing of information can be more often among these organization thus leading to better understanding of the supply chain by the participant in the chain. **c)** The transport sector - the weakest link in the supply chain - is largely under government control (directly and/or indirectly). **d)** Infrastructure: - Reliable communication network and information technology infrastructure needed to deploy the information sharing mechanism do exist to a large extent in the government sector.

For example, in the public health sector this can lead to faster delivery of medicines which can help in prevention of epidemics. In situation like flood, drought or any other calamity the relevant supply chain can be used to provide medical help, food etc. Thus, the application of SCM paradigm is needed not only by private enterprises engaged in the pursuit of profit but also by organizations that are involved in providing services for meeting social objectives and for the welfare of the society at large.

Conclusion

Supply chain management has become not just a question of efficient logistic process, but is related to the growth and survival of organization(s). With customers becoming more demanding in their requirement of services from the suppliers, the construction of an efficient and integrated supply-chain has assumed paramount importance. Information technology plays a major role in the formation of the supply chain. Efficient dissemination of information upstream and downstream is a major requirement for the implementation of the supply chain, IT provides this with internet, EDI and GroupWare's and other application software's. The decision support provided by IT products (ERPs, Network construction tools etc) can help the decision makers in the development of the supply chain process and in implementation. The dissemination of the demand (forecast) information throughout the chain can lead to avoidance of the "Bullwhip" effect^[17]. The quantitative models embedded in the DSS's for supply chain management are still at a

very elementary stage (in comparison to the theoretical developments), for decision support in the construction of an integrated demand-supply chain, use must be made of these advanced techniques. Organizations can gain supply chain related benefits through the use of internet, namely:

- more collaborative, timely product development through enhanced communication between functional departments, suppliers, customers and even regulatory agencies;
- reduction of channel inventory and product obsolescence owing to closer linkage across the supply chain and better insight into the demand signals to drive product schedules and ultimately achieve build-to order capability;
- reduction in communication costs and customer support costs with more interactive, tailored support capability inherent with internet technologies;
- new channel capabilities to reach different customer segments and further exploit current markets; and
- Ability to enhance traditional products and customer relationships through customisations driven by internet connectivity and interactivity.

The SCM paradigm can provide the mechanism for the survival of the public sector enterprises in the changing global scenario, where the globalization of the world economy and the liberalization of the Indian economy is no longer a buzzword, but a fact. The failure of these enterprises can be traced to the ad-hocism and the non-application of efficient managerial practices. This is not to say that these enterprises have lost their relevance in the present scenario. These enterprises have to adopt “change management” i.e. to change their style of functioning, and to form strategic alliances with partner public sector enterprises

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