CHAPTER II

REVIEW OF LITERATURE

Recently, the powerful forces of globalization of industries, the total quality management (TQM) movement, rapid advances in technology and a shift in the balance of power toward customers have fundamentally changed the rules for business success (Grue, 1977). Gruen (1977) suggests that, as result of these changes, there has been a shift in relationships from adversarial to cooperative and the key to obtaining a higher share of customers. He further suggests that the key to obtaining a higher share of each customer's lifetime business is the systematic development and management of cooperative and collaborative partnerships. The results of cooperative strategies are positive: A survey by Coopers and Lybrand found that involved in alliances increased their revenues faster by generating 23% more goods and services than those not involved in them (Gruner, 1996). Cooperative strategies have become increasingly popular since the mid-1990s (Hitt, Ireland, & Hoskisson, 1999). Porter (1985) argues that coordinating and jointly optimizing with channels (downstream) and suppliers (upstream) lowers cost and/or enhances differentiation. He refers to the capabilities of buyer-seller relationships as vertical linkages that reflect interdependencies between and firm's activities and the value chains suppliers and channels. In the same context, Stern and Reve (1980) suggest that cooperative behavior facilitates coordination and programming of activities within the channel that, in turn, provide potential cost advantages and improve competitive strength. Given this, there is positive relationship
between the level of cooperation within the channel and the joint profits obtained by it.

According to Porter (1985), there are two basic types of competitive advantages: cost leadership and differentiation. Cost leadership entails being able to perform value chain activities at a cost lower than competitor's while offering a parity product (Porter, 1985; Day & Wensley, 1988). Linkages, whether inside or outside a firm, create the opportunity to lower the total cost of the linked activities (Porter, 1985). Cost saving through cooperation is also possible, even in past moving technology based industries.

Generally speaking, technology is more expensive when acquired through a merger/acquisition; it must pay for the control. An alliance, on the other hand, allows a firm to avoid acquiring superfluous technology and assets (Hamel & Prahlad, 1994). Many times, the locus of innovation is other than the manufacturer (i.e. with suppliers and members of the supply chain) (Urban & Hauser, 1993). For example, DuPont invented Teflon cookware, which benefited cookware manufacturers as well as DuPont, and Alcoa pioneered the idea of aluminum truck trailers for heavy-duty hauling (Urban & Hauser, 1993). Thus, supplier linkages mean that the relationship with suppliers is not a zero sum game in which one gains only at the expense of the other, but in a relationship in which both gain (Porter, 1985). As such, uniqueness in meeting buyer needs may be the result of cooperation with suppliers. This is also the case in channel linkages with customers. For example, discussions with the butchers in grocery stores led Mrs. Budd's Foods to develop a fresh meat pie that would increase the margins for the fresh meat section of the store (Urban & Hauser, 1993).
A carefully selected and managed (single-source) supplier offers the greatest guarantee of consistently high quality, namely, commitment to the product because suppliers feel part of the family and permits manufacturers to subject them rigorous inspection, certification and education (Burt, 1989). Burt (1989) also argues that allowing suppliers to review the design of the entire subassembly before committing to it not only teases out new ideas but also helps the supplier understand what its customers really needs—or may need in future. Over the past years the structure of the market economy has fundamentally changed. As a result of the individualization of customer demand as well as receding market and technology cycles, businesses are increasingly concentrating on their core competencies. Customer satisfaction and service have become the highest priority. The realization of these objectives demands extensive cooperation with customers and suppliers. (Buxmann, Dirks and Heintz, 1998; Stich and Wrede, 1999) However, the new focus on the customer requires a rethinking of corporate processes (Baumgarten, 2000; Schonsleben, 1998). For this reason the companies have to reorganize their material and information flows oriented by an inter-corporate view of their processes along the supply chain.

**Demand and Supply**

Supply chain management has become an important managerial issue in recent years. Owing to the trends in international procurements, new information technologies, increasing pressure from customers on responsiveness and reliability, and the globalization of operations and markets, supply chain management has become a challenge and an opportunity. (Bowersox and Closs, 1996)
The flow of academic research in the area has increased to provide a better set of guidelines for effective implementation and execution of supply chain management. (Holmberg, 2000) Clearly the idea of supply chain management is to view the chain as a total system and to fine-tune the decisions about how to operate the various components (firms, functions, and activities) in ways which produce the most desirable overall system performance in the long run. Doing so is extremely difficult due to the number and complexity of the decisions to be made, as well as the inter- and intra-organizational issues that must be addressed. Among the priorities of companies is a surge of attention towards the pitfalls of supply chain management. Lee and Billington (1992) described fourteen pitfalls in supply chain management.

