## SUPPLY CHAIN AND INFORMATION TECHNOLOGY

The role IT in supply chain- The supply chain IT frame work Customer Relationship Management – Internal supply chain management – supplier relationship management – future of IT in supply chain – E-Business in supply chain.

## 5.1. THE ROLE OF IT IN A SUPPLY CHAIN

Information is a key supply chain driver because it serves as the glue that allows the other supply chain drivers to work together with the goal of creating an integrated, coordinated supply chain. Information is crucial to supply chain performance because it provides the foundation on which supply chain processes execute transactions and managers make decisions. Without information, a manager cannot know what customers want, how much inventory is in stock, and when more products should be produced or shipped. Information provides supply chain visibility, allowing managers to make decisions to improve the supply chain's performance.

IT consists of the hardware, software, and people throughout a supply chain that gather, analyse, and execute upon information. IT serves as the eyes and ears (and sometimes a portion of the brain) of management in a supply chain, capturing and analysing the information necessary to make a good decision. For instance, an IT system at a PC manufacturer may show the finished goods inventory at different stages of the supply chain and also provide the optimal production plan and level of inventory based on demand and supply information.

Using IT systems to capture and analyse information can have a significant impact on a firm's performance. For example, a major manufacturer of computer workstations and servers found that most of its information on customer demand was not being used to set production schedules and inventory levels. The manufacturing group lacked this demand information, which essentially forced it to make inventory and production decisions blindly. By installing a supply chain software system, the company was able to gather and analyse demand data to produce recommended stocking levels.

Using the IT system enabled the company to cut its inventory in half, because managers could now make decisions based on customer demand information rather than manufacturing's educated guesses.

Availability and analysis of information to drive decision making is a key to the success of a supply chain. Companies that have built their success on the availability and analysis of information include Seven-Eleven Japan, Walmart, Amazon, UPS, and Netflix.

To support effective supply chain decisions, information must have the following characteristics:

**1. Information must be accurate.**
Without information that gives a true picture of the state of the supply chain, it is difficult to make good decisions. That is not to say that all information must be 100 percent correct, but rather that the data available paint a picture that is at least directionally correct.

**2. Information must be accessible in a timely manner.**
Accurate information often exists, but by the time it is available, it is either out of date or it is not in an accessible form. To make good decisions, a manager needs to have up-to-date information that is easily accessible.

**3. Information must be of the right kind.**
Decision makers need information that they can use. Often companies have large amounts of data that are not helpful in making a decision. Companies must think about what information should be recorded so that valuable resources are not wasted collecting meaningless data while important data go unrecorded.

**4. Information must be shared.**
A supply chain can be effective only if all its stakeholders share a common view of the information that they use to make business decisions. Different information with different stakeholders results in misaligned action plans that hurt supply chain performance.

Information is used when making a wide variety of decisions about each supply chain driver, as discussed next.

**1. Facility.** Determining the location, capacity, and schedules of a facility requires information on the trade-offs among efficiency and flexibility, demand, exchange rates, taxes, and so on (see Chapters 4, 5, and 6). Walmart's suppliers use the demand information from Walmart's stores to set their production schedules. Walmart uses demand information to determine where to place its new stores and cross-docking facilities.

**2. Inventory**. Setting optimal inventory policies requires information that includes demand patterns, cost of carrying inventory, costs of stocking out, and costs of ordering (see Chapters 11, 12, and 13). For example, Walmart collects detailed demand, cost, margin, and supplier information to make these inventory policy decisions.

**3. Transportation**. Deciding on transportation networks, routings, modes, shipments, and vendors requires information about costs, customer locations, and shipment sizes to make good decisions (see Chapter 14). Walmart uses information to tightly integrate its operations with those of its suppliers. This integration allows Walmart to implement cross-docking in its transportation network, saving on both inventory and transportation costs.

