BUSINESS PERFORMANCE MANAGEMENT

TITLE

Tools and Techniques for Implementing Integrated Supply Chain Management

CREDITS

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BUSINESS PERFORMANCE MANAGEMENT

Tools and Techniques for Implementing Integrated Supply Chain Management

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BUSINESS PERFORMANCE MANAGEMENT

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I. RATIONALE

Today, the assumption that the supply channel is an unbendable business constraint is being challenged. Company after company is turning to integrated supply chain management (ISCM) in order to bridge the gap between trading partners. For example, Procter & Gamble, DuPont, 3M, Xerox, Coors, Cummins Engine, Land O'Lakes, Alpo Pet Foods, and Thom McAn—to cite only a few of a diversified lot—have adopted ISCM. Focused on improving the flow of materials through the entire supply chain, ISCM techniques are being used to create networks, or trading alliances, that allow the participating firms to compete externally as though they were one entity.

ISCM creates a new business design, one that cuts across organizational boundaries and establishes direct communication, information, and structural links across firms. ISCM supports cross-organizational innovation by removing the waste caused by miscommunication, fragmentation, and interorganizational tension, as well as by leveraging the competencies of multiple organizations into a new competitive weapon.

Gaining these advantages begins with designing, then implementing, ISCM through a variety of powerful tools and techniques. Focused on the unique challenge of cross-organizational change, ISCM tools and techniques emphasize the creation of mutually beneficial procedures and processes, knitting participating organizations together with a common vision and strategy—to deliver superior service and value to the supply chain's customers.

II. SCOPE

This Statement on Management Accounting (SMA) is addressed to financial professionals and others who may lead or participate in efforts to implement integrated supply chain management in their organizations. It supplements the Institute of Management Accountants' SMA publication, *Implementing Integrated Supply Chain Management for Competitive Advantage*, which describes the ISCM implementation process.

The focus of this publication is on *core* tools and techniques that improve the effectiveness of implementing supply chain management. Core tools are emphasized because it is beyond the scope of this guideline to discuss all of the many tools and techniques that can be used to support the implementation of ISCM.

This SMA assumes the reader is already familiar with basic supply chain concepts. This guideline is intended for organizations that have already decided to implement ISCM. The tools and techniques discussed apply to any organization regardless of its size or primary industry focus. It will help an organization:

- develop a framework for planning and managing the implementation of ISCM;
- learn about the various core tools and techniques to improve the effectiveness of implementation of ISCM; and
- understand the roles and responsibilities of financial professionals in implementing ISCM.

III. THE ROLE OF MANAGEMENT ACCOUNTING

Finance professionals play an increasingly vital role in all major improvement initiatives in organizations today. Serving on design and implementation teams, these professionals provide analytical expertise, an economic perspective, and an objective mindset with which to examine, evaluate, and prioritize the opportunities and challenges inherent in a major change initiative such as ISCM.

ISCM implementation creates unique opportunities for the participation and support efforts of the finance function. Specifically, the finance professional provides services to the teams charged with ISCM design, development, and execution. These services include:

- developing financial analyses of the costs and benefits of ISCM to the participating firms;
- creating performance benchmarks, milestones, and measures to support the development of the ISCM business case;
- providing economic and nonfinancial evaluation of alternative improvement opportunities to facilitate the development of ISCM priorities;
- participating in the identification and implementation of new databases and information technology enablers for key supply chain transactions;
- supporting process redesign efforts focused on removing waste, reducing throughput time, and increasing the flexibility and responsiveness of financial transactions across the supply chain;
- collaborating with finance and operations professionals in the partnering organizations to find creative ways to solve logistics and support problems;
- providing analytical support to ISCM teams including identifying and estimating the costs and benefits of various decisions throughout design, conversion, and execution efforts;
- creating management reporting and evaluation tools to ensure that the ISCM initiative meets its objectives and delivers the required performance improvements; and
- ensuring the integrity of supporting databases, internal control procedures, key proprietary technologies, processes, and physical and/or knowledge assets.

The role of the finance professional, who is serving as a team member with a unique set of analytical skills and competencies, is not to control or audit the ISCM initiative. Finance professionals are not the policemen of the change process—they are active participants in the management process. Collaborating, supporting, enabling, and analyzing, the finance professional brings a unique perspective and objectivity about the potential costs and benefits of the change for all trading partners. These professionals provide the facts and figures, as well as insights, required to ensure that ISCM achieves its promised profit and performance improvements for all the organization's stakeholders.

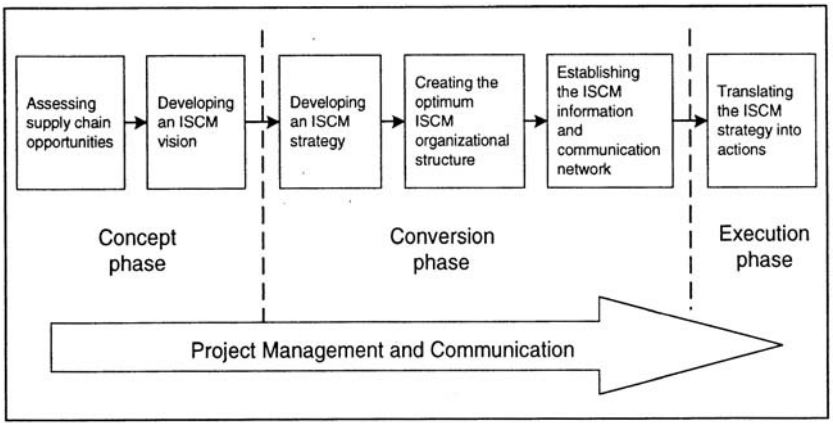
The finance professional is required to have a solid understanding of the basic concepts that make up ISCM, as well as the core tools and techniques that support its design, implementation, and use. Having gained this basic knowledge, he or she can develop new analytical tools, performance metrics, and processes to support and sustain the ISCM system in its drive for superior service to customers.

IV. ISCM IMPLEMENTATION STEPS

While each ISCM effort is unique, an organization's actual implementation will likely include most or all of the six steps outlined in Exhibit 1, although not necessarily in the order presented. Keeping this fact in mind, ISCM implementation steps include:

- assessing supply chain opportunities;
- developing an ISCM vision;
- developing an ISCM strategy;
- creating the optimum ISCM organizational structure;
- establishing the ISCM information and communication network; and
- translating the ISCM strategy into actions.

EXHIBIT 1. ISCM IMPLEMENTATION STEPS



The first stage of ISCM implementation is assessing customer needs within existing and new customer segments. Since the driving force for implementing ISCM is the provision of superior service to customers, the starting point in its design and rollout is gaining detailed knowledge of what customers expect, when, where, and why. It is also important to determine how well the current supply chain is delivering against customer expectations so that improvements can be focused on those areas where major problems or opportunities exist.

To begin with, the existing and potential needs of customers are identified. Then attention turns to developing a shared vision for the channel partners—one that can guide implementation and downstream execution decisions. Followed by a competitive strategy assessment, which ensures that the integrated design will provide a competitive advantage, channel partners develop a supply chain strategy that makes optimal use of interorganizational competencies and knowledge.

The supply chain vision, once designed and focused, is transformed into reality through a series of changes to the structure of relationships and communication among the channel partners. Establishing the communication and information network is key to the development of the ISCM structure. Finally, the design is translated into action as the ISCM strategy is executed.

Each of these core implementation steps requires a different set of tools and techniques for achieving its stated goals and providing required benefits at minimal cost and disruption. Typically, ISCM implementations are undertaken in the midst of ongoing operations at all of the affected firms. Therefore, it is important that the initiative be well structured and executed.

V. IMPLEMENTATION TOOLS AND TECHNIQUES

Assessing Supply Chain Opportunities

ISCM provides unique opportunities for creating added value for customers by leveraging the competencies and knowledge of the entire trading alliance, including:

EXHIBIT 2. SUPPLY CHAIN SEGMENTATION FACTORS

Example factors	Specifications
Buying relationships	
· Demand forecasting	Limited, extensive, joint forecasts/schedules
· Price determination	Basic, volume, agreed returns on investment
Ordering and billing	
· Order entry mechanism	Phone, facsimile, EDI
· Billing mechanism	Invoice, COD, EFT, EDI
· Order confirmation	Immediate, 2 days
· Order tracking	Visibility, bar coding
Delivery and support services	
· Use of time slots	None, strict
· Driver unloading role	None, expected
· Order receiving	ASN, automated receiving support
· Delivery requirements	Special pallets, special bar codes
Ordering complexity	
· Variability and demand	Low, medium, high
· Regularity of orders	High, medium, low
· Order predictability (size and product mix)	High, medium, low
· Order frequency	Weekly, monthly
· Average order sizes	Boxes, pallets, truck loads
Delivery complexity	
· Drop off points	Central, single, multiple
· Site accessibility	Low, medium, high
· Emergency deliveries	None, expected
· Requirement for reverse logistics	None, expected

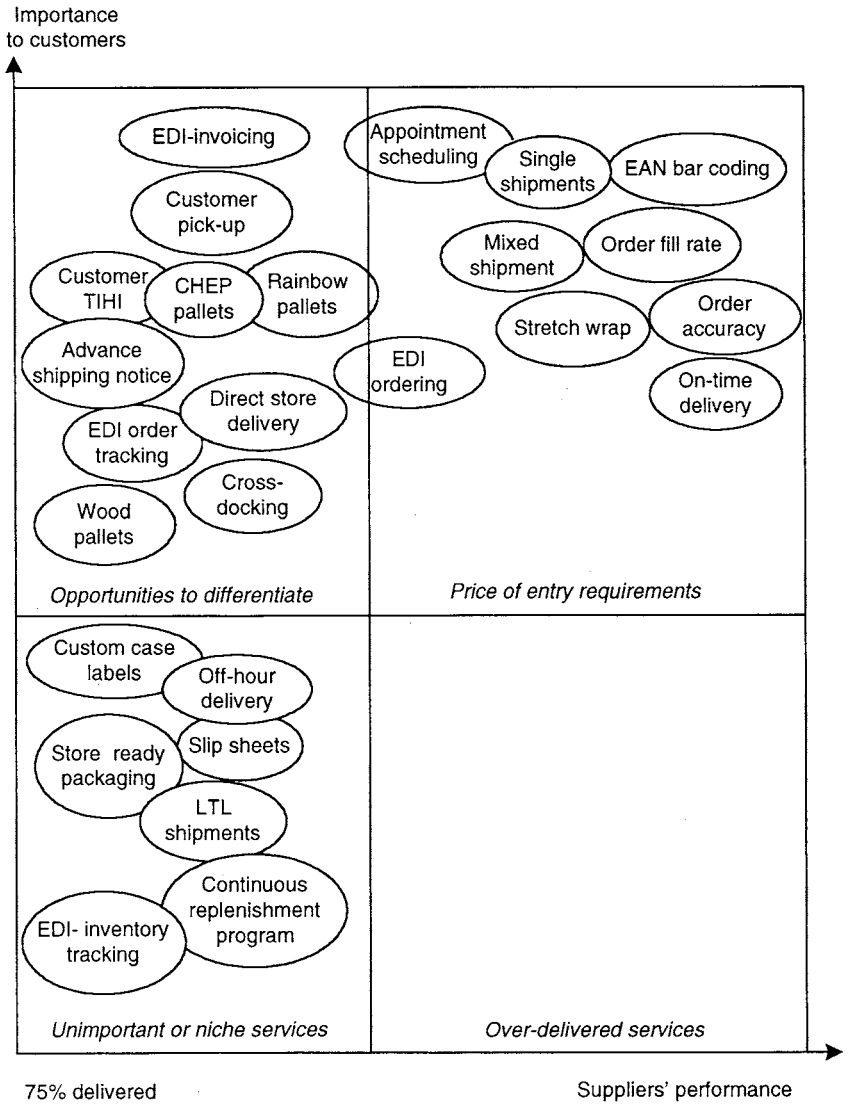
Source: L. Torres and J. Miller, 1996: 49.