These are: inadequate definition of customer service, no supply chain metrics, inaccurate data on delivery status, inefficient information systems, ignoring the impact of uncertainties, simplistic inventory stocking policies, discrimination against internal customers, poor coordination, incomplete analysis of shipment methods, incorrect assessment of inventory costs, organizational barriers, product-process design without supply chain consideration, separation of supply chain design from operational decisions, and incomplete supply chain.

One of the factors fuelling this attention to the pitfalls of supply chain management is the realization that businesses allot more than half of their total spending for supply chain activities. Nicholas (1998) wrote: 'All organizations rely on suppliers for inputs, and an estimated 60-70 per cent of the
final cost of manufactured items is purchased materials, components, and services.' Traditionally, companies are focused on manipulating their own costs by constantly negotiating with the suppliers. Since all internal opportunities have been exhausted in order to be competitive in the business, companies now need to optimize the overall supply chain. (Lee and Whang, 1999) One key issue known to impact on the effectiveness of a supply chain is that of uncertainty. (Davis, 1993) The uncertainty can be of demand, lead time, or supplier delivery.

In supply chains the information transferred in the form of orders tends to be distorted and can misguide the upstream members in their production and inventory decisions. This distortion is amplified as we move upstream. This phenomenon is known as bullwhip effect and it leads to tremendous inefficiencies like excessive investment, poor customer service, lost revenues, misguided capacity plans, ineffective transportation, and missed production schedules. (Lee et al., 1997) The bullwhip phenomenon has been recognized in many diverse markets.

**Demand Signal Processing**

Updating of demand forecasts from downstream level to upstream level in a supply chain based on the signal of increase or decrease in demand is referred to as demand signal processing. The demand signal processing is one of the causes for whiplash or bullwhip phenomenon. The objective of this paper is to study the impact of demand signal processing on bullwhip effect and how information sharing can minimize the curse of this phenomenon. The existence of inefficient supply chains has been recognized for at least forty years. Forrester
(1961) illustrated the bullwhip effect in a series of case studies and pointed out that it was a consequence of industrial dynamics or time-varying behaviors of industrial organizations. Sterman (1989) reported evidence of the bullwhip effect in the 'beer distribution game', in an inventory management experimental context. He interpreted the phenomenon as a consequence of players' systematic irrational behavior or 'misperceptions of feedback'. Lee et al. (1997) identified four causes of bullwhip effect: demand signal processing, batching of orders, rationing or shortage gaming, and fluctuations in price. Chen et al. (2000a) quantified bullwhip effect for simple two-stage supply chains consisting of a single retailer and a manufacturer. Their model includes two of the factors commonly assumed to cause the bullwhip effect: demand forecasting and order lead times. The results are extended to multiple supply chains with or without centralized customer demand information and demonstrate that the bullwhip effect can be reduced, but not completely eliminated, by centralizing demand information. Chen et al. (2000b) demonstrated that the use of an exponential smoothing forecast by the retailer can cause bullwhip effect and contrasted these results with the increase in variability due to the use of a moving average forecast.

**Some managerial insights include:**

1. Bullwhip effect exists, in part, due to the retailer's need to estimate the mean and variance of demand.
2. The increase in variability is an increasing function of the lead time.
3. The more complicated the demand models and the forecasting techniques, the greater the increase.
4. Centralized demand information can reduce the bullwhip
effect, but will not eliminate it.

