

Abstract Number: 025-0803

**Enabling supply chain efficiencies through technology and process integration: A
framework^{1,2}**

¹Dr. N. Chandrasekaran

Vice-president, Corporate Affairs,
Take Solutions Limited,
Chennai.

E-mail: nchandrasekaran@takesolutions.com

²Dr. Ramasubramaniam Muthurathinasabapathy,

Centre for Logistics and Supply Chain Management,
Loyola Institute of Business Administration,
Chennai – 600 034.

E-mail: rams@liba.edu.

POMS 23rd Annual Conference

Chicago, Illinois, U.S.A.

April 20 to April 23, 2012

Abstract: Supply chain efficiencies have been the central theme of a focal organization in designing and implementing supply networks. In this paper, authors discuss importance of technology and process for improving supply chain efficiencies. According to them, complexity of supply network increases process intensity and technology enables efficiencies in such situations.

Keywords: Information Technology, Supply Chain Management

Introduction: In an era of technology eruptions and proliferations of its applications in business, business competition has become intensive even in matured industries. Breakthroughs are becoming possible through process innovation, new offerings and achieving cost advantage with increased offering of responsiveness to customers. Management has to on every customer group in a product category to achieve supply chain objectives of responsiveness and cost efficiency. In this paper, we have discussed the framework for enabling supply chain efficiencies through technology and process integration in a vertically integrated supply network.

Supply chain Management:

Supply chain management is all about network of relationship and roles around a focal firm's ultimate customer to server his demand or impending demand. Increasingly, the management of multiple relationships across the firms in the supply chain network is being referred to as supply chain management (SCM). The supply chain is not a chain of businesses with one-to-one, business- to-business relationships, but a network of multiple businesses and relationships (Drucker 1998). This mainly happens through linkage of processes namely planning and analytics, supplier relationship management, internal supply management and customer relationship management. In that sense, SCM deals with total business process excellence and represents a new way of managing the business and relationships with other members of the supply chain (Bowersox 1997).

A supply chain is a set of firms that move materials forward. Normally, several independent firms are involved in manufacturing a product and placing it in the hands of the end user in a supply chain—raw material and component producers, product assemblers, wholesalers, retailer merchants and transportation companies are all members of a supply chain (La Londe and Masters 1994). Similarly, Lambert, Stock, and Ellram define a supply chain as the

alignment of firms that brings products or services to market. Note that these concepts of supply chain include the final consumer as part of the supply chain.

Another definition notes a supply chain is the network of organizations that are involved, through upstream and downstream linkages, in the different processes and activities that produce value in the form of products and services delivered to the ultimate consumer (Christopher 1992). In other words, a supply chain consists of multiple firms, both upstream (i.e., supply) and downstream (i.e., distribution), and the ultimate consumer.

Thus, a supply chain focus on network of firms around a focal firm's ultimate customer wherein each of the constituents including the customer perform certain functions to share part of the revenue and profit generated in the transaction.

Interface of Technology, Process, and People Revolutionizing Supply Chain

The quality measures and technological advances have revolutionized supply chain in the last two decades. Business processes mapping and documentation have attained sophistication because quality initiatives are being increasingly adopted across the globe. Rather, quality adherence has become mandatory and transparent if one is in global business.

At the same time, global business has been impacted by technology development. Technology can be divided into information technology and purely business-specific technology. The advancement of each of this independently triggered growth for the other, and customers were the biggest beneficiaries. A classic example would be e-business, especially trading in goods from apples to apartments, books to boutiques, cards to cars, and so on. One could see success achieved in different models like B-to-B, B-to-C, G-to-C, and so on. Today, in India, one can buy a bouquet of flowers off the web and get it delivered in any corner in the country. Greeting someone with a bunch of flowers is an expression of love. This is how technology empowers customers. Selling flowers online is a simple idea

but a great effort from the supply chain perspective. One is now able to send flowers to the remote parts of India, which are not easily accessible and where bouquets may not be available. Aggregators deliver this service at an affordable price because technology has opened up new business opportunities that thrive on economies of scope and collaboration rather than on simple model of economies of scale.

It can be said that business applications have moved from the simple use of technology for transactions and management information system to real-time connectivity and integration with partners, reducing time and eliminating the need to stock information and cash.

Today manufacturing firms have supplier networks linked to their servers. Their visibility in production plans and schedule is enabled for efficiency and effectiveness in the supply chain. It is difficult to imagine life and business without the interface of technology, which is now more like a routine and close to being a universal truth.

