

Information Technology and the Supply Chain Management

Information is crucial to the performance of a supply chain because it provides the basis upon which supply chain managers make decisions. Information technology (IT) consists of the tools used to gain awareness of information, analyze this information, and act on it to improve the performance of the supply chain. In this chapter we explore the importance of information, its uses, and the technologies that enable supply chain managers to use information to make better decisions.

Role of IT in SCM

All supply chain drivers discussed up until this point have dealt directly with some physical aspect of the supply chain. Unit 2 discussed how to manage inventories, we have already discussed transporting the product through the supply chain network and issues regarding facility location and capacity that managers face when designing a supply chain network. This chapter, instead, focuses on information about both the product and the supply chain that produces the product. Information is the supply chain driver that serves as the glue allowing the other three drivers to work together to create 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 will not know what customers want, how much inventory is in stock, and when more products should be produced and shipped. In short, without information a manager can only make decisions blindly. Therefore, information makes the supply chain visible to a manager. With this visibility, a manager can make decisions to improve the supply chain's performance. In many ways, information is the most important of the four supply chain drivers because without it, none of the other drivers can be used to deliver a high level of performance.

Given the role of information in a supply chain's success, managers must understand how information is gathered and analyzed. This is where IT comes into play. IT consists of the hardware and software throughout a supply chain that gather, analyze, and act on information. IT serves as the eyes and ears (and sometimes a

portion of the brain) of management in a supply chain, capturing and analyzing the information necessary to make a good decision. For instance, an IT system at a PC manufacturer may tell a manager how many Pentium chips are currently in stock. IT is also used to analyze the information and recommend an action. In this role, an IT system at a PC manufacturer could take the number of chips in inventory, look at demand forecasts, and determine whether to order more chips from Intel.

Using IT systems to capture and analyze information can have a significant impact on a firm's performance. For example, a major manufacturer of computer workstations and servers found that much of the information on customer demand was not being used to set production schedules and inventory levels. The manufacturing group lacked this demand information, which forced them to make inventory and production decisions blindly. By installing a supply chain software system, the company was able to gather and analyze 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 information rather than educated guesses. Large impacts like this underscore the importance of IT as a driver of supply chain performance.

How does a manager take this broad scope? The supply chain scope is made up entirely of information and the breadth of this information determines whether the scope is global or local. To obtain a global scope of the supply chain, a manager needs accurate and timely information on all company functions and organizations in the supply chain. For example, it is not enough for the workstation manufacturer mentioned earlier to know how much inventory is on hand within the company when trying to determine production schedules. The company also needs to know the downstream demand and even the upstream supplier lead times and variability. With this broader scope, the company is able to set production schedules and inventory levels that maximize profitability.

Information must have the following characteristics to be useful when making supply chain decisions:

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

at least directionally correct.

2. *Information must be accessible in a timely manner.* Often accurate information exists, but by the time it is available, it is either out of date or if it is current, 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 will have large amounts of data that is not helpful with decision making. Companies must think about what information should be recorded so that valuable resources are not wasted collecting meaningless data while important data goes unrecorded.

When managers have good information, they have supply chain visibility, enabling them to take a global scope. With this global scope, they are able to make the best decisions for the supply chain. Therefore, information is a key to supply chain success.

Information is a key ingredient not just at each stage of the supply chain, but also within each phase of supply chain decision making—from the strategic phase to the planning phase to the operational phase. For instance, information and its analysis plays a significant role during the formulation of supply chain strategy by providing the basis for decisions such as the location of the push/pull boundary of the supply chain. Information also plays a key role at the other end of the spectrum in operational decisions such as what products will be produced during today's production run. Managers need to be able to understand how to analyze information to make good decisions. Much of this book deals with just that idea—how to identify a supply chain problem that needs to be solved, obtain information, analyze it, and then make a good decision to act on that information.

For example, Wal-Mart has been a pioneer not only in capturing information, but also in understanding how to analyze that information to make good supply chain decisions. Wal-Mart collects data in real time on what products are being purchased at each of their stores and sends this data back to the manufacturers. Wal-Mart analyzes this demand information to determine how much inventory to hold at each store and to decide when to ship new loads of product from the manufacturer. The manufacturer uses this information to set its production schedules so that it produces products in time to meet Wal-Mart's demand.

Both Wal-Mart and its key suppliers do not just capture the information they have; they analyze it and base their actions on this analysis.

Information is used when making a wide variety of decisions about inventories, transportation, and facilities within a supply chain, as discussed here.