Forecast sharing is studied in a supply chain with a manufacturer that faces stochastic demand for a single product and a supplier for a critical component. (Cachon and Lariviere, 2001) Optimal supply chain performance requires the manufacturer to share the initial forecast truthfully; however, manufacturer may inflate the forecast to induce the supplier to build more capacity. The supplier is aware of this bias, and so may not trust the manufacturer's forecast, harming supply chain performance. The paper analyzed two compliance regimes, forced compliance and voluntary compliance, and studied contracts that allow the supply chain to share demand forecasts credibly under either compliance regime. Collaborative forecasting applies supply chain management concepts to the forecasting function and uses available information and technology to force a shift from independent, forecasted demand to dependent, known demand. (Helms et al., 2000) Chen (1999) studied decentralized supply chains subject to information delays. He investigated the impact of irrational behavior on supply chain performance.

A similar decentralized supply chain setting has been considered in this paper but along with an assumption of rational behavior among the members of the supply chain.

**There are seven emerging issues in Supply Chain Management viz.,**

1. Demand uncertainty
2. Quality of products and processes
3. Cost optimization
4. IT Connectivity
5. Collaborative research
6. Constraint management
7. People management
1. Demand Uncertainty

Customer requirements are diverse for different types of products and range enormously from one market sector to another. It is not possible to service everybody with everything via a single all-embracing supply chain strategy. Shewchuk, (1998), Fisher (1997) have highlighted the importance of supply chains to match customer requirements. He identified two fundamental types of supply chain strategy: responsive, which is akin to agility; and physically efficient, which is akin to being lean.

Fisher suggested a simple two-by-two matrix to match supply with demand. Demand uncertainty in the X axis, and as this increases, a more responsive or agile strategy is required to satisfy customer requirements, hence a match is illustrated in Chart 2.1 below.

This enables competitiveness where availability is the market winner. In circumstance of low demand uncertainty, a lean supply chain is the best match, driving competitiveness on the basis of cost.

It is inappropriate to use a lean strategy in circumstances of high demand uncertainty because variability in demand volumes and variant mix make level scheduling infeasible. Conversely, it is also inappropriate to use an agile strategy for products with relatively low demand uncertainty because the surplus flexibility would not be cost competitive. It is required to adopt a varying mix of both lean and agile principles to best match the degree of demand uncertainty.
2. Quality Management of Products and Services

The ever escalating consumer requirements have made the marketplace more competitive than ever before. And although many factors now go into the competitive mix, the ability to design, produce, move and sell high quality products and services to end customers will always remain a primary qualifier. This translates to total supply chain quality. Today's consumers demand products and services that are on time, of the right quality with the right features and at the lowest total cost. Producers are afforded minimal forgiveness when they fail to satisfy these demands. Alternatively, managing total supply chain quality is not only desirable; it is a strategic necessity (Trent, 2001)

Following the lead of General Electric, Motorola, and Allied Signals, Ford has applied Six Sigma to its supply chain processes to eliminate defects, optimize processes, and produce significant financial results across the organization. Its commitment is reinforced by the impetus on training all its employees in applying Six Sigma practices. Six Sigma projects
are led by 'Black Belts' who are chosen for the task because they are high-potential leaders within their task force. When these Black Belts are rotated back into mainstream assignments, they are well equipped to apply Six Sigma techniques in their everyday work. Black Belts are supported by 'Green Belts', salaried employees, who work part time on Six Sigma projects.

Ford currently has 20,000 employees trained as Green Belts and hopes to have nearly every employee trained as such by 2004. In the words of Al Ver, Ford's vice-president of advanced manufacturing and engineering, 'Six Sigma is not something else we do. It is the way we must execute supply chain processes to deliver quality for customer satisfaction.'

3. Cost Optimizations

All over the world, the industry's last concerted push was on quality. But quality now is just about a given — it is so much higher than it had been earlier. The battleground has switched to cost and throughout the supply chain, the mantra is more for less. (McGravey, 2002) To survive, businesses are constantly scrutinizing every budget item to lower costs, while they leverage information technology to find fleeting competitive advantage. Cost-cutting efforts previously focused on familiar items such as freight consolidation, distribution network design, and outsourcing, but new supply chain information systems allow companies to uncover new opportunities.