The performance of people in the supply chain domain has also been improving dramatically. The competencies of people are critical at the operating and planning levels, and the advances in technology have enhanced their output. For instance, while delivering a courier, the delivery personnel usually take the confirmation of receipt on a document. It leaves one wondering when they would confirm delivery to the consigner. Nowadays some delivery personnel carry a small handheld device and take a signature on the monitor of the same. Thus, one can track from anywhere in the world the delivery status of one's consignment on near real-time basis. Similarly, stores staff, which handles a huge number of documents for reordering and analysis, is able to do so efficiently because of new technology. The personnel have not changed but their performance has improved dramatically. One can go on listing such examples from around us. These could be in public life, in services like banking, insurance and education, or in manufacturing like engineering

and pharmaceuticals. The productivity of people has moved up due to new business models and developments in the supply chain. The relationship is illustrated in Figure 1.

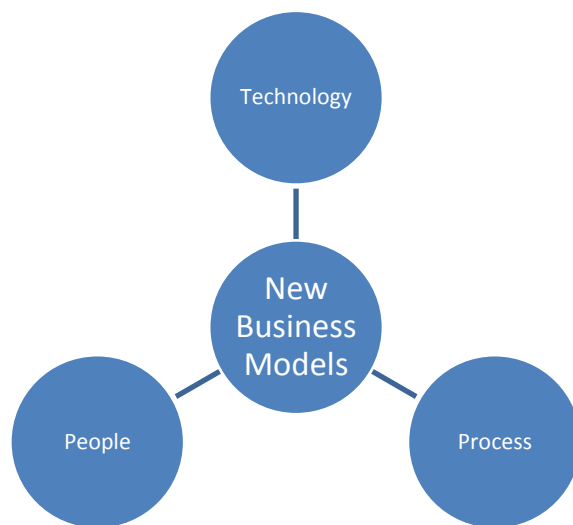


Figure 1 Relationship among technology, process, and people

It is important to note that development of new business models is happening not just because of technological advancement or process improvement or quality of people. It is rather due to the ability to interface all of these in a systematic way. In reality, improvements in one leads to the other and new improved models evolve. One would be amazed at the changes that have occurred during this decade in financial services, especially in stock broking. The players are able to assimilate information and act quickly because of the availability of information, improvements in processes, and heightened skills of people who assimilate and make use of such changes. The interface among technology, process, and people has benefited all stakeholders. Similarly, one can look at how many purchasing decisions at the corporate level have improved. It is important to note here that the level of interface would vary according to the business. However, it is certain that interfaces among technology, process and people are facilitating the configuration of new supply chains, either directly or indirectly, and have dramatically improved supply chain performance.

Supply Chain Efficiencies:

One of the supply chain objectives is to achieve efficiency. Efficiency is measured by delivery performance, product quality, backorders and inventory level, whereas effectiveness is measured by service quality and the service needs. Long-term competitiveness therefore depends on how well the firm meets customer preferences in terms of service, cost, quality, and flexibility, by designing the supply chain, which will be more effective and efficient than the competitors'.

Optimisation of this equilibrium is a constant challenge for the firms which are part of the supply chain network. To be able to optimise this equilibrium, many strategic decisions must be taken and many activities coordinated. This requires careful management and design of the supply chain. The design of supply chains represents a distinct means by which companies innovate, differentiate, and create value. The challenge of supply chain design and management is in the capability to design and assemble assets, organizations, skills, and competences. It encompasses the team, partners, products, and processes.

Said these, SCM is concerned with improving both efficiency (i.e., cost reduction) and effectiveness (i.e., customer service) in a strategic context (i.e., creating customer value and satisfaction through integrated supply chain management) to obtain competitive advantage that ultimately brings profitability. If we distinguish between the operational function of customer service and the resultant goal of customer value and satisfaction, this discussion leads us to conclude the consequences of SCM are lower costs and improved customer value and satisfaction to achieve competitive advantage. This has been cited in literature on the subject quite commonly and one of the schematic presentations is given in Figure 2.