1. *Inventory*: Setting optimal inventory policies requires information that includes demand patterns, cost of carrying inventory, costs of stocking out, and costs of ordering. For example, Wal-Mart collects detailed demand, cost, margin, and supplier information to make these inventory policy decisions.

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

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

In summary, 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 (inventory, transportation, and facilities). IT enables not only the gathering of this data to create supply chain visibility, but also the analysis of this data so that the supply chain decisions made will maximize profitability.

The Supply Chain Framework

Given the wide realm of information discussed earlier, it is important to develop a framework that helps a manager understand how this information is utilized by the various segments of IT within the supply chain. Our vision of this framework is presented in the next several sections of this chapter. It is valuable to note that the driver of IT in the supply chain has increasingly been the enterprise software developed to enable processes both

within and across companies. Enterprise software collects transaction data, analyzes this data to make decisions, and executes on these decisions both within an enterprise and across its supply chain. Certainly other parts of IT beyond enterprise software such as hardware, implementation services, and support are all crucial to making IT effective. Within a supply chain, however, the different capabilities provided by IT have as their most basic building block the capabilities of the supply chain's enterprise software, in many ways, software shapes the entire industry of IT as the other components follow the software lead. It is for this reason that we use enterprise software and its evolution as the primary guide in analyzing IT and its impact on the supply chain. The evolution of enterprise software provides insights not only into the future of IT, but also into what the key supply chain processes are. We now discuss this evolution and its impact on companies' supply chain processes.

The enterprise software landscape became increasingly overpopulated during the late 1990s. The unprecedented flow of venture capital into new software companies led not just to an increase in the number of software companies, but also to the proliferation of entire categories of software. The growth of the number of software companies, the emergence of new categories, and the expansion of software product lines combined to create an enterprise software landscape that was not only much more crowded than in the past, but also much more dynamic. It was an environment ripe for significant evolutionary change to take place.

The downturn in technology spending since the second half of 2000 has brought about this evolutionary pressure, thereby causing many software companies to cease operations or merge with existing software firms. Some entire software categories are well on their way to extinction, with many of the recently created categories landing on this endangered species list.

What drives this evolution of the enterprise software landscape? Why are some categories of software companies headed for a profitable long-term future, whereas others have tailed? Certainly there are a wide variety of factors affecting the natural selection of software companies. We propose, however, that three of the main drivers of the evolution taking place in enterprise software are the three major groups of supply chain processes, which we call supply chain *macro processes*. The successful categories of software will be

those focused on the macro processes. The failures, on the other hand, will not have such a focus.

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, and processes focused upstream. We use this classification to define the three macro supply chain processes (see Chapter 1) 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.

We must also note that there is a fourth important software building block that provides the foundation upon which the macro processes rest. We call this category the transaction management foundation (TMF), which includes basic 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 each other. The relationship between the three macro processes and the transaction management foundation can be seen in Figure 17.1.

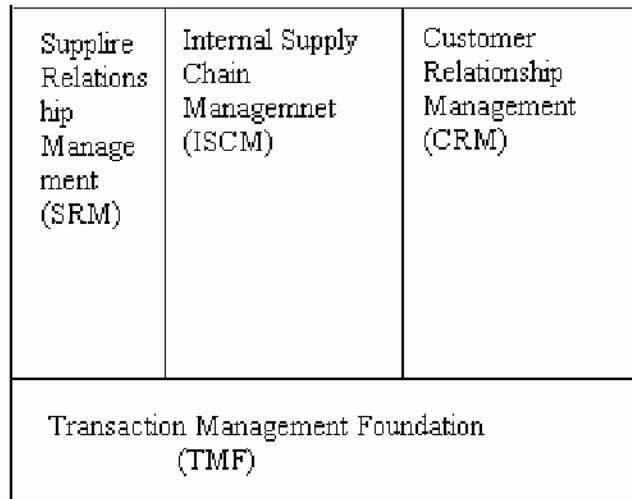


Fig. 17.1

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. After decades of focusing on internal processes, a firm must expand the scope beyond internal processes and look at the entire supply chain to achieve breakthrough performance. As we have discussed, the goal should be to increase the total profitability of the supply chain (also referred to as the supply chain surplus). Good supply chain management is not a zero sum game where one stage of the supply chain increases profits at the expense of another. As discussed in Chapter 2, good supply chain management is instead a positive sum game where supply chain partners can increase their overall level of profitability by working together. Therefore, to increase the supply chain surplus (and therefore their firm's own profitability) most effectively, firms must expand their scope beyond their enterprise and think in terms of all three macro processes.