The trend has been defined by manufacturers who are moving production to low-cost locations such as China, India, Mexico, and Central America. This shift has meant re-engineering the entire supply chain to connect suppliers with the new production facilities, and to establish cross-border distribution
strategies for finished goods. The challenge is being met with collaborative supply chain systems, coupled with experienced logistics providers to consolidate supply chain operations and manage complex flows of materials and finished goods over great distances and across borders. To gain the cost and service benefits of consolidation, more and more companies are turning to large 3PLs that offer warehousing and transportation across the world, as well as sophisticated supply chain capabilities. Such 3PLs are the quickest path to reduced inventories and improved order fulfillment. Supplementing this initiative are visibility and event management tools. These tools become a safe net when companies are cutting inventories, because they expose the system by replacing inventory with information, thereby improving overall efficiency and lowering cost.

4. Connectivity IT

For the last couple of years, the information technology (IT) function in a company built systems internally or customized purchased applications. Things are changing now. Companies are teaming up with other companies to use others' applications to feed into their own applications. Supply chain managers are pushing the envelope on security, on network, and on the concept of what is central or sacred to an organization. They are looking at everything in terms of their definition of core competency. Conceptually they are working with a continuum that stretches from activities that must be handled by the company ('company-centric') to activities that could be outsourced ('partner-centric') based on risk factor, core competency, and interfaces (Figure 1.3). For this they are defining each activity or process as sacred or fluid - 'sacred' are business processes or system interfaces that are central to
an organization's identity and must be maintained in-house (for example, price information or financial valuation); 'fluid' is those processes and systems that are peripheral, and can be shared and maintained by business partners. The simple concept makes business scalable and flexible to respond to changing customer needs. It enables all supply chain partners to have more capacity and the capability to bring a complete solution to the end-customers. (Pazmany, 2000)

**Chart 2.2 Where should the Driving Line Exist?**

![Diagram showing Decreased Risk Factors from Company to Increase Risk Factors from Partner, with Core Competence Scale and Processes/System Interfaces interfaces]

**Source:** Composed by the Researcher

**5. Collaborative Relationship**

Traditionally collaborative relationship in supply chain is defined as 'maximum value, at a minimum cost, by having all pieces of the supply chain in harmony as if they were one, totally under your own control'.

However in this definition 'your own' means something different to each supply chain partner. These disconnections lead to internal squabbles, external blame, offloading of annoying responsibilities, increased costs, customer disappointment, and dropped responsibility. As part of its ongoing research, AMR Research talked to dozens of company
executives about collaboration. One truth remains evident: enterprises that have learned to collaborate internally are the most successful in creating collaborative relationships outside the enterprise.

Organizations such as these have common traits: they tend to be united by a singleness of purpose and are cocksure of their mission. Because of this, they are, in many cases, the most powerful in their supply chains. These include companies like Microsoft, Dell Computer, Intel, General Electric, Wal-Mart, and Unilever, to mention a few. Because they understand their true value proposition, they often become eager outsourcers of business processes and thus become expert in the art of managing the activities of external partners to meet their goals.

The recent CPFR (collaborative planning, forecasting, and replenishment) report by AMR Research identifies four levels of supply chain relationships - moving from transaction to information sharing to collaboration and finally to process optimization. Research confirms that the strategic value and the level of benefit received dictates the type of relationship formed and also the technology employed to support it. Cooperation, the keystone of supply chain relationship, can only be achieved after companies develop internal capabilities to handle their own transactions and to share information effectively. (Sabath, 2002). Effective collaboration does not need cutting-edge technology. In fact, technology is often the scapegoat for ineffective collaboration. How many times have we heard 'I'm sorry, but our computers are down' as the excuse for why the individuals cannot answer our questions about service? One supplier of critical
expendable materials to the steel industry is recognized for having one of the finest integrated operating system in its segment.

A senior executive, when complimented on the company's collaboration with its customers, answered with great surprise: 'We really don't have the ability to collaborate. We have very few important customers: A mere five of them make up 80 per cent of our demand. So rather than having fancy technology, we use the telephone and fax. Someone from our shop talks to them everyday. Our marketing folks can trust their forecasts.