- lowering costs;
- providing superior customer service;
- adding new value-added services;
- achieving greater flexibility; and
- attaining faster innovation.

The key to effective ISCM implementation is to target service enhancements to the needs of specific customer segments. Not every customer wants the same bundle of services delivered in the same way. It is the underlying diversity of customer requirements that makes the development of a supply chain strategy, based on careful assessment of opportunities for differentiation and competitive advantage, so important.

The development of a balanced supply chain segmentation approach requires the identification of reasonably sized groupings of customers that have similar requirements and expectations, as illustrated in Exhibit 2. Typical factors that are part of a segmentation analysis include buying relationships, order-taking and billing requirements, delivery and support services, and ordering and delivery complexity.

EXHIBIT 3. CUSTOMER SERVICE SURVEY



Source: L. Torres and J. Miller, 1994: 56.

Meeting this challenge requires unique information about customer service levels, expectations, costs, and segmentation characteristics. Various core tools and techniques are available to provide the information required in the assessments phase of ISCM implementation, including:

- customer service survey;

- transaction survey; and
- value chain mapping.

Customer Service Survey

An important technique in assessing supply chain opportunities is gathering key information from customers through customer service surveys. Well-designed customer service surveys accomplish several things, including:

- providing a quantitative understanding of key customer requirements for each of the basic features of the service profile, including speed of delivery, delivery reliability, order completeness, product availability, and billing features;
- supporting the development of customer segments by ensuring that a broad spectrum of customers serve as the basis for the study;
- measuring the relative importance of each element of customer service, using a forced ranking (e.g., allocation of 100 points among requirements based on importance to customer) approach if possible;
- assessing the performance of the organization compared to the firm's major competitors on each element of customer service; and
- identifying and defining the relative significance of customer service issues in the customer's overall buying decisions versus other core features such as price, product features, quality, and innovation.

Typically, a cross-functional, cross-entity task force develops the survey. The first chore of the task force is to decide on the method for completing the survey (telephone, mail, interviews, focus groups, or a combination). Subsequent decisions include the survey target within the customer's organization, the definition of customer and product groups, the design of the survey itself, and the analysis to be conducted once the study is completed.

The output of a customer service survey for a large U.S. paper products manufacturer is illustrated in Exhibit 3. It was developed from interviews with a large number of customers of varying size, geographic coverage, and supply chain. The task force discovered that all customers viewed order accuracy, fill rate, and on-time delivery as very important. In contrast, the varying importance of other service requirements indicated a potential opportunity for the organization to differentiate itself.

The task force learned that while their organization was performing well on these basic requirements, all paper suppliers are doing well in these areas, so these requirements presented no opportunities for differentiation.

For the other services providing an opportunity to set apart the organization's offerings (in the upper left-hand corner), the task force learned that they did not consistently deliver many of these. An opportunity in the lower left corner would have been developed if an important customer considered it important, and if the economics supported it.

A well-designed customer service survey can help identify the existing versus required strategic focus of the supply chain. It also provides information on specific requirements and design criteria for the supply chain, facilitating communication and development of a shared vision and strategy within the organization and across the trading alliance. The valuable competitive insights yielded by a customer survey can provide clear direction to the ISCM implementation, including the optimal choice from among the range of opportunities available for creating superior customer service.

For example, Mobil Oil Corporation's lubricant unit in Fairfax, Va., ordered supply chain management software after it received disturbing results from its customer survey. The division, which makes oil, lubricants, and other materials, was told by its customers that it was not very easy to do business with Mobil. Mobil did not always have what the customer needed at the right place and at the right time. As a result of the survey, changes were made that allowed Mobil to deliver on demand more often. Inventory was better managed, and sales data were tied to supply and inventory management for better forecasting, as well.

Transaction Survey

A transaction survey is a real-time data collection tool that isolates the supply chain's performance on a specific transaction. Simple and inexpensive to use, the transaction survey provides a powerful means of keeping in touch with customers on an ongoing basis. It also provides an effective tool for evaluating the level of supply chain compliance with customers' expectations and requirements and for assessing supply chain opportunities.

The basic transactions that customers have with the supply chain include order placement, receiving shipment, making order/status inquiries, placing complaints, receiving credits and invoices, and paying the invoice. Each of these transaction types can be monitored for actual versus expected performance by contacting a small sample of affected customers (2-5 percent) on a daily or weekly basis.

While the exact structure of the transaction survey can vary, several core questions typically are included in the questionnaire, such as:

- Did the service meet all of the customer's needs?
- Was the order/request handled quickly and effectively?
- Was the company/supply chain representative courteous and responsive?
- How could the company have better met your needs?
- Are competitors more effective/responsive in performing these activities for you?

The optimal way to conduct the transaction survey is to make direct phone contact with an appropriate individual at the customer's location. The details of the transaction should be reviewed to ensure that the response is reflective of recent performance on the transaction under study.

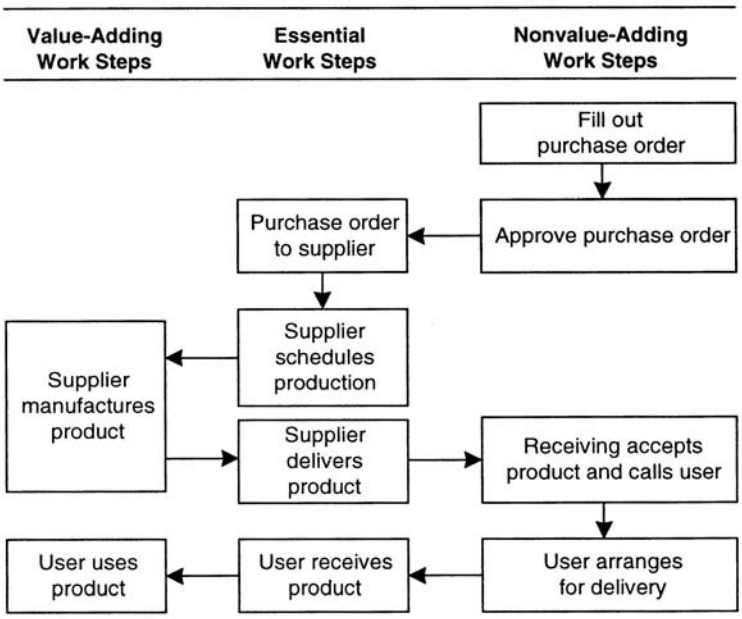
Transaction surveys can provide a source of real-time information about the current performance level of the supply chain. These surveys can supply accurate, reliable feedback, which serves much the same purpose as statistical process control, finding and correcting problems rapidly before they create excess costs or reduce customer satisfaction and loyalty.

Value Chain Mapping

Value chain mapping allows the trading partners to examine all the steps currently embedded in the supply chain. This analysis supports the brainstorming efforts required, eliminating unnecessary steps and waste from the value chain. Mapping also highlights opportunities to leverage the value-adding efforts of the participating firms. Combined, these analyses lead to the development of a list of continuous improvement initiatives that span every facet of the value chain.

A value chain is a process that comprises a number of related activities, each adding unique value to the final outcome. Value chain mapping

EXHIBIT 4. PURCHASING PROCESS VALUE CHAIN MAP



Source: D. Riggs and S. Robbins, 1998: 72.

is the analysis of the process to identify the underlying activity structure and better understand the value added (or not) by each activity. Developed by a cross-functional, cross-organizational team, the complete set of steps for providing a material or service from initial supply source to the end user is detailed. What emerges is a picture of the intricate interlocking steps that span the supplier and purchaser relationship. Three goals drive effective value chain mapping, including:

- achieving the best/lowest total cost, including all process, transactional, and handling costs for the entire supply chain;
- pursuing the fastest cycle time performance; and
- identifying and implementing "best-in-class" practices for each core activity, subprocess, or process.

Value-adding activities are required elements of the supply chain, while essential activities encompass indirect support of the value-added efforts. Nonvalue-adding activities are not necessary or required. As detailed in Exhibit 4, a value chain map can be used to categorize the supply chain activities visually into three distinct groupings: value-adding, essential, and nonvalue-adding.

For example, a large pharmaceutical company created a multiplant model of its internal supply chain by using value chain mapping. The process map identified 97 different production nodes—

links within the supply chain—spanning six different plants around the world. At the completion of the mapping project, the pharmaceutical company had achieved substantial inventory reductions without compromising customer service. In some locations, inventory levels were trimmed by as much as 90 percent, with 20 percent to 30 percent being a common reduction at a given node. Lead times were reduced by 50 percent.

As a source of real-time information about the current performance level of the supply chain, transactional surveys supply accurate, reliable feedback that serves much the same purpose as statistical process control—finding and correcting problems rapidly, before they create excess costs or reduce customer satisfaction and loyalty.

Developing an ISCM Vision

ISCM visioning places emphasis on thoroughly understanding customer requirements and how the current supply chain compares to competitors' supply chains in meeting these requirements. Effective visioning ensures that the resulting value proposition is consistent with the way the organizations have chosen to compete in the market. Visioning is also used to establish stretch targets for ISCM, challenging the channel partners to find innovative ways to improve supply chain performance.

Finally, ISCM visioning provides the framework for crafting a focused strategy for the supply chain. The visioning initiative serves to enhance cross-functional and cross-organizational links and develop boundary-spanning solutions to the supply system challenge. Exhibit 5 is an example of an ISCM vision developed at Whirlpool Corporation, the world's leading manufacturer and marketer of major home appliances, with revenues of $8 billion in 1997. Whirlpool's supply chain challenge was to improve productivity, lower finished goods inventories, improve product availability, and improve its cash-to-cash cycle.

Three core techniques that have proved helpful in the visioning process effort are:

- scenario building and "what-if" analysis;
- cost/service trade-off; and
- competitive/internal benchmarking.