Macro Processes Applied to the Evolution of Software

As the downturn in technology spending has applied evolutionary pressure on the enterprise software landscape, we see a distinct pattern emerging. The majority of survivors have chosen to focus their products on improving their customers' macro processes. Some software firms cross over into more than one macro process, whereas others only

address a small portion of a macro process. But the common theme we see is that to survive, and particularly to thrive, enterprise software firms must focus on one or more of these macro processes. Almost all areas of enterprise software growth exist within CRM, ISCM, or SRM. Both new companies and large firms within enterprise software are now targeting these three macro processes much more sharply. In the future, we see the ability to improve the three macro processes driving the winners and losers in enterprise software.

Examples of failures that did not focus on these macro processes are B2B marketplaces and the software companies providing marketplace software that proliferated during 1999 and 2000. Marketplaces focused more on creating whole new information intermediaries within the supply chain rather than on improving the performance of the macro processes within supply chains. This lack of focus on the macro processes was a key contributor to the downfall of marketplaces.

The software firms behind the marketplaces have also had a difficult time, with the major players Ariba and Commerce One losing well over 95 percent of their peak market capitalization. To survive, these companies have evolved away from being marketplace providers and toward being software firms focused on a macro process. Both Ariba and Commerce One now focus almost exclusively on the SRM macro process. Surviving marketplaces have also started focusing on improving the performance of a macro process within the supply chain, rather than trying to be independent intermediaries as marketplace operators.

A third example of a software category that is being transformed by a focus on macro processes is the ERP category. ERP software has been successful in improving data integrity within the supply chain, but by itself, data integrity provides little value. The real improvement from more accurate data results only when the data can be used to improve decision making. This is where the three macro processes enter the picture. The real value from having ERP systems in place can only be obtained if these systems can be used to improve decision making in the three macro processes. Every major ERP player has realized this and is remaking themselves into a company emphasizing products focused on the macro processes.

The drivers of the software landscape are not just important to software providers. Companies that are users of software must understand these macro processes as well. By

understanding whether or not software companies are addressing the macro processes and actually enabling improvements in performance in these areas, a company can better gauge whether or not a particular type of software is valuable for them.

The Software Winners within a Macro Process

Among software firms focused on a macro process, the following three factors determine their success:

1. Functional performance
2. Integration with other macro processes
3. Strength of the software firm's ecosystem

Functional performance is important to customers because it provides them with capabilities to create a competitive advantage. In addition to raw functional performance (qualities such as the ability to optimize both price and supply in an integrated fashion), we believe that the ease of use is crucial to success in this category. Some software has very advanced functionality but is very difficult to use. As a result, the advanced functionality is rarely utilized. Software firms with lower levels of functionality but with high ease of use can, in essence, provide more "usable" functionality to their customers and therefore gain an edge.

The ability to integrate is important to a customer for a variety of reasons. Applications that are easy to integrate are generally easier to get implemented and producing value. Integration is also crucial across different macro processes. Applications that integrate across macro processes will be able to provide the benefits of making decisions for the extended supply chain. This gives an edge to firms that offer a full line of integrated solutions in all three macro processes.

Finally, a firm's ecosystem—the network of software partners and, more importantly, systems integrators and installed base—provides assistance in selling and implementing software. Firms that work well with implementation partners and build up large groups of customers trained on their solutions have built a highly defensible position. For another firm to capture this business requires that they be so far superior that it is worth the retraining and reintegration effort, which is often quite

significant. For a customer, a strong ecosystem means a strong network to provide support both during implementation and down the road.

As we stressed earlier, these criteria are also important for customers of supply chain software. These criteria are the key to success for software companies precisely because they improve supply chain performance for firms. Thus, companies should evaluate software providers along these lines to determine their choice of software vendor.

We now discuss each of the macro processes, what segments they consist of, who the players are, and what the future will look like.

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 customer to target, how to target customers, what products to offer, how to price products, and how to manage the actual campaign targeting customers. Successful software vendors 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 (compared to marketing where processes are more focused on planning who to sell to and what to sell). The sell process includes providing the sales force the information they need to make a sale and then executing the actual sale. Executing the sale may require the sales person (or the customer) 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. Successful software

providers have targeted 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 fulfillment. This process ties together demand from the customer with supply from the enterprise. Order management software has traditionally been handled by legacy systems or been a part of an ERP system. Recently, new order management systems have emerged with additional functionality that enables visibility of orders across the often numerous order management systems that exist within a company.
- **Call/Service center:** A call/service center is often the primary point of contact between a company and its customers. A call/service center helps customers place orders, suggests products, solves problems, and provides information on order status. Successful software providers have helped improve call/service center operations by facilitating and reducing work done by customer service representatives, often by allowing customers to do the work themselves.