Whenever there is an urgent change they can warn us. If we are ever short, we warn them as early as we can and they let us know exactly what their short-term urgent need is, so we can be responsive. They are a joy to work with, and many of our people would rather talk with them than with any of our other customers.' In fact, this example illustrates collaboration at its finest. Technology does not make collaboration. Processes do not guarantee it. Although both are important, it is ultimately the human interface and the trust that it can engender that builds a truly collaborative relationship. Looking beyond technology, the true winners in the supply chain collaboration game have been the companies that have capitalized on the synergies between collaborative relationships and customer differentiation. A research project, for a group of supply chain partners, by Deloitte & Touche professionals analysed individual operational relationships and incentives; then moved over to customer needs, sensitivities, and economics; and negotiated relationship rules and restrictions to the mutual benefit of all supply chain partners.
They attacked costs; metered their efforts to mobilize only those resources that were required to deal with each critical relationship; and let business drivers, especially economics, define the nature of collaborative relationships and the requirements for managing each one of them. As a result, they found that 80 per cent of the benefit — related to cutting cost and adding flexibility to the supply chain - came from 15 per cent of the effort. Thus, the best collaborators are able to focus their companies' resources to solve their partners' biggest problems to build relationships. Often access to those resources is enhanced through technology, which is only a facilitator. The first step on this journey — to achieve a true collaborative relationship - is to ready its internal operations to move confidently in the future.

6. Constraint Management
A common weakness of many supply chains is their failure to recognize and effectively manage the critical elements necessary to improve company-wide performance. Theory of Constraints (ToC) is a management philosophy that can provide the needed overall direction. In ToC, the key to improving performance is the constraint of the system. A constraint is defined as 'any element that limits the performance of the system, where performance is measured relative to the system's goal. (Goldratt and Cox, 1992) Drum-buffer-rope (DBR) is an application within the umbrella of TOC that specifically seeks to overcome the weakness of recognizing and effectively managing a constraint through the three separate mechanisms of the drum, the buffer, and the rope. (Srikanth et al., 1997)

Figure 1.3 shows the key elements in an illustration of a simple DBR system. The drum is the detailed master
production schedule that emerges when market demand is matched with the capabilities of the system's constraints. The buffer protects the constraint and the system from the disruptions inherent in all supply chain processes. Buffers may be either time buffers or stock buffers. In complex DBR systems, often both types of buffers are necessary to provide the needed protection. The rope is the mechanism for synchronizing all resources in the system to the pace of the drum. An important function of the rope is to generate the timely release of just the right materials into the system at just the right time to support the drum schedule.

Chart 2.3 Illustration of a Simple Drum-Buffer-Rope

7. People Management
Consider David Bradley, logistics director of Monsanto, Brussels, Belgium, who states: 'A logistics executive should have, in addition to logistics expertise, communication abilities and the ability to work with people. To look at a problem from a different point of view and come up with a simple solution requires creative skills.' As of now, much of the teaching in logistics and supply chain management focuses on the technical aspects of the role. This includes modeling, concepts on MRP, and inventory allocation and positioning formulas, in a very formalized and mathematical manner.
However, the textbook knowledge (the logistics expertise), as mentioned above, is just a qualifier, not a differentiator, and a wide range of other human resource capabilities is needed as well. Research has shown that the importance and criticality of the human aspects in supply chain are becoming increasingly apparent. A detailed survey by the Society of Human Resource Management (Fitz-Enz, 1997) further emphasized the need for emotional intelligence in achieving supply chain excellence. They analyzed a series of top companies, selected for profitability, cycle times, volumes and other key performance measures. It was found that the outstanding companies had, among others, the following competencies in managing their 'human assets': open communication and trust building with all internal and external stake-holders;
1. an interest in building relationships inside and outside the organization;
2. collaboration, support, and the sharing of resources;
3. passion for work; and
4. an environment where innovation, risk taking, and learning together are promoted.
5. The survey concluded that in order to develop these capabilities, supply chain managers may need to:
6. Show positive emotions, e.g. passion, enthusiasm, sincerity, humility, integrity, etc., and learn how to control disruptive emotions.
7. Be open and genuinely share information; adopt collaborative rather than competitive behaviors.
8. Be sensitive to others who are different from oneself; learn how to step into the world of others and see things from their point of view.
9. Learn how to build rapport, actively listen and to read all
the non-verbal cues.

10. Take an interest in non-work matters such as current affairs, the arts, the business in which they work, etc.
11. Develop the ability to challenge diplomatically.
12. Be curious, expand their horizons, extend their locus of influence.
13. Become a master at networking.
14. Practice the art of brainstorming to develop alternative and creative ideas and strategies.