Scenario Building and "What-if" Analysis

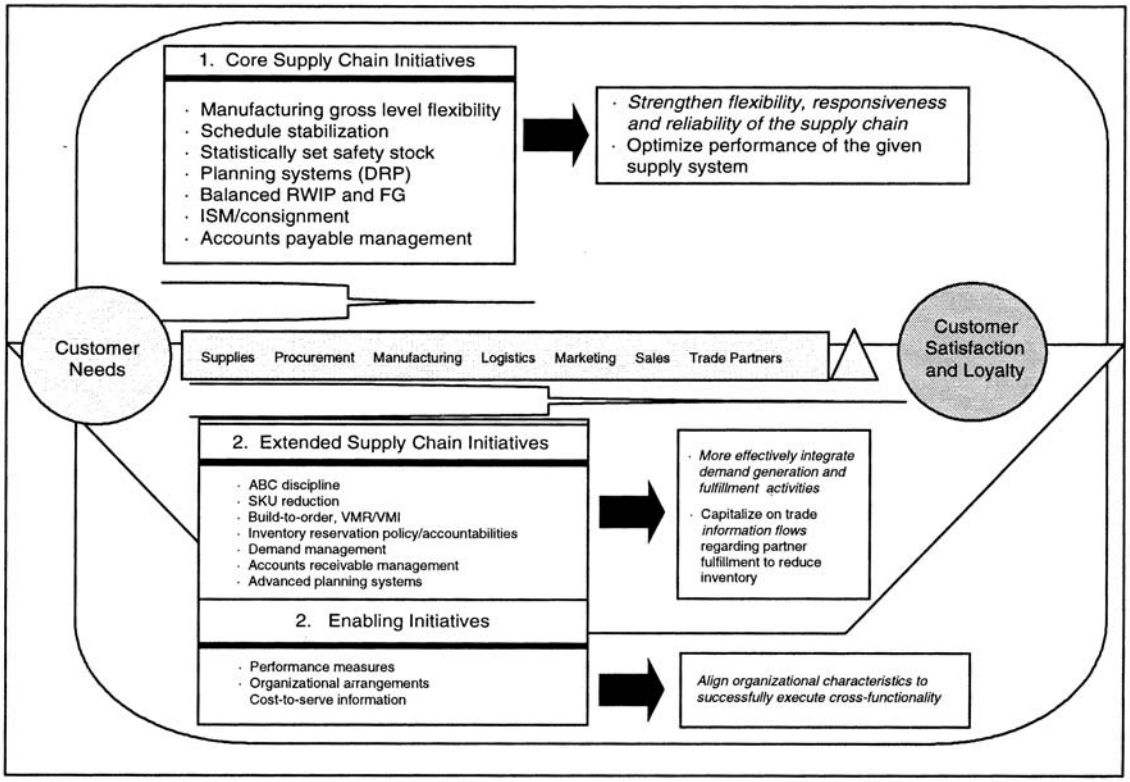
The emphasis of this visioning tool is on the development of plausible "what-if" scenarios that assess the risks and rewards of new supply chain opportunities. Decision trees and scenario building efforts are used to assess the value of the different strategies open to an organization, based on the probability of various combinations of events occurring. Some of the events that might be considered are changing sales volumes by channel, reaction of competitors, changes in operating costs, and any number of potential reactions by supply chain partners to strategic shifts.

Inherent in the development of scenarios for different channel and segment opportunities is the recognition that the number, value, and complexity of different strategies must be tested. Two specific forms of information are usually incorporated when using this tool: 1) the impact on supply chain partners and end users and 2) the calculation of risks and rewards.

Assessing the Impact on Partners and End Users

If not pursued carefully, ISCM opportunities can actually alienate rather than integrate trading partners or customers. In this case the risks of losing business might well outweigh any projected benefits from the implementation of new supply chain opportunities. Three key questions that

EXHIBIT 5. SUPPLY CHAIN VISION—WHIRLPOOL CORPORATION



Source: Planet Supply Chain Summit: Dallas, September 1998.

should be considered during the visioning phase to help avoid undesirable results include:

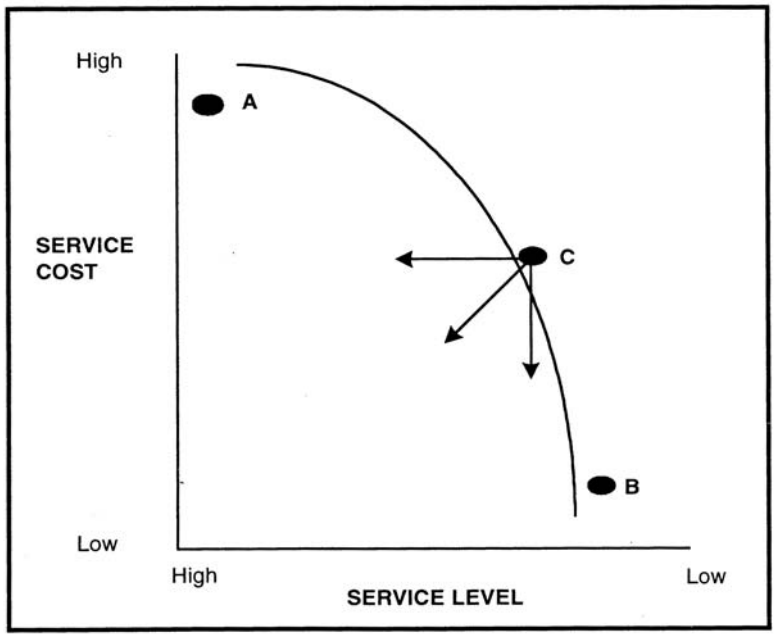
- How will the new channel affect existing supply/distribution channels?
- What will be the true net increase in sales (e.g., will the new channel take sales away from existing channels)?
- How much impact will the new channel have on trading partners' margins?

The profitability of channel partners can be significantly affected by shifts in the supply chain strategy. Changes in sales volume, mix, or services offered can reduce revenues or increase costs at any point in the supply chain. In developing a vision, it is important that the impact of alternatives on each partner's economic performance be considered.

Calculating Risks and Rewards

The ultimate goal of differentiation and the development of new supply chain opportunities in ISCM is to improve profits within acceptable risk limits. In creating scenarios and evaluating them, it is important for the channel partners to lay out what the economic impact of the deci-

EXHIBIT 6. COST/SERVICE TRADE-OFF CURVE



Source: W. Copacino, 1997: 28.

sions will be, as well as to openly debate and challenge the risks of the identified options. It is often useful to develop a business case for the most desirable options, including a cash flow analysis, statement of impact on economic value added or related financial performance metrics, and estimated impact on nonfinancial performance criteria.

Cost/Service Trade-off

A key activity of ISCM visioning is determining the level of performance required to meet (or exceed) customer requirements.

While delivering superior service is the goal, the ongoing realities of business underscore the fact that the ISCM strategy is shaped by the cost/service trade-off. A useful way to depict this relationship is illustrated in Exhibit 6.

In creating this graphic, the cost-versus-service levels provided by the potential list of supply chain strategies are plotted against each other. On one end is the high-service, high-cost option (point A). This might imply more warehouses, use of premium transportation modes, and higher inventory levels so that high service levels can be provided. Its alternative, the low-cost, low-service position, is placed at point B. This option might imply a single warehouse, longer order lead times to allow for more consolidation, and use of less costly transportation modes. The resulting curve represents the optimal horizon for assessing ISCM opportunities.

In most instances, the ISCM strategic options will fail initially to fall on the efficient horizon. In reality, many organization's supply chains are not at maximum efficiency, and they are located off

EXHIBIT 7. MATRIX OF POTENTIAL VALUE: BEST-IN-CLASS—INTERNALLY

	Locations					
Key Drivers	*City A*	*City B*	*City C*	*City D*	*Internal Best*	*System Value*
Changeover (hours)	12	6	10	8	6	$xxx
Line efficiency	91	92	88	94	94	xxx
Shrinkage (%)	8	12	5	10	5	xxx
Shipping cost/unit	$24	$28	$27	$30	$24	xxx
Labor hours/unit	1.4	1.2	1.5	1.1	1.1	xxx
Returns (%)	1.5	0.92	0.75	2.1	0.75	xxx
Lost time rate	2.2	1.6	1.7	0.8	0.8	xxx
Workman's comp.	$558K	$1,200K	$475K	$1,430K	$475K	xxx
			Internal best—total system value			$xxx

Source: C. Poirier and S. Reiter, 1996: 165.

the curve (point C). By measuring the gap between the cost-service performance of the preferred solution, channel partners can gauge the level of improvement needed and brainstorm to identify alternative ways for closing the performance gap.

Competitive/Internal Benchmarking

Objective information is key to effective supply chain visioning. While a number of sources of information can be harvested from the supply chain, benchmarking remains one of the most powerful tools available to ISCM visioning.

Benchmarking is a process of gathering, analyzing, and using data about the structure and performance of comparable processes within or across organizations. Benchmarking is one of the best ways to gain consensus and motivation for process improvement by emphasizing the evaluation of current performance against a definable standard.

Many different approaches can be used to gather benchmarking information, including telephone or mail surveys, research of external databases, focus groups, and company site visits. The focus of data collection can be on comparable internal processes, competitor performance, industry standards, or best-in-class performers. A best-in-class benchmarking study examines the practices and results of best-practice organizations for a specific type of process, regardless of what industry the company is in.

Exhibit 7 illustrates the development of a hypothetical performance matrix that identifies key *internal* process drivers of a completed benchmark study. Focused on key performance drivers, such as changeover time and line efficiency in a manufacturing setting, the performance matrix provides an overview of the relative performance of the supply chain against benchmarked alternatives. By comparing current against best-practice results, the matrix provides details on what can be accomplished by an effective supply process and the immediate value that could be reaped from achieving this level of performance. A strong incentive to improve is created by the objective appraisal of benchmarked results.

Most leading organizations also look *externally* to determine how their performance compares to the best in the industry or the "best in their category." Exhibit 8 illustrates a hypothetical performance matrix that can be developed to find the highest benchmarks for each driving category that can be proved to be attainable anywhere in the industry. This matrix can be used to develop meaningful benchmarks in key areas, with the focus on competitors and on firms that operate in similar industries or have similar characteristics. This requires looking for the best in class in each category, regardless of the business. The final column becomes the potential value for bringing all sites up to the best-in-class level of performance. The grand total for this column is typically quite impressive and can establish the basis for a multiyear improvement effort, as actions are oriented around the highest-value categories in the prioritized system.

As organizations use this type of performance matrix to develop their visions for improvement, they invariably begin within their organization, developing internal best practices before going to the outside for further improvements. By starting on the inside, they bring existing operations to the best level that can be achieved, either with current technology and equipment or with a careful redeployment of people, equipment, and selected new investments. They then benchmark against the best in class, regardless of the industry, in the areas critical to success and competitive advantage. With this information, they set out to exceed the benchmarks and establish new norms for the competition to pursue.