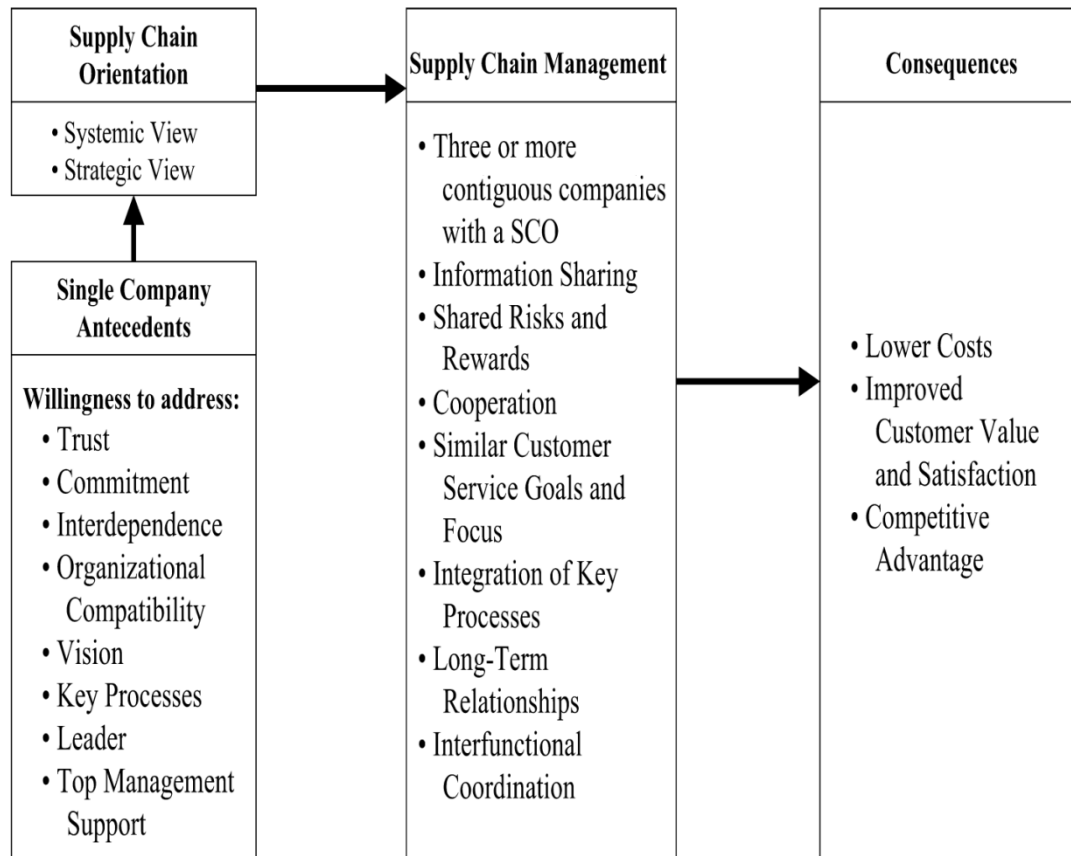


Figure 2: the consequences and antecedents of SCM (Adopted from Tyndall et al., 1998)

Thus, supply chain efficiencies focus on cost advantages achieved through supply chain function and thereby creating a competitive advantage could be a way Dell did cutting across intermediaries in home PC market or configure one's own PC or through using any of the traditional management techniques and process management from supplier end to customer end.

Supply Chain network:

It may be important at this point to emphasis the concept of supply chain network. Supply chain efficiency must be from this perspective. Supply chain is defined as a set of three or more entities (organizations or individuals) directly involved in the upstream and downstream flows of products, services, finances, and/or information from a source to a customer.

Encompassed within this definition, one can identify three degrees of supply chain complexity:

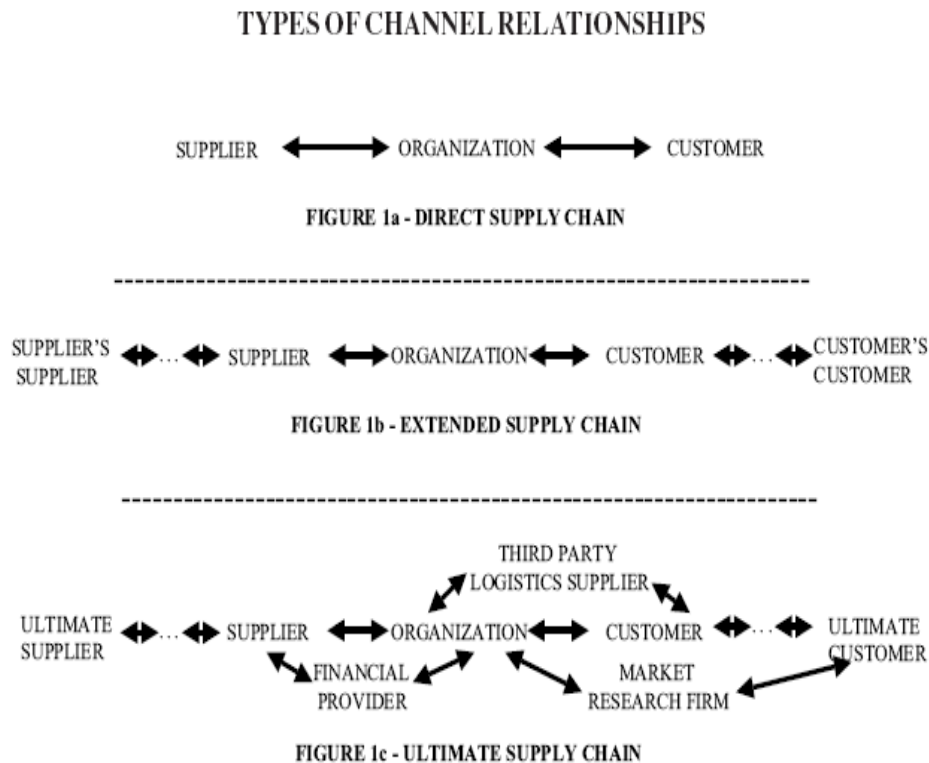
1. “Direct supply chain,”
2. “Extended supply chain,” and
3. “Ultimate supply chain.”

A direct supply chain consists of a company, a supplier, and a customer involved in the upstream and/or downstream flows of products, services, finances, and/or information (Mentzer et al (2001) as represented in figure 1 a.

An extended supply chain includes suppliers of the immediate supplier and customers of the immediate customer, all involved in the upstream and/or downstream flows of products, services, finances, and/or information (Mentzer et al 2001) as represented in Figure 1b.

An ultimate supply chain includes all the organizations involved in all the upstream and downstream flows of products, services, finances, and information from the ultimate supplier to the ultimate customer (Mentzer et al 2001) as represented in figure 1 c. A third party financial provider may be providing financing, assuming some of the risk, and offering financial advice; a third party logistics provider is performing the logistics activities between two of the companies; and a market research firm is providing information about the ultimate customer to a company well back up the supply chain.

Figure: 3 Types of supply chain relationships (Adopted from Mentzer et al.2001).



As one may observe the complexity of supply network increases, challenges of supply chain efficiency also moves up. Unless one deploys right kind of technology, process and people management, supply chain network cannot be a competitive differentiator.

Horizontal and vertical integrated firms: While discussing on importance of supply chain network, it is worth taking a view on integrated firms. Traditionally, firm strategist believed that competitive advantage could be achieved through integrating firms vertically or horizontally.

Vertical integration refers to the degree to which a firm owns its upstream suppliers and its downstream buyers. Since it can have a significant impact on a business unit's position in its industry with respect to cost, differentiation, and other strategic issues, the vertical integration becomes significant. On contrary to this, horizontal integration focuses on expansion of a

chain of firm's business through its products / services at the same level of value chain. The objective here could be to achieve advantage through market share acquisition and moving to position of dominance.

It may be noted here that integration strategy is more of firm's objective to achieve its own internal strategic financial goals rather than being an integrated supply network player.

Supply Chain Macro-Process

It could be useful to have an understanding of the macro-processes of supply chain. One may cite the linkages among supply chain processes as being key to synchronization of activities and delivering value to customers. Process orientation links identifiable flows and value-adding activities. The debate about value addition and value creation is kept outside this discussion and these terms are used here interchangeably. Figure 3 shows the supply chain macro-processes.

Traditionally, logistics were looked upon as a functional activity. The orientation was towards the accomplishment of tasks by grouping various resources. This was a silo approach (meaning 'acting independent of') and led to suboptimal decisions. There was a complete lack of systemic thinking. For example, an inventory-control manager would look at reducing inventory holding so that the cost is reduced. The inventory policy could be at times independent of the market situation wherein consolidation could have been initiated. With reduction in ordering cost, frequent orders could be placed, leaving the scope of price negotiation to the procurement department. The conflict would become more pronounced with the procurement department as well as with marketing, which may prefer responsiveness. Apart from poor managerial effectiveness, another major problem would be

behavioral concerns and playing the blame game, which would lead to further loss of effectiveness in supply chain. The worst cases were those where the lost sales could not even be mapped and escalated as behavioral issues which superseded managerial demands of growth and customer satisfaction. Thus, the functional approach was effective only where the boundaries of operation were clear with definite deliverables and adequateness of resources.