**4. Sourcing**. Information on product margins, prices, quality, delivery lead times, and so on, are all important in making sourcing decisions. Given sourcing deals with inter-enterprise transactions, a wide range of transactional information must be recorded in order to execute operations, even once sourcing decisions have been made.

**5. Pricing and revenue management**. To set pricing policies, one needs information on demand, both its volume and various customer segments' willingness to pay, and on many supply issues, such as the product margin, lead time, and availability. Using this information, firms can make intelligent pricing decisions to improve their supply chain profitability.

Information is crucial to making good supply chain decisions at all three levels of decision making (strategy, planning, and operations) and in each of the other supply chain drivers (facilities, inventory, transportation, sourcing, and pricing). IT enables not only the gathering of these data to create supply chain visibility, but also the analysis of these data so that the supply chain decisions made will maximize profitability.

## 5.2. THE SUPPLY CHAIN IT FRAMEWORK

IT provides access and reporting of supply chain transaction data. More advanced IT systems then layer on a level of analytics that uses transaction data to proactively improve supply chain performance. Good IT systems will record and report demand, inventory, and fulfilment information for Amazon. IT systems that provide analytics then allow Amazon to decide whether to open new distribution centres and how to stock them.

### The Supply Chain Macro Processes

The emergence of supply chain management has broadened the scope across which companies make decisions. This scope has expanded from trying to optimize performance across the division, to the enterprise, and now to the entire supply chain. This broadening of scope emphasizes the importance of including processes all along the supply chain when making decisions.

From an enterprise's perspective, all processes within its supply chain can be categorized into three main areas:
• Processes focused downstream,
• Processes focused internally
• Processes focused upstream.

We use this classification to define the three macro supply chain as follows:
• **Customer relationship management (CRM).** Processes that focus on downstream interactions between the enterprise and its customers.
• **Internal supply chain management (ISCM).** Processes that focus on internal operations within the enterprise. Note that the software industry commonly calls this ―supply chain management‖ (without the word ―internal‖), even though the focus is entirely within the enterprise. In our definition, supply chain management includes all three macro processes, CRM, ISCM, and SRM.
 • **Supplier relationship management (SRM).** Processes that focus on upstream interactions between the enterprise and its suppliers.

All operation and analytics related to the macro processes rest on the transaction management foundation (TMF), which includes basic enterprise resource planning (ERP) systems (and its components, such as financials and human resources), infrastructure software, and integration software. TMF software is necessary for the three macro processes to function and to communicate with one another. The relationship between the three macro processes and the transaction management foundation can be seen in Figure 5.1.
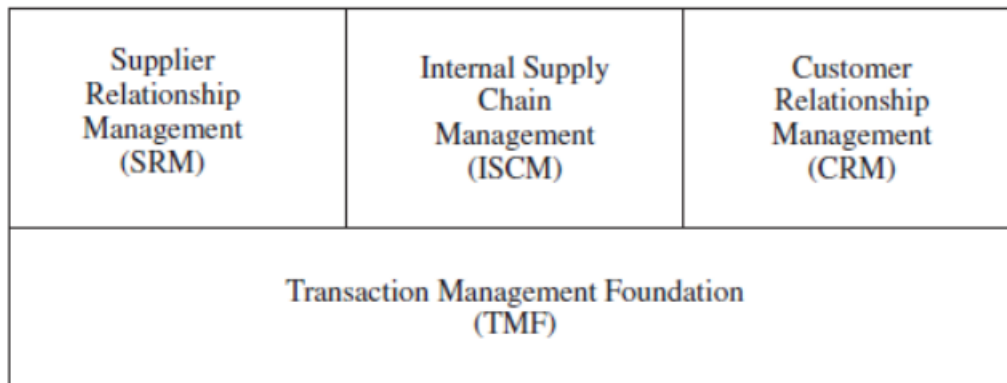
| Supplier Relationship Management (SRM) | Internal Supply Chain Management (ISCM) | Customer Relationship Management (CRM) |
| --- | --- | --- |
| Transaction Management Foundation (TMF) | | |