The aforementioned CRM processes are crucial to the supply chain as they cover a vast amount of interaction between an enterprise and its customers. The customer must be the starting point when trying to increase the supply chain surplus because all demand, and therefore revenue, ultimately arises from them. Thus, the CRM macro process is the starting point when improving supply chain performance. It is also important to note that CRM processes (and also CRM software) must be integrated with internal operations to optimize performance. Too often companies operate with their customer-focused units working independently from their internal operations. The need for integration between CRM and internal operations emphasizes the importance of CRM to an effective supply chain.

CRM software has been the fastest growing, and is now the largest, category of the three macro processes. Software providers in the CRM space have focused on improving CRM processes themselves, but have more work to do to improve integration between CRM and internal operational processes. Future success will be partially driven by the ability to integrate CRM applications into internal operations.

The CRM software landscape consists of three categories of companies: the best-of-breed winner, the best-of-breed startups, and the ERP players. CRM is currently dominated by Siebel Systems, the sole company in the best-of-breed winner category. However, Siebel does face serious competition from both best-of-breed startups who emphasize functional expertise as well as from the ERP players, such as SAP, Oracle, and Peoplesoft, who provide a powerful integration story and strong ecosystems.

Looking forward, Siebel, the best-of-breed winner, provides a combination of superior functionality and a strong ecosystem within CRM. It does lack, however, the ability to integrate across all three macro processes. The ERP players lag somewhat on functionality but can successfully compete with their strengths in integration and ecosystems. Small best-of-breed players will face a very difficult future within CRM given the strength of the best-of-breed winner and the focus ERP players are putting on CRM. Their only chance is to focus on an area of functionality currently lacking in the other players and gain a large lead there—a difficult, though not impossible, task.

International Supply Chain Management

ISCM, as we discussed earlier, 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*: The goal of this process is to plan resource availability in the supply chain network. The decisions made include where to locate plants and warehouses, what type of facilities to build, and what markets to serve from each facility. Although a few people make these decisions infrequently, the impact on supply chain performance can be quite large and is felt potentially for years. Successful software providers with this functionality are including the capability of analyzing strategic plans under uncertain future environments.
- *Demand planning*: This set of processes involves forecasting future customer demand. In addition to forecasts, demand planning also includes decisions to manage demand, such as promotions planning. Successful soft

ware providers in this area allow the firm to come up with a demand plan accounting for marketing and promotional efforts.

- *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.
- *Fulfillment*: Once a plan is in place to supply the demand, it must be executed. The fulfillment process links each order to a specific supply source and means of transportation. The software applications that typically fall into the fulfillment 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.

Given that the ISCM macro process aims to fulfill 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 behavior. Similarly, the ISCM processes should have strong integration with the SRM macro process. Supply planning, fulfillment, 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 in CRM, must integrate closely with fulfillment and be an input for effective demand planning. Again, good 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 primarily in improving integration with CRM and SRM.

Like CRM, today's ISCM landscape consists of three categories—the best-of-breed winners, the best-of-breed startups, and the ERP players. Unlike CRM, however, there is not a clear leader. There are two best-of-breed winners, i2 Technologies and Manugistics, which were ISCM pioneers and are currently the functional leaders. Startups with superior functionality and ERP players are making inroads into their leadership, however. In fact, one ERP player, SAP, has claimed to have taken the top spot in ISCM revenue away from i2.

The best-of-breed ISCM players have the leading functionality, but lack strong integration and ecosystems. These companies have been working to offer more products in the SRM and CRM space to improve their integrated offering. The ERP players' advantages are their integrated product and their ecosystems, although some ERP players' functionality is becoming more and more competitive. Relative to the CRM space where Seibel has a large lead over the ERP providers in terms of functionality, the functionality gap in the ISCM space between the best-of-breed players and some of the ERP providers (in particular, SAP) is smaller and shrinking. As a result, an ERP provider such as SAP has the potential to dominate the ISCM space. To stay competitive, best-of-breed leaders will have to relentlessly improve functionality while providing acceptable integration and ecosystems. There are some smaller players in ISCM taking advantage of new functionality that will remain viable, especially those targeting customers in specific industries that are very dependent on advanced functionality.