The above capabilities help supply chain managers develop the ability to influence and the ability to arrive at collaborative win-win strategies. A legitimate question is: 'How does one operationalize this approach?' Managers will have to become more proactive, as they move away from reproducing existing practices, simply doing the job they are told to do and putting in the necessary working hours, blaming the boss if something goes wrong. They now have to commit to problems they are going to solve themselves and find out a way to do so, driven by results.

Leaders, then, are no longer in a position where they have to tell their people what to do and how to do it. They should rather identify challenges and assign people to them, then coach, support and leverage their capabilities ex ante, rather than control ex post, and evaluate weaknesses of employees. The job of organizing then becomes a job of supporting constant change for progress rather than developing rigid structures and putting people in boxes within the organization.

In supply chain management leaders should take that beyond company walls in, for example, helping suppliers support
better service to customers rather than do what they are told to do. Supporting both intellectual and emotional capability within the organization, along the above lines, will lead to increased identification with the organization and its challenges. (Hoek et al., 2002) Supply chain managers are a critical factor in achieving strategic and operational objectives and inducing change in the supply chain. This is not reflected well in today's supply chain managers and leaders. Companies often find it difficult to find and grow the proper workforce. Achieving strategic objectives and inducing changes have to do with people skills and the understanding of, and sensitivity to, the needs and concerns of the people impacted. The approaches mentioned above would lead to the required development of people in supply chain management.

The use of modern SCM systems compared to the gradual planning approaches of traditional ERP systems offers considerable advantages to all partners in the supply chain. A crucial condition for a successful implementation of SCM concepts is, in addition to organizational aspects, a suitable IT support, by means of which the problems of executive organization structures can be overcome. This paper presented a model that provides a framework for the deduction of planning activities on the one hand, and a systematic description of software system functionalities on the other. A survey conducted among providers of SCM systems in Germany indicates the state of the art as it relates to system performance.

At the same time, there are tremendous opportunities for creating better supply chains as a result of worldwide regulation, new management concepts and advances in
computers and communication technology. The researcher has found several gaps in the SCM processes and their impact on the financial performance of select originations in general and pharmaceutical industry in particular.

**Supply Chain Management**

The concept of supply chain management (SCM) encapsulates methods and procedures for the comprehensive configuration, planning and control of cross-business and company wide supply chains. (Thaler, 1999; Walther and Bund, 2001) The core philosophy of SCM is the integration of all value-added levels from the extraction of raw material to the sale of the finished product to the ultimate customer, whilst taking into account organizational, technological, and human factors (integrated supply chain). In this way the lack of transparency and in particular the complexity of supply chain processes can be reduced and flexibility enhanced.

The potential of integrated supply chains is considerable. For example, a global study conducted by the Supply Chain Council demonstrated the potential for cost reductions between 3 and 6 per cent of turnover (Supply Chain Council). The planning tasks can be divided into three different levels which encapsulate the following areas of responsibility within integrated supply chains: 'supply chain configuration', 'supply chain planning' and 'supply chain execution' (Figure 2.1).
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These levels temporally and logically follow from each other and differ with respect to the planning horizon and planning.
The underlying basis of cooperation is a suitable organizational, technological, and relationship management. In this context, organizational management comprises the implementation of business processes. Technological management focuses, in particular, on the structure of suitable IT support for company-wide and cross-business production, planning, and control. Finally, relationship management entails the building and strengthening of trust between participating companies. (Walther and Bund, 2001).

In particular, within the organizational management of integrated supply chains, considerable demands are placed on the planning and control procedures of interconnected businesses.

**Supply Chain Configuration**

The task at this level is the optimal configuration of the production and logistic network in order to implement a long-term business strategy. This requires the analysis and modeling of customer’s supply channels, from raw material suppliers to end-user markets. (Hartweg and Luczak, 2001) This is usually done on the basis of annual production and sales figures, as well as existing stock. Besides these statistical data, the model must take into account capacity and time-related information, e.g. the production and storage capacity of individual sites or the lead time of the various production levels and logistics processes. The object of this modeling task is to provide a realistic picture of the actual supply chain structure and its restrictions.
In addition to quantity and capacity-related information, cost data from the various divisions of the supply chain must be incorporated as well, e.g. production, storage, and transportation costs for individual products. The inclusion of cost data facilitates numerical comparisons between alternative configurations, which are partly IT supported by SCM systems. This comparative analysis is a first step towards a simulative approach to optimize the logistical structure.