**Figure 5.1. The Macro Processes in a Supply Chain**

**Why Focus on the Macro Processes?**

As the performance of an enterprise becomes more closely linked to the performance of its supply chain, it is crucial that firms focus on these macro processes. Food supply chain management is not a zero-sum game in which one stage of the supply chain increases profits at the expense of another. Good supply chain management instead attempts to grow the supply chain surplus, which requires each firm to expand the scope beyond internal processes and look at the entire supply chain in terms of the three macro processes to achieve breakthrough performance. A good supply chain coordinates all the macro processes across all stages.

Apple is an example of a company that has coordinated all macro processes to introduce and sell blockbuster products such as the iPad2. Apple has been very successful in its interactions with customers both in designing products that meet their needs but also in operating Apple retail as a successful and profitable endeavour. All its products are designed in-house but manufactured by a third party. Despite this, Apple managed the release of the iPad2 to effectively meet huge demand. Strong coordination across all the macro processes has been fundamental for the level of success achieved by Apple.

**5.3 Customer Relationship Management**

The CRM macro process consists of processes that take place between an enterprise and its customers downstream in the supply chain. The goal of the CRM macro process is to generate customer demand and facilitate transmission and tracking of orders. Weakness in this process results in demand being lost and a poor customer experience because orders are not processed and executed effectively.

The key processes under CRM are as follows:

•**Marketing**. Marketing processes involve decisions regarding which customers to target, how to target customers, and what products to offer, how to price products, and how to manage the actual campaigns that target customers.

Good IT systems in the marketing area within CRM provide analytics that improve the marketing decisions on pricing, product profitability, and customer profitability, among other functions.

•**Sell.** The sell process focuses on making an actual sale to a customer. The sell process includes providing the sales force with the information it needs to make a sale and then to execute the actual sale. Executing the sale may require the salesperson to build and configure orders by choosing among a variety of options and features. The sell process also requires such functionality as the ability to quote due dates and access information related to a customer order. Good IT systems support sales force automation, configuration, and personalization to improve the sell process.

•**Order management.** The process of managing customer orders as they flow through an enterprise is important for the customer to track his order and for the enterprise to plan and execute order fulfilment. This process ties together demand from the customer with supply from the enterprise. Good IT systems enable visibility of orders across the various stages that an order flows through before reaching the customer.

•**Call/service centre**. A call/service centre is often the primary point of contact between a company and its customers. A call/service centre helps customers place orders, suggests products, solves problems, and provides information on order status.

Good IT systems have helped improve call/service centre operations by facilitating and reducing work done by customer service representatives and by routing customers to representatives who are best suited to service their request.

Amazon has done an excellent job of using IT to enhance its CRM process. The company customizes the products presented to suit the individual customer (based on an analysis of customer preferences from past history and current clicks). Quick ordering is facilitated by systems that allow one-click orders. The order is then visible to the customer until it is delivered. In the rare instances when a customer uses the call centre, systems are in place to support a positive experience including offering a call back in case the call centre is heavily loaded.

The five largest CRM software providers in 2008 (as reported by Gartner) were SAP (22.5 percent), Oracle (16.1 percent), Salesforce.com (10.6 percent), Microsoft (6.4 percent), and Amdocs (4.9 percent).

**5.4. Internal Supply Chain Management**
ISCM is focused on operations internal to the enterprise. ISCM includes all processes involved in planning for and fulfilling a customer order.

The various processes included in ISCM are as follows.

•**Strategic planning**. This process focuses on the network design of the supply chain.

•**Demand planning**. Demand planning consists of forecasting demand and analysing the impact on demand of demand management tools such as pricing and promotions.

•**Supply planning.** The supply planning process takes as an input the demand forecasts produced by demand planning and the resources made available by strategic planning, and then produces an optimal plan to meet this demand. Factory planning and inventory planning capabilities are typically provided by supply planning software.