Given the drawback of the functional orientation, one may look upon process orientation for supply chain efficiency and effectiveness. Process orientation emphasizes on ‘how’ of an activity rather than ‘what’. Each process has a set of certain flows and defined activities. With respect to supply chain at the macro level, informational, physical and financial flows are paramount. At the macro level, activities would pertain to supplier management, the focal organization’s internal supply chain, channel management and customer relations. Each of the macro activities could be seen as a nodal point for decisions which are inter-linked, and the three flows ensure that the deliverables are achieved. A good process orientation would have defined procedures and policy for such activities so that quality is adhered to.

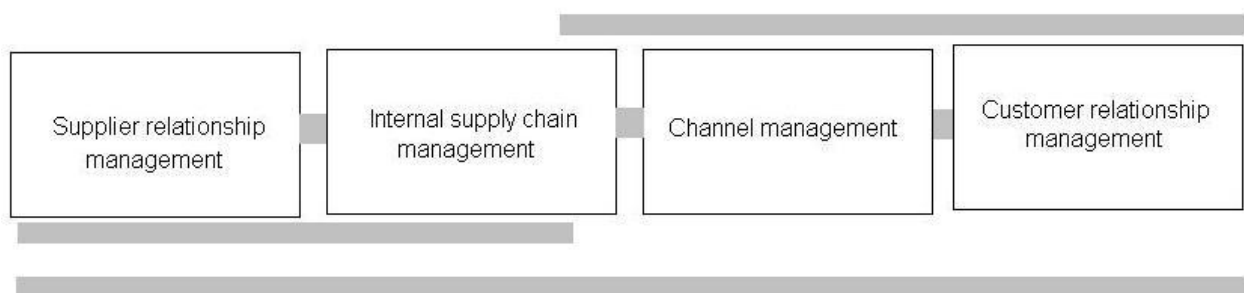


Figure 4: Supply Chain Macro-processes

Supplier management process would include the goal of ensuring supplies at the best cost and terms, depending on whether it is a tactical purchase, a strategic buy, a negotiated

purchase, or an engineered item. Each of these would have a different process. By and large, the process would include analysing information on supplier capabilities and pricing. Strategic buying and engineered buying would have more activities in the process of evaluation, especially at the initial stage of collaboration. It must be clearly understood that the entire supplier management process is driven by the nature of purchase and linked to the product manufactured.

Internal supply chain process includes a number of activities with respect to receiving, conversion, and despatch of finished goods. During this process, goods are internally value added through in-plant logistics operations like stores management, movement and storage, and so on. All these activities are heavily linked to supplier collaboration like joint inventory taking (JIT), kanban (a technique of inventory management discussed later in the book), and design collaboration, and also with channel partners and customers. One may note that automated information flow and physical movement are synchronized for supplier-maintained inventory at the plant. The same would be true if one were to consider the importance of information flow from the customer's end to plant operations, especially with regard to changes in the weekly production as per the change in market conditions. Financial flows are fundamentally essential in these. Hence the functional approach to manufacturing would be limited to excellence in manufacturing but may lack supply chain synchronization unless it is explicitly pursued.

The next important macro process is **channel management**. One can look at this as a key distribution functionality. Instead of looking at distribution as a function, one may treat this as a process. It is important to note linkages in distribution with multi-tier arrangements, depending upon the type of products moved. In case of fast-moving consumer goods

(FMCG) and the consumer products group, it may have a multi-tier structure. In case of heavy capital goods, it may be a simple channel structure but with complicated movement and handling activities. The goal in this stage is mainly to reduce channel cost and improve availability to customers. Channel conflicts emerge because of priorities and conflicts in objectives between channel partners and the focal organization. Unless flows are synchronized and trust is created among stakeholders, the supply chain would suffer in terms of effectiveness and efficiency.

Another important macro process is **customer relationship management**. As mentioned earlier, the purpose of a supply chain network is to serve an ultimate customer of the focal organization. The focal organization orients itself to synchronize its role agents and processes to serve a customer at a right price. Customer delight happens only if the product meets the customer's satisfaction in terms of time, quantity, responsiveness, and cost. Also aspects like warranty, service support, and parts availability are critical. Customer retention and upgradation would be key expectations of the focal organization, which could happen only if financial, informational and product flows are managed effectively. The interdependence among processes and role agents must be well-appreciated and synchronized for effective and efficient supply chain network. Customer relationship management from supply chain management perspective must take care of responsiveness, reliability, and flexibility. These could be possible only when the focal organization seamlessly integrates all processes.