Developing an ISCM Strategy

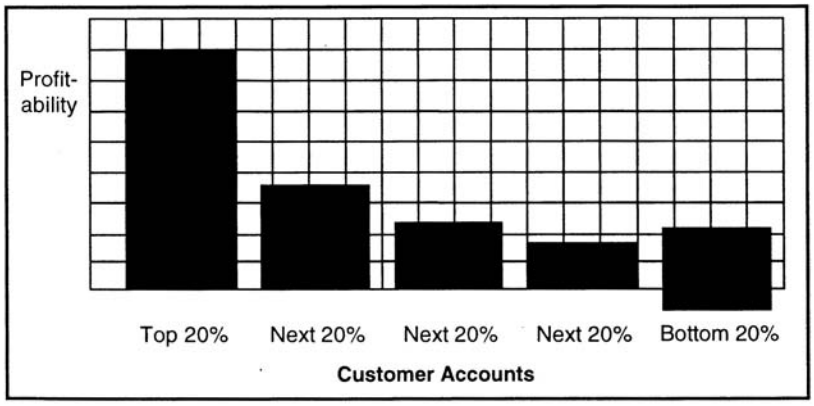
ISCM strategies are usually developed by an organization to answer the question: "How do we get from where we are to where we want to be?" The strategies are shaped by analyses of value chain maps that identify the constraints limiting the performance of the entire supply chain and the benchmark-driven strategic assessment. Strategies should be developed that help channel partners manage identified constraints and achieve best-in-class performance.

EXHIBIT 8. MATRIX OF POTENTIAL VALUE: BEST-IN-CLASS—EXTERNALLY

	Locations							
Key Drivers	*City A*	*City B*	*City C*	*City D*	*Internal Best*	*System Value*	*Industry Benchmark*	*System Value*
Changeover (hours)	12	6	10	8	6	$xxx	.5	$yyy
Line efficiency	91	92	88	94	94	xxx	98	yyy
Shrinkage (%)	8	12	5	10	5	xxx	4	yyy
Shipping cost/unit	$24	$28	$27	$30	$24	xxx	$15	yyy
Labor hours/unit	1.4	1.2	1.5	1.1	1.1	xxx	.8	yyy
Returns (%)	1.5	.92	.75	2.1	.75	xxx	.25	yyy
Lost time rate	2.2	1.6	1.7	.8	.8	xxx	.20	yyy
Workman's comp.	$558K	$1,200	$475K	$1,430K	$475K	xxx	$100K	yyy
					Internal best—total system value		$xxx	$yyy

Source: C. Poirier and S. Reiter, 1996: 168.

EXHIBIT 9. CUSTOMER PROFITABILITY ANALYSIS



Source: W. Copacino, 1997: 145.

Whereas ISCM strategies are concerned with the creation of new visions of supply chain management that transcend conventional techniques of purchasing, producing, moving, storing, and selling products and services, their real importance resides in their ability to assist executives in designing a clear blueprint for new organizational architectures.

Two core tools and techniques have proved especially helpful in the ISCM strategic development effort. These tools and techniques include:

- customer profitability analysis; and
- order-to-cash model.

Customer Profitability Analysis

Customer profitability analysis provides insight into the profitability of various segments, helping channel partners focus on creating competitive strength in those areas where their efforts will yield the greatest payoff. Profitable market share, not share at any cost, is the key to leveraging resources and competencies.

The costs for servicing a specific customer or segment can be found in every corner of the organization and the supply chain, from sale to procurement to manufacturing on to distribution and pre- and post-sales customer service. Either directly or indirectly, most of the costs within the channel alliance should be tied to creating customer value and satisfaction.

Inventory carrying cost and transportation cost to meet unique customer requirements are two key costs to consider when conducting a customer profitability analysis. Other areas that can be affected by unique customer demands include order fulfillment, finance, and customer service, each of which may be asked to perform specific activities for one customer segment that others might not require. The frequency of order placement, delivery, sales calls and support, and accounts receivable efforts all create different levels of cost and potential profitability for the supply chain.

Activity-based cost management, with the inclusion of adjustments for the amount of effort one

customer requires versus another (intensity or complexity factors), can provide much of the information required to analyze the relative profitability of different customer segments.

The resulting analysis, illustrated in Exhibit 9, often reveals that some customer segments are not profitable to serve. In fact, it is often found that 20 percent of the customers generate more than 80 percent of the profits. The results of this type of analysis suggest several different things, including:

- early strategic efforts within the supply chain should ensure that the differentiated supply strategy emphasizes the features and services most desired by the segments with the highest profit margins;
- additional services should be analyzed to ensure that they will yield profit improvements in all customer segments;
- low-performing segments will be unlikely candidates for enhanced services unless they will support premium pricing; and
- dropping segments is not the first order of business. Instead, improvement efforts should be undertaken to convert unprofitable or low-profit segments into ones with acceptable margins. The strategy for low-profit segments should emphasize process improvement rather than service enhancements.

Customer profitability analysis can be used to design the sales and operating policies that guide the business and can also be used to focus continuous process improvement efforts.

Order-to-Cash Model

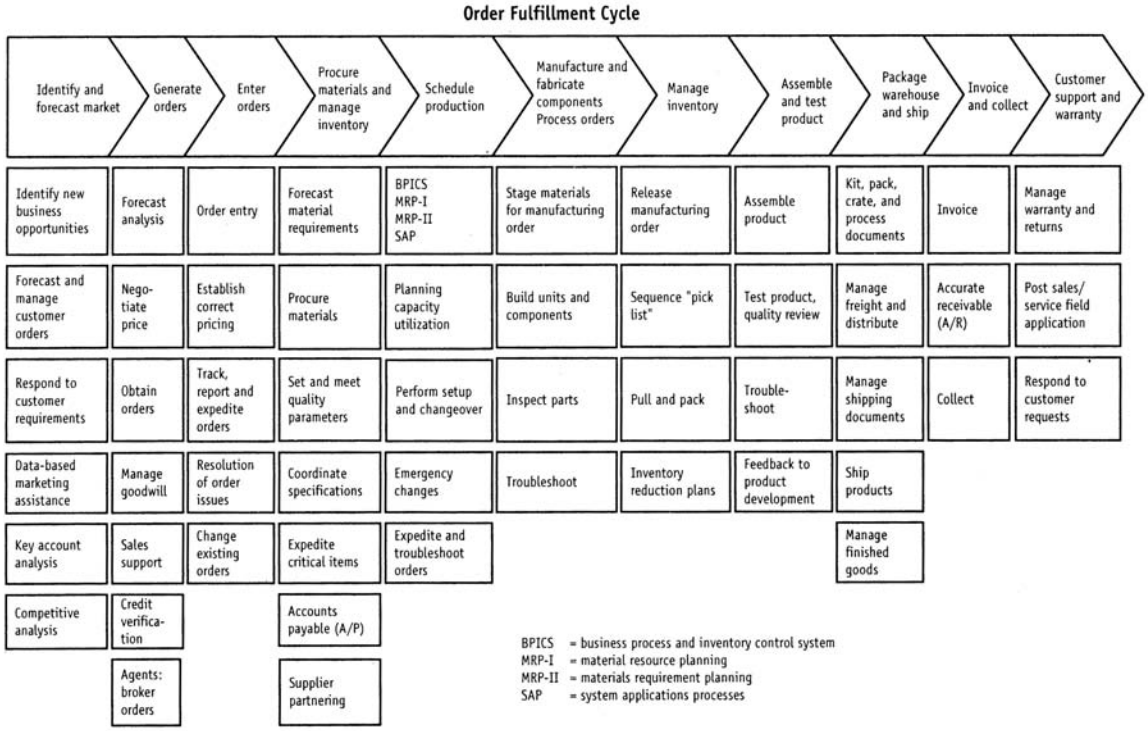
When developing an ISCM strategy, it is important to create a common language and understanding of the value creation process among the supply partners. The order-to-cash model is a tool that facilitates this knowledge building and sharing effort. Across the top of Exhibit 10 are the activities that comprise the order fulfillment cycle for the supply chain. Underneath these core activities are the key supporting activities for that part of the process to be completed effectively. For instance, forecasting and managing customer orders are key elements of the first phase of the supply process, as are responding to customer requirements and completing key account analysis.

From generating orders through order entry and customer support and product warranty, there are activities that need to be completed synchronously by one or more of the supply chain partners to achieve optimal customer service levels. A graphic model also allows the development and strategic assessment team to note where continuous improvement efforts are underway and identify points where changes still need to be made. Two assumptions drive the use of the order-to-cash model:

- any organization of any size has a number of important initiatives already started, in various stages of temporary completion. It would be hard, and deemed inappropriate, to divert attention away from the best efforts, so joint initiatives should be focused on building further enhancements; and
- no organization has all of the resources necessary to complete all of the valuable initiatives at one time.

Through a mutual sharing of resources, the supply chain can improve the performance and remove many of the constraints facing a non-aligned competitor. First and foremost, channel partners should eliminate activities in the matrix where sufficient resources are already being applied, where substantial improvements have already been gleaned, or where more resources

EXHIBIT 10. ORDER-TO-CASH MODEL



Source: C. Poirier and S. Reiter, 1996: 186.

would actually inhibit the successful completion of current improvement efforts.

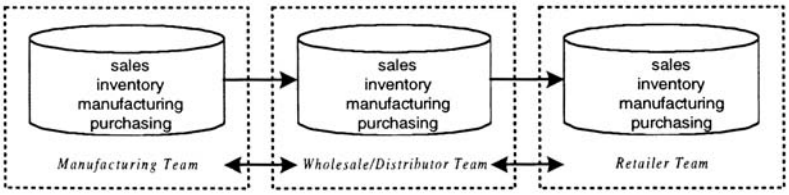
As the order-to-cash model is completed, the channel partners will be able to identify activities that should be eliminated or minimized and those to which additional resources need to be directed. The model also provides a useful baseline for identifying customer segments and specifying the unique demands and effort each segment requires from the supply chain. Focusing collective thinking on those areas most likely to yield high payoffs for all involved parties is the primary benefit of the order-to-cash model.

Creating the Optimum ISCM Organizational Structure

Once the ISCM strategy is created, it needs a structure. The ISCM organization does not simply apply a traditional pyramid structure to a new functional initiative. In fact, the ISCM structure isn't really a structure at all—it is a comprehensive collection of work tasks and role definitions, processes, organizational mechanisms, and competencies that together span traditional boundaries, wherever they occur.

To create an organizational structure founded on business partnering concepts, it is important to ensure that internal barriers to cooperation are

EXHIBIT 11. CROSS-CHANNEL PROCESS TEAMS



Source: D.F. Ross, 1998: 310.

first removed. Breaking down functional or expertise-based silos to create the integrated structures required for synchronous action begins inside each channel partner organization before it can be ready to link efforts with its channel partners. Team problem solving and cross-boundary sharing of information must become engrained in the culture and actions of partnering organizations.