•**Fulfilment**. Once a plan is in place to supply the demand, it must be executed. The fulfilment process links each order to a specific supply source and means of transportation. The software applications that typically fall into the fulfilment segment are transportation and warehousing applications.

•**Field service.** Finally, after the product has been delivered to the customer, it eventually must be serviced. Service processes focus on setting inventory levels for spare parts as well as scheduling service calls. Some of the scheduling issues here are handled in a similar manner to aggregate planning, and the inventory issues are the typical inventory management problems.

Given that the ISCM macro process aims to fulfil demand that is generated by CRM processes, there needs to be strong integration between the ISCM and CRM macro processes. When forecasting demand, interaction with CRM is essential, as the CRM applications are touching the customer and have the most data and insight on customer behaviour. Similarly, the ISCM processes should have strong integration with the SRM macro process. Supply planning, fulfilment, and field service are all dependent on suppliers and therefore the SRM processes.

It is of little use for your factory to have the production capacity to meet demand if your supplier cannot supply the parts to make your product. Order management, which we discussed under CRM, must integrate closely with fulfilment and be an input for effective demand planning. Again, extended supply chain management requires that we integrate across the macro processes.

Successful ISCM software providers have helped improve decision making within ISCM processes. Good integration with CRM and SRM, however, is still largely inadequate at both the organizational and software levels. Future opportunities are likely to arise partly in improving each ISCM process, but even more so in improving integration with CRM and SRM.

Like CRM, today's ISCM landscape consists of three categories-the former best-of-breed winners, the best-of-breed start-ups, and the ERP players. The ERP players dominate this segment, although this was not always the case. There were two best-of-breed winners, i2

Technologies and Manugistics, which were ISCM pioneers and basically built the category. They showed the power of IT in supply chain management. However, they grew too quickly and spread their product lines across too many products, causing them to lose focus. This allowed the ERP players to improve their functionality relative to the best-of-breed players and eventually to take the supply chain leadership role away from them. Today, these ERP players are the only large players in supply chain IT. Manugistics, i2, and some start-ups still exist, but the landscape looks to be dominated by SAP and Oracle for the foreseeable future.

## 5.5 Supplier Relationship Management

Supplier Relationship Management SRM includes the processes that are focused on the interaction follows:

**Design collaboration:** Between the enterprise and suppliers that are upstream in the supply chain. There is a natural fit between SRM processes and the ISCM processes, as integrating supplier constraints is crucial when creating internal plans. The major SRM processes are as

This software aims to improve the design of products through collaboration between manufacturers and suppliers. The software facilitates the joint selection (with suppliers) of components that have positive supply chain characteristics such as ease of manufacturability or commonality across several end products. Other design collaboration activities include the sharing of engineering change orders between a manufacturer and its suppliers. This eliminates the costly delays that occur when several suppliers are designing components for the manufacturer's product concurrently.

**Source:** Sourcing software assists in the qualification of suppliers and helps in supplier selection, contract management, and supplier evaluation. An important objective is to analyze the amount that an enterprise spends with each supplier, often revealing valuable trends or areas for improvement. Suppliers are evaluated along several key criteria, including lead time, reliability, quality, and price. This evaluation helps improve supplier performance and aids in supplier selection. Contract management is also an important part of sourcing, as many supplier contracts have complex details that must be tracked (such as volume-related price reductions). Successful software in this area helps analyse supplier performance and manage contracts.

**Negotiate:** Negotiations with suppliers involve many steps, starting with a request for quote (RFQ). The negotiation process may also include the design and execution of auctions. The goal of this process is to negotiate an effective contract that specifies price and delivery parameters for a supplier in a way that best matches the enterprise's needs. Successful software automates the RFQ process and the execution of auctions.

**Buy:** ─Buy‖ software executes the actual procurement of material from suppliers. This includes the creation, management, and approval of purchase orders. Successful software in this area automates the procurement process and helps decrease processing cost and time.