Technology options:

Developments in supply chain needed strong complementary support from Information systems (IS). And one such information system, the enterprise resource planning (ERP)

system, is sweeping across industry since early 2000s. An ERP system is an integrated enterprise computing system that is designed to automate the flow of material, information, and financial resources among all functions within an enterprise on a common database. From a technical perspective, ERP can be seen as the logical extension of the Material Requirement Planning (MRP) systems of 1970s and the Manufacturing Resource Planning (MRP II) systems of 1980s. The ERP was subsequently designed to overcome the operational problems that companies experienced with previous information systems. ERP systems should not be looked at simply as tools that have a fixed and measurable output, but rather as comprising a technological infrastructure designed to support the capability of all other tools and processes used by a firm. Functionally, an ERP system primarily supports the management and administration of the deployment of resources within a single organization. The problem is that the first generation of ERP products has been designed to integrate the various operations of an individual firm, whereas in modern SCM, the unit of analysis has become a network of organizations, making these ERP products inadequate in the new economy (Y.-f. Su, 2010). This in turn led to strong growth in SCM technology solutions system in the beginning of this century.

This in turn led to Best of Breed solution providers, who were able to offer superior products, rather than a simple extension to existing ERP solutions. And, major players are following their ways to enhance and enrich their existing ERP solutions. In this context, some major ERP players are also studied in this research, to assess the industrial trend.

Three pillars of SCM

From process perspective, supply chain was earlier grouped under four processes. To deploy technology, Supply chain activities can be divided along three different layers namely:

1. Supply Chain Planning (SCP)

2. Supply Chain Collaboration (SCC)

3. Supply Chain Execution (SCE)

Understanding of various activities within each layer is necessary to differentiate various SCM software solutions. A brief list of activities coming in each of these layers will be discussed in this section.

1. Supply Chain Planning

Various activities coming under Demand Management are:

a. Demand Management

- _ Develops forecasts from multiple demand streams: orders, shipments, POS Data and customers' DC withdrawals, BOM etc.
- _ Manages product lifecycle, from new product introductions through phase-out
- _ Decomposes baseline demand to improve forecast and manage promotions

b. Production Planning & Scheduling

- _ Concerned with feasible, optimized and responsive production plans Optimizes materials, resources, changeovers and capacities across multistage/site manufacturing, distribution and supplier networks driven by prioritized customer demand
- _ Production planning enables the planner to create feasible production plans across the different production locations (also with subcontractors) to fulfil the (customer) demand in time and to the standard expected by the customer. For the long and medium-term time horizon, planning is based on time buckets and determines requirements of resources (machines, humans, production resource tools) and materials. Solvers, real-time data, and high supply chain visibility (KPIs, alerts) support the planner's decision-making process.
- _ MRP is part of the production planning process and generates replenishment schedules for all manufactured components, intermediates, purchased parts, and raw materials. MRP sets

due dates for production orders and purchase requisitions through lead-time scheduling, depending on buffers, operation times, lot-sizing rules and so on.

- _ Detailed Scheduling delivers optimized order sequences that can be released for production. Scheduling heuristics and solvers take into account constraints and costs to schedule the optimized order sequence, based on business objectives.

c. Distribution Planning

- _ The distribution planning process is used to determine which demands can be fulfilled by the existing supply elements, i.e., A tactical planning process for the entire supply chain network, helping to optimize the day-to-day flow of goods from supplier to manufacturer, manufacturer to distributor, and distributor to customer.

- _ Vendor Managed Inventory- The aim of vendor-managed inventory (VMI) is to integrate key customers in supply chain planning. The customer regularly sends stock and sales data to the vendor, and based on that information, the vendor determines replenishment requirements for the customer. It improves the vendor's access to the actual customer requirements, and also enables the vendor to make informed decisions about how to distribute goods for different customers

d. Supply Network Planning (SNP)

- _ The Supply Network Planning considers a plan that meets all the demand requirements and determines sourcing requirements for plan.