Several specific tools and techniques are available to develop operational alternatives for the alliance, including:

- cross-channel process teams;
- strategic vendor-customer-manufacturer alliances;
- outsourcing; and
- business process redesign.

Cross-Channel Process Teams

Cross-channel process teams that span the entire supply channel have become an increasingly important dimension of competitive advantage. The linkage of underlying marketing, production, and information flows across the supply channel, from raw materials to end consumers, creates a powerful foundation for performance improvement and innovation.

Several primary advantages accrue to organizations using cross-channel process teams: 1) sharing infrastructure competencies; 2) leveraging channel infrastructures; 3) reducing process cycle times; 4) increasing process capabilities; 5) expanding market reach; and 6) developing unique solutions.

The cross-channel process teams shown in Exhibit 11 are made up of individuals with complementary skills who perform similar activities within each organization involved in the supply pipeline. In other words, the professionals working in sales at the manufacturing site, at the wholesaler, and at the retailer all belong to the same cross-channel process team. The same can be said for similar teams involved in transportation, purchasing, and other functional areas.

Creating total channel value does not necessarily mean radical reengineering of underlying processes, organizations, or relationships. Instead, the emphasis of these teams is on building commitment to the other organizations in the supply chain. Other goals are borderless sharing of power and knowledge among channel partners, empowerment of teams to develop and implement innovative solutions to supply chain challenges, and the creation of an effective basis for combating politics and authoritarianism in one or all of the affected organizations.

There are six key steps to follow in the development of cross-channel process teams.

- *Develop objectives*. Multi-company process owners need to distinctly define the channel process to be used and agree on the objectives and benefits to be gained from its deployment.
- *Confirm commitment*. All individuals and organizations that participate in the supply chain must be fully committed to providing critical resources, participating in joint activities, and continually searching for improvements that benefit the trading alliance.
- *Develop ISCM teams*. The individuals who will serve on cross-organizational process teams need to be identified and assigned by the participating firms. It is important that the required skills and competencies for team members be detailed for and possessed by the candidates.
- *Develop network links*. Inter-channel communication and information linkages are a critical element of effective ISCM. The process team members must have access to, and the ability to leverage, technology enablers such as EDI, fax, computer notes, and related support tools if the virtual structure that is a prerequisite to cross-organizational teaming is to be achieved.
- *Ensure team management skills*. There is no clear process owner in a multi-company process team. Multiple leaders with multiple objectives are more likely to be found in ISCM process teams. Creating a team structure that will accommodate this factor and that will meet the unique needs of each trading partner is critical. Strong team management skills are the means for achieving this difficult goal.
- *Develop performance measurements*. Without the creation of effective channel-wide performance measurements, the integration effort will not reach its potential.

The success of joint efforts, such as Apple's partnering with Sony to bring the Macintosh Powerbook to market and with Sharp to manufacture the Newton, underscores the simple principle that forming collaborative inter-company process teams, regardless of how they are formed or what their objectives are, can provide unique sources of competitive advantage.

Strategic Vendor-Customer-Manufacturer Alliances

Once organizations begin to exhaust what they can do autonomously, they begin crossing organizational boundaries. For example, if they are developing a new product and want to do it more quickly, they may need to use the assets of their suppliers. Organizations may also need to use assets of their customers in terms of what they will do in product service design, what investment they will make, and what investment their tier one and tier two suppliers will need to make. Building *alliances*, or processes through which the channel partners pool resources in a trusting atmosphere focused on continuous, mutual improvement, is key to developing a sustainable competitive advantage.

For example, some organizations, including Bose Corp., IBM Corp., Honeywell, Inc., and Allied Signal, are bringing carefully selected vendors into their plants or warehouses. This approach is known as JIT II, a concept that was developed originally by Bose Corp. Under JIT II, vendors have access to their customer's production schedules. Based on that and other information, they order raw materials, parts, or components and get them to the manufacturing line just in time. The benefits for the buyer are significantly lower costs and reduced administrative burdens. The vendor gets higher sales volumes, lower cost of sales, reduced administrative costs, and long-term contracts. Both parties, of course, also benefit from the close relationship that is required to make this joint effort work.

Extending the core supply chain to other organizations in this way creates an entire set of challenges as the costs of finding and integrating new members is compared to the benefits of the enhanced supply network structure. The danger is that unfocused supplier integration can create waste and duplication instead of reducing it. The need in many organizations is to examine closely what is necessary to tie critical suppliers into the overall finished production or new product development processes. The degree of complexity tends to rise from that required for a structure serving a simple partnership or alliance, but the potential rewards also rise. Because alliances deal with opportunities to improve over time and among multiple organizations by jointly looking at issues and problems, it is often possible to build a much better overall solution than would be possible by simply looking at problems from the point of view of one company's organization.

Among other organizational considerations that need attention as companies get involved in vendor-customer alliances is the matter of reconciling differences in operating style and coordination. Thought needs to be given to the appointment of leadership or coordinating persons to preside over the integration among organizations. For instance, problems involving shifts in personal relationships may need to be addressed. Typically, one organization's technical community comes to think that it has sole responsibility for product design and development. However, in a new integration mode, design and development may become a shared decision process.

In addition to personnel considerations, the restructuring needed to make vendor-customer alliances work often involves resolution of a large number of disparate problems. Some examples are:

- ownership of intellectual properties, a major issue in new product development;
- investment concerns, such as how much investment each party will have to make in terms of human capital, resources, and capital investment, versus what each party can expect to gain from its investment;
- determination of investment priorities in common types of computer-aided design;
- information disclosure concerns for ongoing production or order fulfillment;
- identification and resolution of compatibility issues between alliance information systems, for instance, how a firm can provide information regarding its production plans and schedules to its first- and second-tier suppliers; and
- consensus on methods of analysis of ongoing production, including reaching agreement on how to improve the product cost structure in terms of how the product is being produced, where inventory is being stored, and how inspection is being carried out.

Strategic vendor-customer alliances, if applied thoughtfully and managed well, can be beneficial. For many companies they are a critical success factor. However, partnerships cannot be taken lightly.

Outsourcing[1]

While the creation of strategic alliances is the ultimate in ISCM structures, organizations that lack the core competency, resources, or inclination in their own supply chain processes may find that outsourcing is a preferable solution. In outsourcing, an organization makes the conscious decision *not* to pursue the development of leading-edge practices in every area of the business. By outsourcing, these organizations find they can direct their scarce resources to activities that strengthen their core competencies.

1 Outsourcing refers to the decision to have processes performed by outside agencies. Numerous tasks, processes, and even entire systems and departments can be outsourced in addition to outsourcing production.

However, while outsourcing is by far the most controversial form of alliance, it can also hold the greatest risk and return potential. The controversy evolves around the idea that others can perform a task or set of tasks better, faster, or cheaper than can be done in-house. The controversy also concerns the effect this has on jobs.

Organizations considering outsourcing need to focus not only on the potential effect on its workforce but also the processes and tasks most likely to be outsourced. Different processes and tasks have different levels of importance to an organization's objectives. The higher the degree of importance, the higher the level of competence and resources dedicated to ensuring that the task is performed well.

At the center of an organization are its *level one* or core processes. Core processes are those tasks that create the goods or service for which the organization is known or are key to its survival. For WEPCO, a utility company, level one processes might be the generation and distribution of electricity. For Miller, it might be the process for brewing beer. But both companies perform many tasks beyond these core processes.

The next level out from these core processes are strategic support or *level two* processes—those tasks that directly support the core processes and help ensure that the core processes are accomplished. For example, warehousing for most companies would not be viewed as a strategic function or task, but WEPCO and Miller would most likely view the storage of coal or barley as strategic support processes.

Warehousing and storage in most companies would be an example of a support or *level three* process. Support processes are those activities that are required but that add little direct value to the accomplishment of the core processes. A mailroom and an accounting department may be required for an organization to operate, but they are somewhat removed from a core process, unless the organization's business is to provide accounting or mail services to its customers.

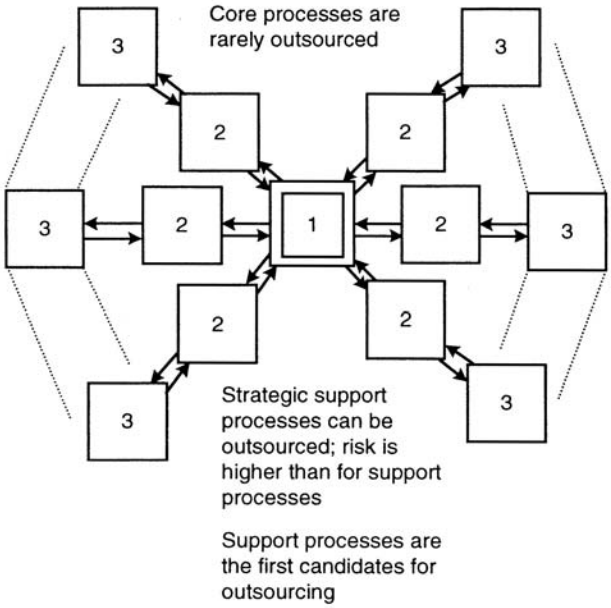
From the standpoint of outsourcing, the further the process is from a core process the lower the risk in outsourcing and the greater the potential return. The reasoning is based on the core competencies of the organization to which the process is outsourced. WEBCO outsources the management of its fleet to Ryder Truck. Ryder Truck's core competence is fleet management; therefore, Ryder should be able to perform the task better, faster, and cheaper once it understands WEPCO's needs.

Core processes are rarely outsourced. The exception can be a lack of capacity or special needs and skills. Strategic processes are susceptible to outsourcing but incur higher risks if the outsource organization does not perform well. Exhibit 12 depicts the three process levels and makes distinctions among their levels of importance to an organization.

As organizations evaluate the outsourcing option, two types of factors are in play, a push set and a pull set.

- *Push set*. The push set includes various internal skill deficiencies (typically technical, functional, or process in nature) and infrastructure deficiencies (typically physical or technological in nature). These deficiencies push organizations in favor of outsourcing as the most attractive option for redressing these shortfalls, considering the time, costs, and risks involved.
- *Pull set*. The pull set includes various dimensions of competitive differentiation or advan-

EXHIBIT 12. OUTSOURCING POTENTIAL



Source: Miller, 1998: 153.

tage in the market. In the supply chain arena, these revolve around improved cost efficiency and improved speed and flexibility. These advantages pull companies to outsourcing.

The most frequently outsourced types of supply chain management activities include:

- transportation and operations management;
- sourcing and procurement;
- warehousing and distribution center operations; and
- manufacturing.