**Supply collaboration:** Once an agreement for supply is established between the enterprise and a supplier, supply chain performance can be improved by collaborating on forecasts, production plans, and inventory levels. The goal of collaboration is to ensure a common plan across the supply chain. Good software in this area should be able to facilitate collaborative forecasting and planning in a supply chain.

Significant improvement in supply chain performance can be achieved if SRM processes are well integrated with appropriate CRM and ISCM processes. For instance, when designing a product, incorporating input from customers is a natural way to improve the design. This requires inputs from processes within CRM. Sourcing, negotiating, buying, and collaborating tie primarily into ISCM, as the supplier inputs are needed to produce and execute an optimal plan. However, even these segments need to interface with CRM processes such as order management. Again, the theme of integrating the three macro processes is crucial for improved supply chain performance.

The SRM space is highly fragmented in terms of software providers and not as well defined as CRM and ISCM. Among the larger players, SAP and Oracle have SRM functionality in their software. There are many niche players, however, who focus on different aspects of SRM. All three macro processes and their processes can be seen in Figure 5.1.

| SRM | ISCM | CRM |
|---|---|---|
| Design Collaboration | Strategic Planning | Market |
| Source | Demand Planning | Sell |
| Negotiate | Supply Planning | Call Center |
| Buy | Fulfillment | Order Management |
| Supply Collaboration | Field Service | |
| TMF | | |

**Fig. 5.1: The Macro Processes and Their Processes**

## 5.6 The Future of IT in the Supply Chain

At the highest level, we believe that the three SCM macro processes will continue to drive the evolution of supply chain IT. While there is still plenty of room to improve the visibility and reporting of supply chain information, the relative focus on improved analysis to support decision making will continue to grow.

The following three important trends will impact IT in the supply chain:
1. The growth in software as a service (SaaS)
2. Increased availability of real-time data
3. Increased use of mobile technology

SaaS is defined as software that is owned, delivered, and managed remotely. Salesforce.com is one of the best-known pure SaaS supply chain software providers (in CRM). Gartner has predicted that SaaS (which comprised about 10 percent of the enterprise software market in 2009) will grow to about 16 percent of global software sales by 2014. This shift is likely to occur because SaaS provides lower start up and maintenance costs compared to applications that are deployed onsite. These factors are particularly important for small and midsized companies. Traditional enterprise software vendors such as SAP, Oracle, and Microsoft are increasing the availability of their software using the SaaS model.

The availability of real-time information has exploded in most supply chains. Whereas current supply chain software is primarily focused on improving strategy and planning decisions (often at the corporate level) that are revisited infrequently, significant opportunity exists to devise software that will use real-time information to help frontline supply chain staff (such as in transportation and warehousing) make smarter and faster decisions that are revisited frequently. The opportunity is to design systems that enable rapid insight based on real-time data.

The increased use of mobile technology coupled with real-time information offers some supply chains an opportunity to better match demand to supply using differential pricing. An example is an initiative by Groupon titled Groupon Now, which offers mobile users deals that are time and location specific. Businesses can improve profitability by offering deals when business is slow at specific locations. Consumers benefit from getting a deal when and where they want it. Such an approach is likely to be applicable in many supply chain settings.

## 5.7 E- Business in Supply Chain

E-Business has emerged as a key enabler to drive supply chain integration. Businesses can use the Internet to gain global visibility across their extended network of trading partners and help them respond quickly to changing customer demand captured over the Internet. E-business can be loosely defined as a business process that uses the Internet or other electronic medium as a channel to complete business transactions.

As classified by Geoffrion and Krishnan (2001), e-business consists of three areas:
(1) Consumer oriented activity and
(2) business-oriented activity supported by
(3) The e-business technology infrastructure.