- _ Cost optimisation for such sourcing considering all the cost involved

- _ Capacity levelling, determining out sourcing requirements

- _ Supply network design

- _ Performance analysis at each level and optimisation/improvements

2. Supply Chain Collaboration (SCC)

a. Procurement

Various activities under Procurement function are:

1. Purchase order Processing

This function includes conversion of demand to Purchase orders, confirmation and Monitoring of purchasing activities, Visibility across Purchasing activities such as procurement tracking and monitoring, alerts and follow up for procurement, performance monitoring

2. Strategic Sourcing

Strategic sourcing includes supplier selection, Supplier contract management, Catalogue management and bid management

3. Receiving and verifying incoming invoices

b. Supplier Network Collaboration

Various activities considered under supplier network collaboration study are:

a. Web based supplier interaction for order management, invoicing and financial settlement, supplier managed e-Catalogue etc

b. Direct document exchange of order, invoice and advanced shipment notice (ASN)

c. Supplier network management with such as supplier onboarding.

d. Supplier performance management, supplier profile management, supplier compliance to industry standards/rules

3. Supply Chain Execution

Various activities considered under this segment are:

a. Warehouse Management System:

1. Inbound processing and out bound processing activities includes Yard management, Advanced Shipping Notification (ASN), Goods Receipt/Issue, Kitting, internal routing, delivery monitoring, delivery processing for production supply, & distribution etc

2. Warehousing and storage activities include picking and put away strategies like LIFO, FIFO etc, Slotting, RFID processing, stocking and storage management activities regarding serial numbers, hazardous material processing etc

3. Physical inventory planning and monitoring including physical counting

4. Mobile Supply Chain applications enable users to perform many common warehouse and shop floor transactions through hand-held radio frequency devices, personal digital assistants and truck-mounted radio frequency scanners. Transactions can be carried out on these wireless devices at the point of use, offering real time transaction processing, improved data accuracy and increased mobility and convenience

b. Transportation Management System:

1. Freight management activities include capture transportation requests, route determination and related workflow management

2. Planning & dispatching activities such as selection of shipment mode and route, Load consolidation, shipping etc

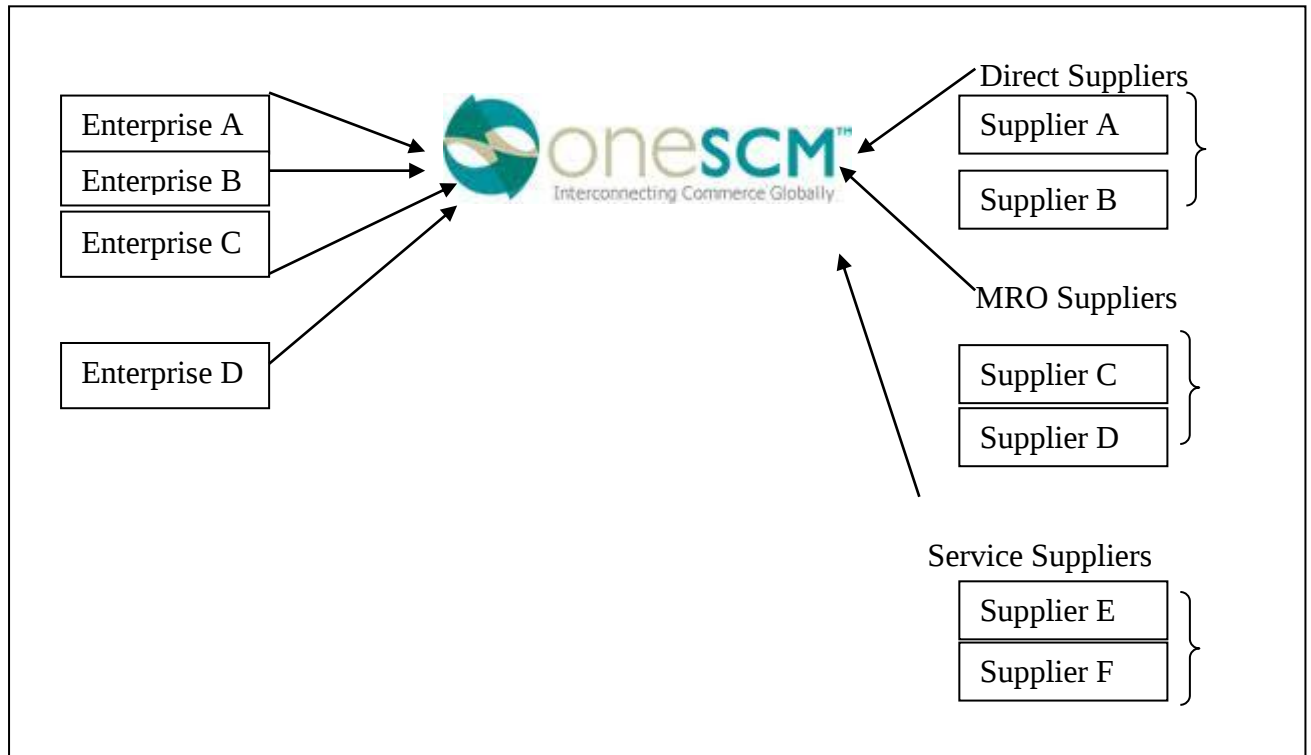
3. Transportation Visibility management includes tracking and monitoring of the transportation process from creation of the delivery notice to the receipt at customer site, alerts and follow ups and transportation analytics.