Ford Motor Company awarded an outsourcing contract to Ryder Integrated Logistics Inc. to design and manage an integrated just-in-time supply chain and transportation system for Ford's 20 North American manufacturing plants. The project integrates their plants' individual supply chain systems and connects them to suppliers for real-time information about component and part inventories, as well as real-time tracking of deliveries. The system helps Ford "squeeze out" the cost of transporting parts and components to its plants. The consolidated system will let Ryder and Ford managers monitor when plants in the same area need deliveries of similar auto parts. Currently, each plant's shipments are delivered individually by separate trucks. Managers now will be able to coordinate parts transportation to multiple plants in the same region using just one truck. Ultimately, outsourcing will help Ford save money, streamline production, and eliminate inefficiencies.

Business Process Redesign

For many older organizations, supply chain networks are often the product of years of decisions driven by tax laws, duties, franchise rights, and transportation channels. These networks can be

so complex and archaic that they need to be redesigned.

For example, Pepsi-Cola has a large and enduring distribution system that grew and matured incrementally over time. Franchises were sold, bottling lines were built, and warehouses were opened and closed with little regard to demographic trends and long-term distribution needs. Decades later, the resulting distribution system, although amazing in its size and ability to deliver, was operating under the shackles of complexity. Introducing new products throughout the United States became an ongoing challenge, as did coordinating marketing campaigns and serving national customers.

Fortunately, supply chain processes lend themselves extremely well to business process redesign (BPR).

The emphasis in BPR is on removing waste from the chain of activities performed to meet a customer requirement or support the productive process. BPR in ISCM supports the drive to find innovative ways to remove inefficiency and cost as the value chain expands to the channel alliance.

In ISCM, the principles of business process reengineering are applied to the overlapping processes among supply chain partners. It is in applying improvement efforts across these commonalties among supply chain member organizations that truly radical, innovative, and advantage-creating solutions are found. Customers do not care if one or many organizations are engaged in the process of meeting their need—they care only about the total value they receive for their expenditures.

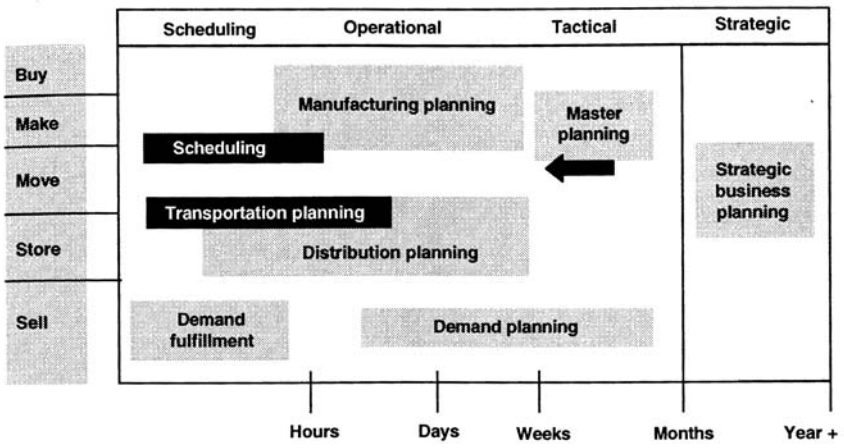
Applying BPR to the supply chain requires that the management team set priorities and choose redesign targets that promise the greatest improvement. Areas that might be considered include forecasting demand, order fulfillment, and purchasing. Having chosen a target process or subprocess, a process improvement team is developed, made up of people from each of the affected organizations.

Organizations benefit by improving existing processes. Within ISCM the improvement potential broadens significantly. BPR partner organizations understand how their internal practices create cost and cause delay within the supply chain, as well as for their trading partners. Often the newly designed process replaces many different, fragmented processes that might have been effective and efficient for one stand-alone company but that are suboptimal when viewed from the perspective of the entire supply chain.

BPR implies a series of paradigm shifts from the old way of doing things to the new. Once the visions that embody these shifts are internalized, they become powerful motivators for the people implementing the reengineering, who are then able to assess the potential impact of these shifts. In redesigning the supply chain, these paradigm shifts include:

- moving from arms-length, adversarial supplier relationships to close, cooperative supplier relationships and partnerships;
- moving from an “over-the-wall,” departmentally oriented environment to cross-functional teams;
- moving from purchasing and supply decisions based primarily on initial price to decisions based on life-cycle costs;
- moving from a bureaucratic process with many hand-offs to a flat, “one-stop” environment; and

EXHIBIT 13. SUPPLY CHAIN ACTIVITIES



- moving from a paper-intensive, heavily clerical requisitioning environment to a "paperless" environment.

BPR applied to supply networks can be a primary source of leverage and competitive advantage. Creating the information and communication network is yet another area in which joint resources can be brought to bear to create superior performance within the supply chain.

Establishing the ISCM Information and Communication Network

The thread that ties the supply chain together is the information and communication network. This network transforms the many organizations into one seamlessly functioning supply chain whole. The broad goal of this information and communication network is to supply computerized intelligence to an ever-growing network of raw-material suppliers, factories, warehouses, distribution centers, delivery vehicles, and points-of-sale. That way, each player in the supply chain conducts business with the latest and best information from everyone else. Product moves from point of origin to that of consumption as quickly as possible, at the lowest cost.

A variety of supply chain network tools manage the Plan, Source, Make, and Deliver processes both inside a company and among a firm and its suppliers and customers. These tools can range from transactional systems (focused on day-to-day operations) to planning systems used for weekly or monthly operational planning. Strategic tools can also be used to design and implement the supply chain infrastructure.

While there is no single supply chain management solution to the challenges of creating a cross-organizational information network, there are hundreds of supply chain management tools, ranging from ERP systems to sophisticated supply chain planning tools and PC-based forecasting packages.

As suggested by Exhibit 13, the underlying reason for their use comes down to one simple objective—to support the operation of and flow of information in the supply chain. Key tools and techniques include:

- strategic business planning;
- demand planning;
- distribution planning;
- supply planning;
- transportation planning;
- warehouse management;
- enterprise resource planning; and
- electronic commerce.

Strategic Business Planning

Strategic business planning tools are used to collect and deliver the information required to determine the optimal infrastructure of the trading alliance and to support strategic decision making. For example, many organizations have a growing need to coordinate production and distribution across national boundaries. Production is frequently divided among several factories. For many, this is a long, slow, and highly sensitive process, but the opportunity to reduce stock levels (and unit costs) while improving response times is vital if competitiveness is to be maintained.

Decisions that fall under the heading of strategic business planning include the number, capacity requirements, and preferred location of distribution centers, warehouses, terminals, and plants; supplier and transportation mode preferences; optimal material sourcing locations and product group manufacturing sites. The types of information required to support these efforts include time-phased customer/regional demand patterns; key resource constraints and costs; transportation, warehousing, and manufacturing costs; performance capabilities; and overall profit and return on investment targets.

Demand Planning

Demand planning entails predicting the future demand for the range of products and services provided by the supply chain. Focused on improving key demand drivers through statistical modeling of prior demand patterns, demand planning tools provide decision-making support. These sophisticated forecasting models deploy a varied range of simulation and analytical approaches, incorporate projected promotion-based demand and price elasticity, and allow the examination of the impact of varied customer, supplier, and industry trends on overall requirements.

Demand planning tools depend on accurate information from retail, distribution, manufacture, and supply locations. Enabled by technologies such as EDI and supported by the creation of integrated, networked databases, these tools merge scanner data from retail point-of-sale systems with forecasts to create real-time adjustments to the supply chain sourcing plan. Since no retail plan goes exactly according to predictions, adjustments can be made to accommodate the incremental changes necessary. This information is then fed to the manufacturer's planning, scheduling, and distribution systems; orders are processed effectively; and the goods are sent to the stores without the need for excess safety inventory stocks.

For example, the Lee Apparel Company, based in Merriam, Kan., is part of VF Corp., the giant Reading, Pa.-based clothing maker. VF Corp. has a replenishment program with nine retailers, supplying them with jeans and other merchandise within seven days, based on point-of-sale data. In the case of four of those retailers, Lee automatically ships the jeans to maintain what it calls a "model stock." Basically, a "model stock" is the mix of products that Lee and the retailer determine they should keep in a store to maximize sales. Point-of-sale data are transmitted electronically from the retailer to Lee on either a weekly or daily basis. The retailer can easily convey the identity of fast-selling products because each garment is bar-coded. That is, every Lee

garment shipped to a store comes with a universal product code (UPC) bar code that is attached at the manufacturing plant. When that bar code is scanned at the checkout counter, the retailer's computer records the item's style, color, and size. Lee uses the point-of-sale data for more than just determining what to ship. That information also is used to drive its production.

Related tools for demand planning include product life-cycle modeling, online review of actual consumption and unexpected changes for all supply chain partners, exception-based performance measurement and reporting, and reconciliation of multiple forecasts at the intra- and inter-enterprise level.

Distribution Planning

The cost of distribution typically accounts for up to 40 percent of an organization's sales revenue, and of that amount as much as 60 percent goes for transportation. Even if a manufacturer cannot reduce its transportation costs, eliminating the warehouse or minimizing stored goods inventory will make a big difference in the bottom line.

Distribution planning begins with anticipating demand. Then as orders come in, manufacturers decide how to make, store, and distribute goods. It requires users to look at the big picture, not just implementing new picking techniques to optimize the warehouse or reducing the number of shipments to minimize transportation costs.

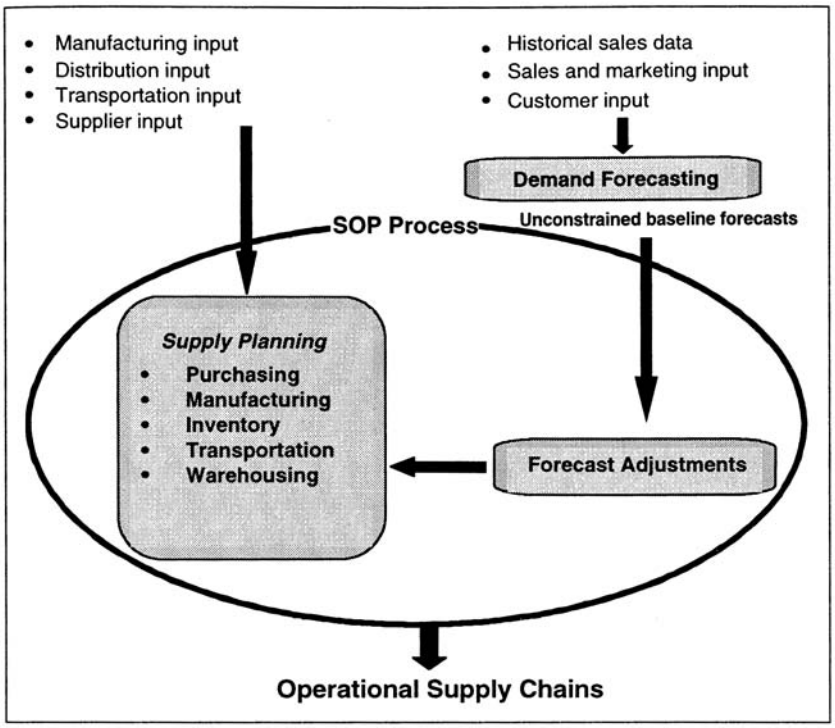
A good example is in the furniture industry. A manufacturer may make only a few styles of sofas yet offer hundreds of fabrics and cover patterns. By displaying a few finished sofas and numerous fabric swatches at showrooms, the manufacturer can eliminate finished goods inventory. The manufacturer then predicts customer demand and builds frames and includes the stuffing, which is the time-consuming stage. When an order is received, the manufacturer decides which facility will fulfill the order, based on proximity to the customer location and prevailing shop-floor capacity. Workers then cut the specific fabric, attach it to the sofa frame, and ship the sofa.