Supplier Relation Management

SRM includes those processes focused on the interaction between the enterprise and suppliers that are upstream in the supply chain. There is a very 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 follows;

- *Design collaboration*: The goal of this process is to improve the design of products through such ideas as 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 concurrently designing components for the manufacturer's product. Good collaboration at this stage can create huge value because about 80 percent of product cost is determined at the design stage. Successful software in this area facilitates such collaboration.

- *Source*: The source process qualifies suppliers and helps in supplier selection, contract management, and supplier evaluation. A key goal 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 price reductions for reaching certain volume targets). Successful software in this area helps analyze 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 needs. Successful software automates the RFQ process and the execution of auctions.

- *Buy*: The buy process 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 would require inputs from processes within CRM. Sourcing, negotiating, buying, and collaborating primarily tie into ISCM as the supplier inputs are needed to produce and execute an optimal plan. But even these segments have the 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 has four groupings of competitors. There are two best-of-breed groups that focus exclusively on SRM, one focused on design collaboration and another focused on procurement. Leading design collaboration firms include Agile and MatrixOne while leading procurement firms are Ariba and CommerceOne. The third type of player in SRM is the best-of-breed ISCM vendor that has made the natural extension of ISCM into SRM—companies such as i2 and Manugistics. Finally, the fourth category consists of the ERP players moving up into the macro processes again. SAP is the largest SRM player among the ERP vendors and has shown the most commitment to entering this space.

Given the youth of the SRM space, the solely SRM focused players have not had a chance to develop large functional leads and their ecosystems are virtually nonexistent.

SRM	ISCM	CRM
Design Collaboration	Strategic Planning	Market
Customer Sourcing	Demand Planning	Sell
Negotiate	Supply Planning	Call Center

Buy	Fulfillment	Order Management
Supply Collaboration	Field Service	
TMF		

Fig.17.2

SRM has already attracted all the big players from both ISCM and ERP. Therefore, the solely SRM focused players mentioned earlier will have to battle the much larger ISCM and ERP players who have superior integration capability and far superior ecosystems. Without a tremendous functional advantage, it will be difficult for SRM best-of-breed players to survive on their own. Therefore, the future SRM landscape is likely to be dominated by one or two ISCM players and one or two **ERP** players. All three macro processes and their processes can be seen in Figure 17.2.

THE TRANSACTION MANAGEMENT FOUNDATION

The transaction management foundation is the historical home for the largest enterprise software players. In the early 1990s, when much of the thinking in supply chain management was just getting off the ground and ERP systems were rapidly gaining popularity, there was little focus on the three macro processes we discussed earlier. In fact, there was little emphasis on software applications focused on improving decisions. Instead, the focus at that time was on building transaction management and process automation systems that proved to be the foundation for future decision support applications. These systems excelled at the automation of simple transactions and processes as well as the creation of an integrated way to store and view data across the division (and sometimes the enterprise).

The huge demand for these systems during the 1990s drove the ERP players to become the largest enterprise software companies. SAP has continued as the market leader but other powerful ERP players included Oracle, Peoplesoft, JD Edwards,

and Baan. Eventually, however, ERP sales slowed and one of the big five, Baan, even ceased to exist independently.

The real value of the transaction management foundation can only be extracted if decision making within the supply chain is improved. Thus, most recent growth in enterprise software has come from companies focused on improving decision making in the three macro processes. This has set the stage for what we are seeing today and will continue to see in the future—the realignment of the ERP companies into CRM, ISCM, and SRM companies. We expect this shift will continue in the next few years with the majority of the ERP players' revenue coming from applications in the three macro processes. A major advantage that ERP players have relative to best-of-breed providers is the inherent ability to integrate across the three macro process, often through the transaction management foundation. In our opinion, ERP players that focus on integrating across the macro processes along with developing good functionality in one or more macro process will occupy a position of strength.

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 enterprise software. To this end, we expect to see software focused on the macro processes become a larger share of the total enterprise software landscape and software firms that focus on the macro processes to be much more successful than those that focus elsewhere. For firms targeting a macro process, we see functionality, the ability to integrate across macro processes, and the strength of their ecosystems as the keys to success.

This conclusion has important implications for companies that are users of software. As we mentioned earlier, the criteria for successful software companies were chosen precisely because they are the characteristics of software that improve performance of its users. Thus, a user of supply chain software should first identify areas within the three macro processes where improvement will provide the maximum leverage. Software and IT decisions should then support the goal of improving performance along these processes.