4. Rating, billing and settlement regarding invoice request and supplier/customer transportation charges.

Case on Multi –Enterprise Collaboration tool:

A simple illustration of large vertically integrated supply network is shown in Figure 5. They have deployed a product called OneSCM, by Take Solutions Ltd. OneSCM Creates an Online Ecosystem for Suppliers to Work with Customers. With contract manufacturers, third party

logistics service providers (3PLs), and suppliers directly dealing with customers across organizational boundaries, there is a growing need to collaborate with trading partners.



In multi enterprise collaboration, not just one-to-one collaboration it connects all trading partners — from buyers to suppliers, contract manufacturers to logistics carriers and everyone else in between — to a single ecosystem that aggregates data from all systems, regardless of which system is in place, into a single, consolidated view. The OneSCM platform delivers critical components in supply chain network:

- Procure-to-Pay (P2P)
- Order-to-Cash (O2C)
- Accounts Payable Automation
- Accounts Receivable Automation

The benefits OneSCM includes:

- Improved User Interface.

- Buyer/Supplier Synchronization.
- Supplier On-Boarding.
- Advanced Search Features.

Approach to IT and its dilemma: From the above it may be seen that there are standard solutions and applications are widely available for optimizing a supply chain network. The complication or dilemma arises from the complexity of supply network, competitive strength of each of the players in the network, vintage of technology pursued and more than often, one may come across multiple supply chain network involving key players and can one customize technology for each of the network? Unfortunately answers are not simple and straight. A common rule is process gets priority and business need is utmost important. Technology need to be an enabler and must be flexible for adaption and change. This may also explain growth and future of IT firms enabling business processes!

Conclusion: It is concluded that technology is key enabler in achieving efficiency in supply chain network. But more importantly understanding business process efficiencies, roles, responsibilities and competitive positioning of firms in the network to choose appropriate technology application are vital. If blanket approach to technology is adopted, probably supply network could be vulnerable to failure in a competitive market.

Acknowledgement: Authors thank TAKE SOLUTIONS LTD, Chenani for its input and support on this article. Dr.N .Chandrasekaran acknowledges support of his PhD scholar Mr.R.Arunachalam, General Manager, Supply Chain Initiatives Redington India Ltd and Mr.Hari Krishnan Namboothiri U, PGPEX – VLM student, IIMC who is on internship project on Competitive Intelligence on Supply Chain software.

References:

1. Drucker, P. (1998) On the Profession of Management. A Harvard Business Review Book
2. Bowersox, D. J. Integrated Supply Chain Management: A Strategic Imperative, presented at the Council of Logistics Management 1997 Annual Conference, 5-8 Oct. Chicago, IL.,1997
3. Bernard J. La Londe, James M. Masters, (1994) "Emerging Logistics Strategies: Blueprints for the Next Century", International Journal of Physical Distribution & Logistics Management, Vol. 24 Iss: 7, pp.35 - 47
4. Lambert, Douglas M., James R. Stock, and Lisa M. Ellram (1998), *Fundamentals of Logistics Management*. Boston: McGraw Hill
5. Christopher, M., (1992), *Logistics & Supply Chain Management*, Pitmans, London, UK
6. .Tyndall, G., Gopal, C., Partsch, W. and Kamauff, J. (1998). *Supercharging supply chains: New ways to increase value through global operational excellence*, John Wiley and Sons, Inc.
7. Mentzer, J.T. et. al. (2001): Defining Supply Chain Management, in: [*Journal of Business Logistics*](#), Vol. 22, No. 2, 2001, pp. 1–25
8. Chandrasekaran N, Supply Chain Management, Oxford University Press India, 2010
9. Chandrasekaran N & Anathanarayanan P S, Strategic Management, Oxford University Press India 2011