It is easier to predict demand for sofa styles than it is to predict demand for sofa styles with specific fabrics or covers. Customers want the freedom to select options, but they also want quick delivery. Accurate distribution planning demand helps manufacturers meet both those requirements.

Ortho-McNeil, a pharmaceutical manufacturer, uses a forecast to plan distribution and transportation activities. As a result, distribution managers plan to receive shipments from manufacturing facilities, know how many workers are required for put-away, and predict space requirements. Cisco Systems, a supplier of internet working solutions, uses distribution planning with product and part allocation to determine inventory levels for its distribution hubs and parts depots. Having the correct inventory levels at the parts depots enables the company to meet its customers' service requirements, typically a two-hour or four-hour response contract.

A range of tools are available for distribution planning, from decision-support tools, which use constraint management to optimize operations, to software products for detailed planning of product distribution and deployment, including vendor-managed inventory and closer integration with forecasting systems.

EXHIBIT 14. INTEGRATED SUPPLY PLANNING PROCESS MODEL



Source: Advanced Manufacturing Research (AMR): 1998.

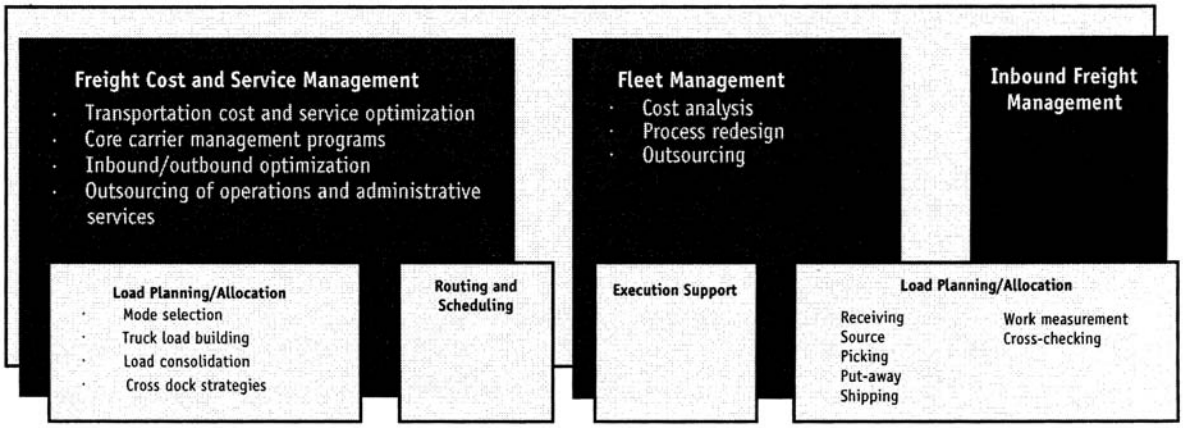
Supply Planning

The other side of the coin in managing the flow of goods through the supply pipeline is supply planning. Supply planning tools support strategic, tactical, and operational decision making, providing guidance on which products to make, how to make them, what order to make them in, and where to source materials. Supply plans are largely created assuming a given demand plan. It is typically achieved through a sales and operations planning (SOP) process with multifunctional teams meeting to develop a consensus-based operational plan. This process ensures that supply meets demand.

Input from the supply side comes from the organizations and suppliers. The output of the SOP process consists of the operational supply plans. Sophisticated supply planning tools include interactive planning, simulations, and key constraints on the system (i.e., capacity utilization, customer priority, and due dates). Exhibit 14 depicts a typical business model in which input from the demand side includes only an unconstrained demand forecast.

Black & Decker Corp. is an example of a company that uses supply planning tools to improve its supply/demand planning efforts. Selling 40 percent of its products through large retailers such as Home Depot and Kmart, the company was faced with the need to meet a seven-day "ship or cancel" sourcing requirement. Discovering that their existing planning systems were incapable of handling this requirement, the company's manufacturing technology group developed a

EXHIBIT 15. TRANSPORTATION PLANNING ELEMENTS



proactive system called "capacity-optimized planning" (COP) to address the impact of seven-day demand directly.

Specifically, the system tracks the availability of parts for seven-day items. When it is found that parts will not be available, the entire manufacturing system is "relieved" of the order, allowing plants to focus on making items that could be completed on time. The customer is notified at the same time as the plants, allowing the entire supply chain to adjust its efforts. Manufacturing flexibility, as well as supply chain communication and responsiveness, have been enhanced by implementing this supply planning tool.

Transportation Planning

At the heart of the supply chain is the set of core logistics activities that ensure that goods are moved between trading partners on time, in the right quantity, and with guaranteed quality, all within acceptable cost limits. Transportation procurement and management alone can consume more than 40 percent of an organization's physical distribution costs and 3 percent to 12 percent of overall corporate revenues. Total costing methods underscore the financial impact of this critical supply chain process.

Service is equally important. Competitive pressures require companies to maintain a high level of differentiated services for their customers, business partners, and internal units. Restraining costs while maintaining or enhancing service levels has become the major challenge facing executives responsible for transportation.

Transportation planning tools facilitate these activities, providing information and decision support on preferred carriers, consolidation and back-haul opportunities, optimal load creation and sequencing, vehicle utilization optimization, shipment tracking, and dynamic routing/route scheduling.

The effective use of transportation planning tools, such as those illustrated in Exhibit 15, can result in automated, faster shipment planning; quicker identification of consolidation opportunities; and the capability to focus shipping choices on fewer, more efficient carriers. The increasing

trend toward customer-driven, small-order sizes, with more frequent deliveries, suggests that decision-support tools that help the supply chain optimize its transportation planning are fast becoming a requirement for achieving competitive advantage.

Warehouse Management

A decade ago, the warehouse was viewed primarily as a necessary evil to hold inventory needed to mitigate risk and uncertainty in physical distribution. The warehouse played an important role in distribution, but that role was not recognized as a source of competitive differentiation. The situation today is much different. Supply chains are trading inventory for information. The warehouse is taking on new roles, each a source of competitive differentiation. To cite three such roles:

- Customers are expecting suppliers to provide specialized physical distribution services (e.g., more frequent and complex deliveries, store specific labels), often in promotion-driven environments. These requirements are pushed up the supply chain, well beyond the retail environments where they were introduced, into final assembly, component manufacturers, and raw material supply. These requirements influence all aspects of warehouse operations including receiving, inspection, put-away, forward replenishment, picking, value-added processing, packing, and shipping.
- Channel partners expect distribution centers to handle flowthrough operation, cross-docking, merge-in-transit, and customer-specific shipment configurations. This ability requires real-time process monitoring of events on the floor, the yard, in transit, and in manufacturing operations.
- Customers expect value-added service processing in such diverse environments as apparel, component assembly, electronics, discrete, and repetitive manufacturing. Differentiated logistics strategies (by customer, market, and product), as well as postponement and late differentiation strategies in manufacturing, are blurring the distinction between manufacturing and warehousing. In some instances, where products are packaged in kits from components, salable items are created just before packing and shipping, with the distribution center taking on some attributes of a manufacturing operation.

Warehouse management tools provide the following functionalities:

- Real-time process monitoring to improve visibility of real-time conditions inside and beyond the four walls of the warehouse, including yard operations, production, and transportation activities. Process monitoring systems spot trends to predict future conditions that fall outside the allowable tolerances of execution plans. Examples of such functionality include key performance indicator reporting systems, management dashboards, and executive information systems. The reporting scope of these systems extends beyond the physical inventory status and covers the status of work against plans, inventory, orders operator performance, and equipment condition.
- Active, alert, and intelligent messaging improves the execution of flow-through, cross-docking, and merge in-transit distribution practices involving shippers and carriers beyond the four walls of the warehouse.
- Decision support capabilities analyze alternative solutions to planned workloads placed on a warehouse (e.g., volume of value-added service processing) and critical conditions predicted by real-time process monitoring.
- Activity-based cost collection and reporting. Decision support capability hinges on the quality of information available for actual costs of key tasks and processes based on the

resources consumed. Facility managers, supply chain planners, and account managers need accurate activity-based cost (ABC) information to analyze customer service agreements executed at the warehouse, to assign demand for value-added service (within a facility and across the network), and to address strategic issues.

Enterprise Resource Planning (ERP)

ERP did not begin as a supply chain management tool, but as organizations have begun to understand the advantages of integrated intra-enterprise information, they have applied these solutions to the challenges of inter-enterprise management.

ERP systems are transactional tools that capture data and reduce the manual activities surrounding the processing of financial, inventory, and customer-order information. These systems achieve a high level of information integration by utilizing a single data model, developing a common definition of the shared data's characteristics and meaning, and creating a set of procedures for accessing and using the data.

With origins as single-plant materials requirements planning (MRP) systems, most ERP products have grown into the ERP designation by adding applications to cover other functional areas, such as order entry and plant maintenance, within the plant or division. Most ERP systems became multiplant-enabled by replicating single plant functions and providing rudimentary support for shared data. Unfortunately, little functionality has been developed to address the inter-plant and intra-organization processes often found in large enterprise supply chains. ERP vendors have been slow to recognize that supply chain management requires process-oriented systems that support cross-organization and cross-company collaboration.

The Supply Chain Council has identified the need for supply chain applications in four broad areas, including tactical logistics, the distributed enterprise, collaborative supply chain, and electronic commerce. From this perspective, no ERP vendor can fully support all requirements. However, the supply chain strategies of the leading ERP vendors represent a wide variety of initiatives ranging from interfaces with niche applications to the creation of new levels of enterprise and collaborative applications. Some of the concepts expressed by the Supply Chain Council are beginning to show up in the product development visions of today's leading vendors.