Supply Chain Planning
The level of supply chain planning includes the coordinated mid- to long-term planning functions to establish a synchronized master production planning across the supply chain while taking into account capacity and time-related factors. Besides the structure of the supply chain, forecasted and actual customer needs are entered as information into the planning of the supply chain.

The possibility of incorporating information relating to factors internal to the supply chain as well as actual capacity utilization facilitates a simulated check on availability when customers make inquiries (ATP - Available to Promise). (Luczak, Eversheim, and Stich, 1999)

Supply Chain Execution
The production plans generated at the planning level have to be executed by the partners. The implementation of these plans forms the interface between the planning conceptions of SCM and the execution carried out by Material Resource Planning (MRP) or Enterprise Resource Planning (ERP) systems (Luczak and Eversheim, 1999). In the implementation of SCM, existing organizational structures can be utilized for production
planning and control. However, these have to be expanded to consider also the interdependencies to external partners.

The fast transmission of information about the current product status within the production process across the value-added levels in the supply chain from the raw material up to the end-user's sale facilitates a more rapid response to unscheduled events (e.g. faults or specialized orders at short notice). Especially on behalf of the IT support, this demands extensive communication with all external partners (Luczak, Eversheim and Stich, 1999).

Information Technology & System Support

In order to plan and control all processes along the supply chain, a transparent flow of information and an integration of different information systems are becoming more and more essential. In this connection information technology is the enabler and the key for an effective implementation of SCM. In recent years SCM systems have developed as a new form of information system for the integrated, cross-organizational planning of supply chains. Building on the model of planning tasks, a consideration of the various functions facilitates a detailed description of SCM Systems. This forms a key prerequisite for the systematic selection of a suitable system. For corporate users it is then possible to both create a catalogue of requirements and to subsequently select a suitable SCM System according to a standardized format.

A preliminary study indicates that SCM systems can be classified according to the supply chain levels (Chart 2.4) to the following categories (Luczak, Eversheim and Stich, 1999):

• Strategic planning systems,
• Optimization tools, and
• Extended ERP systems.

Strategic planning systems focus on the configuration of the supply chain. They support the long-term planning of the production and logistic network configuration. In this context SCM Systems support the efficient structuring of the supply chain.

Essential components are: planning of system configurations, selection of production sites or warehouses through simulation, distribution of production quantities, and representation of transport relations, make-or-buy decisions, as well as the determination of production, transport, and storage capacities (Figure 2.3). Based on 'what-if-analyses', the planner can determine the effects of different network configurations on performance figures such as lead time or service level.

The second category, the optimization tools, offer support for the planning of individual SCM tasks, e.g. production scheduling, demand forecasting, or distribution planning, often as an extension to existing ERP systems (Chart 2.4). This system category is also known as Advanced Planning and Scheduling (APS) systems. In contrast to standard ERP systems that use MRP-based planning approaches, APS systems employ simultaneous, constraint-based planning methods. Thus, it is possible to accomplish a realistic and up-to-date representation of the planning situation within a company.

Moreover, a company is given the capability to make realistic promises to its customers regarding delivery dates, which take
all planning restrictions into account (Available-to-Promise/Capable-to-Promise). Usually, the use of these optimization tools requires additional transaction systems such as ERP systems. The last categories, Extended ERP systems, comprise both execution and planning capabilities. They provide an expansion of conventional ERP systems to include individual functions which support SCM tasks. Execution functionalities serve the purpose of inter-corporate management and control, and offer decision support for operational tasks. This ensures the flexibility of the supply chain. These tasks establish the link to transaction-focused ERP systems and are therefore not directly SCM tasks (Figure 2.4).

Typical planning features of extended ERP systems consist, for example, of collaborative planning and forecasting or production scheduling. An analysis of functions in current SCM systems conducted at FIR is depicted in Figure 2.6. The survey covers functions on the supply chain configuration as well as on the supply chain planning level. Since the execution level is usually covered by transaction systems such as ERP systems, these are not considered in the survey.
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