The consumer-oriented activities consist of business-to-consumer, consumer-to-consumer, and government-to-consumer activities. The business oriented activities comprise business-to-business, business to-government, and government-to-business activities. The technology

infrastructure relates to network infrastructure, network applications, decision technologies, and software tools and applications. Within this broad definition of e-business activities, we will restrict our attention mainly to consumer oriented and business-oriented activities, as well as decision technologies that are employed for supply chain management.

The Internet has influenced the usage of supply chain models in three ways. First, the Internet has facilitated increased use of enterprise resource planning (ERP) and advanced planning and optimization solutions (APS). Second, the ability to obtain real time information and the access to large computer systems is enabling firms to develop detailed (high granularity) supply chain models that can be utilized to make real-time decisions. Last, the Internet has created opportunities to integrate information and decision making across different functional units, thereby creating a need for supply chain models that go beyond a business unit to study the extended enterprise.

This has elevated the role of supply chain models from being decision making enablers for a single business unit to being enablers for driving corporate strategy. Thus, the Internet has greatly elevated the role of supply chain modelling and analysis within a firm. The advent of e-business has also created several challenges and opportunities in the supply chain environment. First and foremost, the Internet has increased the opportunity for consumers to buy products and services without going to a store. Though the practice of direct selling through catalogues and phone was in use earlier by a few firms, the Internet has made this form of sales more significant.

In a direct sales environment, the fulfilment process determines how long customers will wait between sale and delivery. This has made the back-end fulfilment process—which mostly depends on supply chain management—extremely important. Further, in the electronic environment, customer expectations in terms of quick and timely delivery have also increased. At the same time, the Internet has opened up opportunities for firms to share information and efficiently coordinate their activities with other entities in the supply chain.

This has created several new avenues in traditional supply chain areas. For example, in supplier selection and procurement, firms have to decide if they should join private or public exchanges or develop highly-integrated supply partnerships. They need to determine if they should use auction and bidding for contracts and, if so, which type would be most beneficial. In distribution, they need to decide if the firm will offer products through the Internet channel and, if so, how this method would differ from the traditional channel. This raises the question of how the synergies would be realized in terms of inventory, transportation, and distribution.

Similarly, the availability of real-time information has raised important questions such as the degree to which information sharing protocol should be standard or proprietary; the amount and type of information that should be shared with the rest of the supply chain partners; and the types of collaborative processes that may be beneficial. The degree of change in issues related to the supply chain spans a huge spectrum from concepts and issues that have been marginally affected to a whole set of new issues that have emerged as a result of e-business.

First, several issues related to supply chain management have not necessarily changed in principle, although e-business may have had an impact on some of their parameters. For example, to maintain given levels of service, a firm still needs buffer inventory or buffer capacity. This has not changed as a result of the Internet, although the uncertainty involved in the decision making may have decreased with the availability of more information. Similarly, firm still needs to take into account the interplay between fixed and variable costs, while making decisions related to procurement or setting up additional capacity. With the prevalence of the Internet, the firm might more easily be able to obtain a lower procurement price or salvage excess capacity through market mechanisms. Next are existing supply chain issues that have become important as a result of e-business.

For example, leveraging risk-pooling concepts can greatly benefit Internet channels because products may be stored at fewer locations as compared to a traditional distribution channel. Amazon.com can store all inventory for the entire U.S. market in five warehouses as opposed to several hundred retail outlets (hence, stocking points) that would be needed for similar coverage in the traditional channel. Similarly, mass customization has gained a lot of momentum with the Internet because firms can allow customers to interactively specify customizations of their offerings.

It has become more important for firms to understand how to cope with customization in an effective manner. Finally, in the last few years, a third category of issues new to supply chain management has emerged. One example is linking the dynamic pricing of products to the inventory and capacity decisions. Another is coordinating Internet and traditional distribution channels in terms of prices as well as information and product flows. Additionally, the advent of electronic marketplaces and auctions has opened a whole new set of issues related to procurement and supplier relationships.