Electronic Commerce

Electronic commerce (EC) is the application of communication and information-sharing tools among channel partners in the pursuit of business objectives. Three distinct types of electronic commerce exist:

- *Information access* provides search and retrieve capability for public domain and proprietary data archives (examples include www and Gopher sites or private databases on legal decisions). In addition to access, a fully functioning service of this type would provide services related to the creation, update, and maintenance of information.
- *Shopping services* allow one to seek and purchase goods or services through electronic networks. This type of EC is the most popularly held image when the term "electronic commerce" is used.
- *Virtual enterprises* are business arrangements by which enterprises separated by geography and core expertise are able to engage in complex interrelated business activities (common roles played by these enterprises include cus-

tomer, supplier, shipper, regulatory agency, subcontractor, bank, and information service provider). EC is a major enabling technology through which such business arrangements can flourish. Mature examples in this category are electronic data interchange (EDI) arrangements between original equipment manufacturers (OEMs) and their suppliers or between large retailers and their suppliers.

Electronic commerce utilizes several technology enablers to create a fluid supply network: bar coding, EDI, point-of-sale (POS) information, e-mail, electronic storefronts and selling systems, supplier marketplace, web-enabled ERP applications, and universally accessible proprietary applications (such as Federal Express package tracking system).

Bar codes provide a common identification code that links the data surrounding the sourcing, shipment, sale, and replenishment of specific products. EDI allows trading partners to move information electronically. Finally, POS information is the key trigger for the replenishment cycle, integrating the forecasting, demand, supply, warehousing, and transportation planning systems.

For example, customers can go to the public home page (www.bcop.com) of the $2 billion Boise Cascade office products corporation and enter the order site by typing in a user ID and a password. From there, they can peruse an online catalog of about 10,000 products. Or if they make regular purchases, they can call up easy order forms or file a template to order the same products they buy every month. Purchases are made online with common credit cards such as Visa, American Express, and Mastercard. Eventually, customers will be able to use digital cash to buy products. Boise Cascade even has an answer for managers afraid of employees going online and making extravagant purchases. Through the use of IDs and passwords, the system knows who is making a purchase and what he or she is authorized to buy.

Boise Cascade's internet effort has already paid for itself. The company paid in the low hundred thousands of dollars to set up the system, and after six months of operation, it has saved more than $1 million by reducing the time customer service representatives take orders on the phone.

Translating ISCM Strategy into Actions

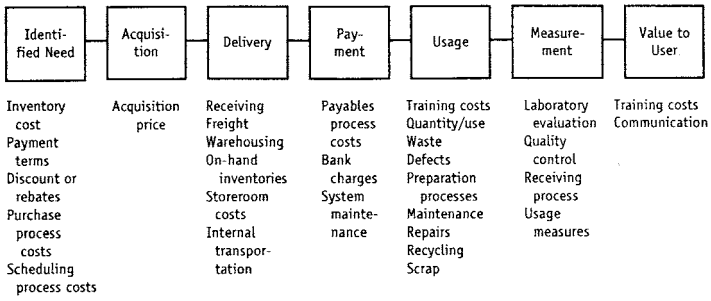
Developing performance measures to gauge the progress of the supply channel network in meeting customer expectations is a required and critical element for successfully implementing ISCM. These measurements are understood and used throughout the organization, using a limited number of key measures toward the corporate pyramid's top and an increasing number of processes and operational measures at lower levels. This principle holds true for measurement of the supply chain and the enterprise as a whole.

While many different metrics can be used, typical factors in ISCM measurement systems are customer satisfaction, asset utilization, operating costs, product quality, and cycle time. If the channel alliance performs well on these critical dimensions, it can create a new competitive environment.

Three useful core tools and techniques facilitating performance measurement include:

- perfect order;
- total cost of ownership measurement; and
- supply chain effectiveness metrics indicators.

EXHIBIT 16. SUPPLY STREAM COSTS



Source: D. Riggs and S. Robbins, 1998: 76.

Perfect Order

The "perfect order" is a specific measurement of customer service and logistics effectiveness. Emphasizing supply process performance, not that of an individual function or organization, perfect order measures the percentage of orders that are performed flawlessly the first time (e.g., no errors, exception handling, or intervention required).

For a service occurrence to be considered perfect, every step in the order fulfillment process must go smoothly. Whether the transaction takes place in order entry, credit clearance, inventory, picking, delivery, invoicing, or accounts receivable, the result must be perfect adherence to requirements with no delay or error. If anything goes wrong, anywhere in the process, the order is not perfect.

For most companies, when initially measured, the perfect order accounts for less than 10 percent of the total orders processed. That means 9 out of 10 customer orders commonly face some form of error or delay, falling short of meeting requirements. A major consumer packaged-goods company has been able to improve its performance significantly, from 10 percent to 60 percent, through business process redesign and the alignment of functional objectives with those of the supply chain. Serving as a viable measure of order management and logistics effectiveness, the perfect order provides a reliable leverage point for improving customer service while reducing service costs.

Total Cost of Ownership Measurement

Many costs are associated with the development and maintenance of the supply chain. The total cost of ownership (TCO) metric summarizes these costs, then uses present value calculations to discount the anticipated future ownership costs over the life cycle of the material or service stream. Serving as a basis for discussion and analysis, the TCO measure is not a precise estimate but rather a way for the channel partners to scope the costs of the planned supply system. This allows for querying projected costs, identifying improvement opportunities, and communicating the benefits that can be gained from enhanced coordination.

As detailed in Exhibit 16, various costs are incurred throughout the supply chain. The TCO measure sums the acquisition costs plus the present value estimate of operating, training, maintenance, warehousing, environmental, and salvage values to create a supply chain life cycle cost estimate that serves as the basis for

incentives, negotiation, baseline performance measures, and target cost improvement efforts.

TCO analysis underscores accountability within the supply chain as well as the improvement available or required for the supply process. The single largest opportunity in developing total cost models is identifying how a material or service is best used. Measures of usage should include how much material or service the supply chain consumes, how long it lasts, its capacity, and how efficiently and effectively it is used. Looking at the supply chain from the long-term perspective, TCO analysis provides supply chain managers with the tool and incentive to identify and implement cost and performance improvements.

Supply Chain Effectiveness Metrics Indicators

Assessing the effectiveness of the supply chain in meeting customer requirements is a key area to which ISCM tools and techniques can be applied during the implementation and execution of the original vision. Metrics often used to make this evaluation are promise-to-deliver time, customer order-to-delivery time, on-time delivery performance, total lead time, and customer retention. These metrics are designed to answer key questions, including:

- How effective is the supply chain strategy in maximizing value per dollar spent by a customer?
- How effective is the management of the supply chain in implementing that strategy?
- How effective is the ISCM strategy compared to that of key competitors?
- To what extent are the key processes within demand planning linked?
- To what extent are the key processes within supply planning linked?

Cycle time metrics provide one means of assessing supply chain effectiveness. Assessing the total time elapsed from the original placement of the order or identification of an unmet customer need to the fulfillment of the request/utilization, cycle-time metrics gauge the relationship of total time in the order cycle versus that time absolutely required to meet customer demand. The cycle-time measure can be trended to ensure improvements in responsiveness are gained. It is a key measure of the supply chain's ability to transfer new features and process capabilities from the supplier through the supply chain to the final customer.

Other supply chain effectiveness measures include satisfaction of requirements (on-time/complete delivery, product/service performance against specifications, quality/price performance) and benefits delivered. Serving as a proxy for customer satisfaction, these measures emphasize meeting customer needs at the right time, in the right place, in the right quantity, at the right price.

On-time and complete metrics detail the number of orders placed and delivered 100 percent complete the first time and/or delivered exactly when requested (not before or after the defined delivery date). Promised dates are the benchmark for the delivery effort: Are customer expectations reasonably set and met? Does the promised date match customer needs? If not, what gap exists between promised delivery and desired performance? How can this gap be closed?

The customer retention metric is an indication of the long-term performance of the supply chain as compared to competitors' performance. Given the inherent investment required to calibrate the supply chain to meet the requirements of specific customers/segments, retention is a critical

EXHIBIT 17. ISCM EFFECTIVENESS INDICATORS

Customer Service Measures	Macro-Productivity Measures	Micro-Productivity Measures	
Percent line Item fill	Logistics costs	Warehousing cost a percentage of sales	Cost per mile per unit
Percent order-fill complete: · At first pass · Within 3 days · Within 5 days	Transportation costs as a percentage of sales	Orders shipped vs. orders received	Cost per ton-mile Cost per pound delivered
		Units picked per labor hour	Percentage empty miles
Delivery lead time	Aggregate Inventory level	Percentage stock loss	
Orders/shipping/billing errors	Inventory time supply	Miles per vehicle per time period	

Source: W. Copacino, 1997: 147.

determinant of life-cycle profitability. The inability to retain customers is a warning sign that the supply chain is not meeting its objective to create superior customer service, and serves as a "failure" indicator. Exhibit 17 provides a list of these and other potential supply chain effectiveness indicators.

Basic guidelines to be incorporated in the supply chain effectiveness measurement effort include:

- *Keep it simple*. The chosen metrics should be easy to track and contain intuitively understandable variables.
- *Tailor measures to ensure controllability*. Focusing measurements on what an area can control, and making sure that what is measured is the right thing, are essential to creating effective supply chain performance. Individuals should be able to control what they are measured against, but the measures should also create behavior that is optimal for the entire supply chain, not just the function or activity being measured.
- *Develop and use multiple measures*. One-dimensional performance measures lead to tunnel vision. Measures should include customer service, supply chain productivity, and subprocess performance metrics.
- *Measure trend performance over time*. Successful ISCM is based on the continuous improvement philosophy. Graphically portraying performance over time captures this key dimension.

Koppers Industries (a $500-million bulk commodities producer of coke, roofing tar, railroad ties, and telephone poles) has a series of eight supply chain effectiveness indicators. They include the value of inventory in dollars, the number of inventory turns, the percentage of shipments made using each transportation mode, the load factor for each shipment, on-time shipment record, equipment utilization, backhaul, and demurrage, the penalty carriers charge when a shipment is not loaded or unloaded from their equipment within a pre-negotiated period of

time. A final metric calculates Koppers' total logistics costs as a percentage of the cost of sales.

A monthly report distributed to all Koppers' locations uses these indicators to track Kopper performance on a company-wide, divisional, and plant basis. Plant managers can see how they are doing in relation to other plants.

VI. CONCLUSION

The supply chain represents, to date, one of the untapped areas of potential performance improvements. When closely aligned with customer requirements, the supply chain can create a sustainable competitive advantage that is hard for fragmented, traditional suppliers to match. Building from the recognition that fulfilling customer requirements entails the cooperation of multiple supply chain organizations, ISCM facilitates a fluid, responsive, flexible supply pipeline from original source materials through the delivery and use of final products by the consumer, synchronizing activities in the supply stream.

ISCM leverages multi-organizational capabilities to provide a platform for creating superior service within defined customer segments or for customers with unique requirements. Replacing the "vanilla" logistics strategies that have dominated in the past, ISCM promises to create customized supply channels at mass production prices—a win-win solution that holds great promise for the future of business.

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