There is one final note worth mentioning with regard to the future of new software players in this area. One might conclude from our analysis that it will be very difficult for a new

company to break into the ranks of successful enterprise software companies given the lead in functionality, integration, and ecosystems that existing firms already have. We believe, however, that there are two potential paths for a company to enter the market. The first is through superior functionality, whether it be specific functionality needed by a particular industry or an application that improves the ease of use of existing functionality, allowing users to take full advantage of the functionality. In this area we see startups adding a significant amount of value to enterprise software.

The other path consists of providing an integrated product that increases the linkage between the macro processes. Certainly, it will be difficult for a startup to garner the resources to build an integrated product across CRM, ISCM, and SRM. However, a large software company with tremendous resources and a history of pulling disparate products into an integrated package could take this path. The one company that comes to mind here is Microsoft. Microsoft has certainly noticed the growth and size of the enterprise software market and has begun to make a significant effort to enter this space. They have made two acquisitions over \$1B and are showing more signs that this will be a focus of theirs in the future. Even with these acquisitions, Microsoft is not yet a significant player in supply chain software and has targeted only small companies as their customers, leaving the large customers and the large revenues to the existing players. Given Microsoft's tried-and-true strategy of going in on the low end and expanding upward, however, they are certainly a company to watch for on the enterprise software landscape.

SUPPLY CHAIN IT IN PRACTICE

Although there are different sets of practical suggestions for each supply chain macro process, there are several general ideas that managers need to keep in mind when making a decision regarding supply chain IT.

1. *Select an IT system that addresses the company's key success factors.* Every industry and even companies within an industry can have very different key success factors. By key success factors, we mean the two or three elements that really determine whether or not a company is going to be successful. It is important to select supply chain IT systems that are able to give a company an advantage in the areas most crucial to the success of the business. For instance, the ability to optimally set inventory levels is crucial in the PC business where

product life cycles are short and inventory becomes obsolete very quickly. However, inventory levels are not nearly as crucial for an oil company where demand is fairly stable and the product has a very long life cycle. For the oil company, the key to success would depend more on utilization of the refinery. Given these success factors, a PC company might pick a package that is strong in setting inventory levels even if it is weak in maximizing utilization of production capacity. However, the oil company should choose a different product, one that excels at maximizing utilization even if its inventory components are not especially strong.

2. Take incremental steps and measure value. Some of the worst IT disasters are due to the fact that companies try to implement IT systems in a wide variety of processes at the same time and end up with their projects being failures (often called the big bang approach). The impact of these failures is amplified by the fact that many of a company's processes are tied up in the same debugging cycle all at once, causing productivity to come to a standstill. One way to help ensure success of IT projects is to design them so that they have incremental steps. For instance, instead of installing a complete supply chain system across your company all at once, start first by getting your demand planning up and running and then move on to supply planning. Along the way, make sure each step is adding value through improvement in the performance of the three macro processes. This incremental approach does not mean that one should not take a big picture perspective (in fact, one *must* take a big picture perspective) but rather that the big picture perspective should be implemented in digestible pieces.

3. Align the level of sophistication with the need for sophistication. Management must consider the depth to which an IT system deals with the firm's key success factors. There is a trade-off between the ease of implementing a system and the system's level of complexity. Therefore, it is important to consider just how much sophistication a company needs to achieve its goals and then ensure that the system chosen matches that level. This is important because erring on the less sophisticated side leaves the firm with a competitive weakness, whereas trying to be too sophisticated leads to a higher possibility of the entire system failing.

4. Use IT systems to support decision making, not to make decisions. Although the soft

ware available today can make many supply chain decisions for management, this does not mean that IT applications should make all of the decisions. A mistake companies can make is installing a supply chain system and then reducing the amount of managerial effort they spend on supply chain issues. Management must keep its focus on the supply chain because as the competitive and customer landscape changes, there needs to be a corresponding change in the supply chain.

5. *Think about the future.* Although it is more difficult to make a decision about an IT system with the future in mind than the present, it is very important that managers include the future state of the business in the decision process. If there are trends in a company's industry indicating that insignificant characteristics will become crucial in the future, managers need to make sure their IT choices take these trends into account. As IT systems often last for many more years than was originally planned, managers need to spend time exploring how flexible the systems will be if, or rather when, changes are required in the future. This exploration can go so far as to include the viability of the supply chain software developer itself. If it is unclear whether a company will be able to get support from a software company in the future, management needs to be sure that the other advantages of this product outweigh this disadvantage. The key here is to ensure that the software not only fits a company's current needs but also, and even more important, that it will meet the company's future needs.